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RISK FACTORS FOR STUNTING IN CHILDREN AGED 6-24 MONTHS IN MAROS REGENCY, SOUTH SULAWESI, INDONESIA

Pupin Astuti [1] *, Andi Zulkifli [2], A. Arsunan Arsin [3], Ansariadi [4], Masni [5] and Healthy Hidayanty [6]

[1,2,3,4,5,6] Faculty of Public Health, Hasanuddin University, Makassar, Indonesia.
*Corresponding Author Email: astutip17k@student.unhas.ac.id

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Abstract

Introduction: The incidence of stunting has increased significantly in Indonesia, especially in Maros Regency, South Sulawesi. Children under two years old are vulnerable to stunting as this period is when their physical growth is most rapid in the entire life cycle. **Methods:** This study aims to analysed maternal factors, child factors, and household factors as risk factors for stunting among children aged 6-24 months in Maros Regency. This research is a case control study of 150 mothers with babies under two years old consisting of 75 stunting cases and 75 controls (not stunting). Direct interviews using questionnaires and review of collected medical records to test research variables. Hypothesis research was tested using *odd ratio analysis*. **Results:** In maternal factors, maternal knowledge (OR 2.688; (5% CI 1.385-5.217) and maternal nutritional status (OR 7.405; 95% CI 3.376-16.244) were found to be risk factors for stunting. In child factors, exclusive breastfeeding (OR 14.058; 95% CI 5.891-33.547) and history of infectious diseases (OR 16.625; 95% CI 7.369-37.505) were found to be risk factors for stunting. In household factors, exposure to cigarette smoke (OR 12.364; 95% CI 5.539-27.595) and family income (OR 7.250; 95% CI 2.790-18.839) were found to be risk factors for stunting. **Conclusion:** Child factors and household factors dominantly influence the incidence of stunting, but maternal factors, namely nutritional status, have the greatest influence on the incidence of stunting.

Keywords: Household, Maternal, Nutritional Status, Stunting.

INTRODUCTION

Stunting is a major health problem of under-five children caused by chronic malnutrition resulting in impaired linear growth that is inappropriate for the child's age and results in developmental delays. The nutritional status of under-five children is a sensitive indicator to determine the nutritional status of a population. Lack of nutritional intake and accumulation of nutrients during the first 1,000 days of life can lead to stunting (Rukmana *et al.*, 2022).

According to WHO data in 2018, stunting affected around 21.9% or 149 million children under five, while wasting affected 7.3% or 49 million children less than five years old. Around 45% of deaths of children under five are caused by malnutrition. This is especially true in low and middle income countries. At the same time, in these countries, the rate of overweight and obesity among children is increasing. Every country in the world is affected by one or more forms of malnutrition. The fight against malnutrition in all its forms is one of the greatest global health challenges.

The results of the 2022 Indonesian nutritional status survey (SSGI) showed that there was a decrease in stunting in Indonesia. The SSGI stunting rate fell from 24.4% in 2021 to 21.6% in 2022 (Ministry of Health Indonesia, 2023). South Sulawesi in 2018 stunting was 35.6% and in 2019 it was 34.8%. There are seven districts / cities in the South Sulawesi region that have a high stunting rate with a total presentation of more than 40 percent, namely Enrekang, Sinjai, Tana Toraja, North Toraja, Pangkep, Maros and Bone while the districts/cities that are classified as low in the number of stunting incidents with a presentation of 20-30 are Makassar city and East Luwu (Ministry of

Health Indonesia, 2018). In 2021 and 2022 the incidence of stunting did not experience a significant decrease, namely in 2021 the incidence of stunting was 27.4% and in 2022 it was 27.2% (Ministry of Health Indonesia, 2023).

The incidence of stunting in Maros Regency has increased considerably. Based on a survey conducted in 2021, the prevalence of stunting in Maros District was 37.5%. The Maros District Health Office reported that there were 4,434 or 14.94% of the 29,685 toddlers who were stunted as of 2022. In 2021, the incidence of stunting in children due to malnutrition was 2,892 or 9.47% of the 30,584 under-fives examined (BPS, 2022).

This suggests that most children under five in Maros are affected by stunting. There are several factors that contribute to the high prevalence of stunting in Maros and other districts in South Sulawesi. These factors include household, parent and child factors. The determinants of stunting in South Sulawesi and West Sulawesi, including Maros, were assessed using data from the 2013 and 2018 Indonesian Basic Health Surveys. Although the determinants of stunting in Maros were not mentioned in several studies, It is possible that factors such as breastfeeding practices, maternal nutritional status, complementary feeding practices, low maternal education, exposure to infections low socio-economic status of the household and access to health services and water and sanitation infrastructure also play a role in the incidence of stunting (Torlesse *et al.*, 2016; Azizah, Dewi & Murti, 2022; Anastasia *et al.*, 2023). This study aims to determine the factors associated with stunting in under-two children in terms of household, parent, and child factors.

MATERIALS AND METHODS

Study design and data collection

The type of research used is an analytic observational study with a *case-control* study design (retrospective). This study was conducted in three sub-districts of Maros Regency, namely Mandai, Tanralili, and Moncongloe sub-districts in November-December 2023. Determination of the number of samples was carried out using the *case-control* study formula from Lameshow (1997) so that 150 under-two children were obtained. Sampling of cases and controls was done in a ratio of 1:1, so that the total number of samples for cases was 75 stunted under-two children and the sample for controls was 75 under-two children. The research samples were collected in three sub-districts in Maros District so that each sub-district would take 50 samples in each sub-district. Sampling was done by simple quota sampling. The study protocol received ethical approval from the Human Research Ethics Committee Unhas No. 5910/UN4.14.1/TP.01.02/2023 (protocol no. 271023032254). In addition, approval was also obtained from the Maros Regency government. The researcher received approval from each sub-district for data collection. Furthermore, health cadres of each sub-district took part in assisting data collection by giving questionnaire sheets to mothers who have children aged 6-24 months. The inclusion criteria in this study were mothers with/and toddlers aged 6-24 months, had a complete MCH Book, and were willing to be respondents in this study. The exclusion criteria in this study were under-two who had mental disorders and/or physical disabilities and did not have a complete MCH book. Before giving the questionnaire, written informed consent was filled in by the mother of the child under study.

Measurements

The variables in this study consisted of maternal factors, namely nutritional status variables, maternal age at delivery, and maternal knowledge. Child factors consisted of the incidence of Low Birth Weight (LBW), history of infectious diseases, child birth order, exclusive breastfeeding, and gender. Meanwhile, household factors consisted of cigarette smoke exposure and family income. Variable data were collected using questionnaires sourced from primary data and secondary data (from the MCH book) in the form of the child's last height and the baby's weight at birth.

Statistical analysis

Statistical analysis was conducted using IBM SPSS Statistic for Window Version 26 (IBM Corp, Armonk, New York, USA). Descriptive data for each variable is categorical data presented in the form of frequencies and percentages. Then crosstabulation between independent and dependent variables was performed. To predict risk factors for stunting, data were analysed using *odd ratio* (OR) and *chi-square* analysis.

RESULTS

Characteristics of Respondent

Table 1: Distribution of Respondents Based on Maternal Characteristics in Maros Regency Year 2023

Maternal Characteristics	Cases		Controls		Total	
	N=75	*%*	*N=75*	*%*	*N=150*	*%*
Education						
Bachelor	6	8.0	5	6.7	11	7.3
Diploma	5	6.7	1	1.3	6	4.0
Senior High School	32	42.7	30	40.0	62	41.3
Junior High School	13	13.3	23	30.7	46	30.7
Elementary School	19	25.3	16	21.3	35	23.3
Age (Year)						
15-19	6	8.0	3	4.0	9	6.0
20-25	22	29.3	23	30.7	45	30.0
26-30	19	25.3	21	28.0	40	26.7
31-35	16	21.3	16	21.3	32	21.3
>35	12	16.0	12	16.0	24	16.0
Age at Childbirth (Year)						
15-19	10	13.3	3	4.0	13	8.7
20-25	23	30.7	29	38.7	52	34.7
26-30	17	22.7	19	25.3	36	24.0
31-35	15	20.0	14	18.7	29	19.3
>35	10	13.3	10	13.3	20	13.3
Age at Marriage						
13-19	27	36.0	29	38.7	56	37.3
20-25	40	53.3	42	56.0	82	54.7
26-30	6	8.0	3	4.0	9	6.0
31-35	2	2.7	1	1.3	3	2.0
Body Mass Index (BMI)						
Underweight	13	17.3	6	8.0	19	12.7
Normal	33	44.0	64	85.3	97	64.7
Overweight	29	38.7	5	6.7	34	22.7
Mother Knows Stunting Before Childbirth						
Yes	40	53.3	45	60.0	85	56.7
No	35	46.7	30	40.0	65	43.3

The results of the cross-tabulation analysis in Table 1 show that mothers with lower secondary education, age 20-25, age > 20 years, overweight, and knowing stunting before pregnancy have more stunted children. Mothers with senior high school education and below had more stunted children than those with diploma and bachelor's degree. Most respondents aged <26 years had more stunted children than those aged below 26 years. Mothers who gave birth at the age of 20-30 years had more stunted children than those aged >30 years. Mothers who married at 25 years old and below had more stunted children compared to those who married at >25 years old. Maternal BMI in the underweight and overweight categories had more stunted children than non-stunted children. Mothers who did not know about stunting before giving birth had more stunted children than those who knew about stunting before giving birth.

Table 2: Distribution of Respondents Based on Characteristics of Under-Two Children in Maros Regency Year 2023

Characteristics of Infants	Cases		Controls		Total	
	N=75	*%*	*N=75*	*%*	*N=150*	*%*
Age (Month)						
6-12	34	45.3	38	50.7	72	48.0
13-24	41	54.7	37	49.3	78	52.0
Gender						
Male	36	48.0	36	48.0	72	48.0
Female	39	52.0	39	52.0	78	52.0
Child Birth Order						
First	24	32.0	20	26.7	44	29.3
Second	27	36.0	24	32.0	51	34.0
Third	16	21.3	23	30.7	39	26.0
≥4th child	8	10.7	8	10.7	16	10.7
Birth Weight						
Normal	61	81.3	65	86.7	126	84.0
Low Birth Weight (LBW)	14	18.7	10	13.3	24	16.0
History of Infectious Diseases						
Diarrhea	23	30.4	22	29.3	45	30.0
ARI	26	34.7	18	24.0	44	29.3
Deworming	5	6.7	4	5.3	9	6.0
Receiving Breast Milk for 6 Months						
Yes	55	73,3	56	74,7	111	74,0
No	20	26,7	19	25,3	39	26,0
Receiving Complementary Foods Before 6 Months						
Yes	22	29.3	21	28.0	43	28.7
No	53	70.7	54	72.0	107	71.3

Those born as first and second children had more stunting than those born as third and fourth children. In addition, most of the stunted under-two children had a history of infectious diseases such as acute respiratory infection (ARI) and diarrhoea. Most of the stunted under-two children also did not receive exclusive breastfeeding, that is, those who received breast milk for 6 months and did not receive complementary food before the first 6 months of birth (Table 2).

Table 3 shows that most of the stunted infants had family incomes below 2.5 million per month and as many as 34,7% claimed to have experienced financial difficulties in the past year, so this could have an impact on the fulfilment of family nutritional needs for infants. Most families with stunted children have family members who smoke and expose children to cigarette smoke.

Table 3: Distribution of Respondents Based on Household Characteristics in Maros Regency Year 2023

Household Characteristics	Cases		Controls		Total	
	N=75	*%*	*N=75*	*%*	*N=150*	*%*
Family Income (Rupiah)						
<1,500,000	32	42.7	24	32.0	56	37.3
1,500,000-<2,500,000	24	32.0	34	45.3	59	39.3
2,500,000-3,500,000	14	18.7	10	13.3	24	16.0
>3,500,000	4	5.3	7	9.4	11	7.3
Financial Difficulties in the Last 1 Year						
Yes	26	34.7	29	38.7	55	36.7
No	49	65.3	46	61.3	95	63.3
Family Member Smokes						
Yes	49	65.3	54	72.0	103	68.7
No	26	34.7	21	28.0	47	31.3

Bivariate Analysis

Bivariate analysis was conducted to determine the magnitude of the relationship between risk factors and the incidence of stunting. This analysis uses the Odds Ratio test with 95% CI. The data analysis in bivariate were data that constituted the research variables, which consisted of maternal characteristics (Maternal Knowledge, Age at Childbirth, and Nutritional Status), Child Characteristics (Gender, LBW Incidence, Exclusive Breastfeeding, Birth Order, and History of Infectious Diseases), and household characteristics (exposure to cigarette smoke and family income).

Table 4: Bivariate Analysis of Risk Factors for Stunting Incidence in Maros Regency Year 2023

Variables	Cases		Controls		*p*	OR (95% CI)
	N=75	%	N=75	%		
Maternal Knowledge						
Poor	50	66.7	32	42.7	0.003	2.688 (1.385-5.217)
Good	25	33.3	43	57.3		
Age at Childbirth						
High Risk	16	21.3	14	18.7	0.683	1.182 (0.530-2.634)
Low Risk	59	78.7	61	81.3		
Nutritional Status						
High Risk	42	56.0	11	14.7	0.000	7.405 (3.376-16.244)
Low Risk	33	44.0	64	85.3		
Sex						
Male	37	49.3	35	46.7	0.744	0.899 (0.473-1.706)
Female	38	50.7	40	53.3		
Birth Weight						
LBW	14	18.7	10	13.3	0.373	1.492 (0.617-3.609)
Normal	61	81.3	65	86.7		
Exclusive Breastfeeding						
Not Accept	47	62.7	8	10.7	0.000	14.058 (5.891-33.547)
Accept	28	37.3	67	89.3		
Child Birth Order						
High Risk	9	12.0	7	9.3	0.597	1.325 (0.466-3.763)
Low Risk	66	88.0	68	90.7		
History of Infectious Diseases						
High Risk	57	76.0	12	16.0	0.000	16.625 (7.369-37.505)
Low Risk	18	24.0	63	84.0		
Cigarette Smoke Exposure						

High Risk	64	85.3	24	32.0	0.000	12.364 (5.539-27.595)
Low Risk	11	14.7	51	68.0		
Family Income						
Poor	69	92.0	46	61.3	0.000	7.250 (2.790-18.839)
Enough	6	8.0	29	38.7		

Table 4 shows that the independent variables of maternal characteristics that are significantly associated with the incidence of stunting are the variables of maternal knowledge and nutritional status (p<0.05) while the variable age at delivery does not have a significant relationship to the incidence of stunting (p>0.05). Maternal knowledge has an OR=2.688 which means that maternal knowledge 2.688 times affects the incidence of stunting. Maternal nutritional status has an OR=7.405 which means that maternal nutritional status 7.405 times affects the incidence of stunting.

The independent variables of the characteristics of infants that are significantly associated with the incidence of stunting are the variables of exclusive breastfeeding and history of infectious diseases (p<0.05) while the variables of gender, LBW, and child birth order do not have a significant relationship with the incidence of stunting (p>0.05). Exclusive breastfeeding has an OR=14.058 which means that exclusive breastfeeding 14.058 times affects the incidence of stunting. History of infectious disease has an OR=16.625, which means that a history of infectious disease 16.625 times affects the incidence of stunting.

The independent variables of the characteristics of infants that are significantly associated with the incidence of stunting are cigarette smoke exposure and family income (p<0.05). Cigarette smoke exposure has an OR=12.364, which means that exposure to cigarette smoke 12.364 times affects the incidence of stunting. Family income has an OR=7.250, which means that a history of infectious disease 7.250 times affects the incidence of stunting.

DISCUSSION

The effect of maternal factors on the incidence of stunting

Maternal knowledge is significantly affected with the incidence of stunting but does not have a significant influence on the incidence of stunting. Mothers with low knowledge have a risk of 2.688 times having stunted children compared to mothers who have sufficient knowledge in Maros Regency. This study is in line with research conducted by Utami, Setiawan, & Fitriyani (2019) and Laksono *et al.* (2022) and Yusridawati (2022) who found a significant relationship using the *chi-square* test. Previous research also found that a better level of education is a protective factor against mothers who have stunted toddlers (Laksono *et al.*, 2022). Utami *et al.* (2019) stated that family knowledge about nutritional parenting is significantly influence the incidence of stunting in toddlers.

Research by Laksono *et al.* (2022) in their study found that mothers who work and have a high school education were 1.416 times more likely to experience severe stunting than mothers with a college education. Mothers' knowledge related to stunting can affect the way they care for their children, especially on matters related to nutrition and child growth and development. Access to stunting information is only obtained from socialization and counselling conducted by health cadres, which is only done several times a year. Health workers explained that they had conducted counselling and socialization and even provided assistance to pregnant women and mothers of

children under-two as a form of stunting prevention. However, health cadres revealed that sometimes the assistance is not optimal due to the indifferent attitude of mothers who have children. This indifference can have a negative impact on their knowledge about stunting. This is a challenge for health cadres to raise awareness regarding the importance of stunting prevention and how the risks of stunting can endanger their children and their children's future. Therefore, maternal awareness has a significant impact on increasing maternal knowledge related to stunting.

The age at which the mother gave birth was categorized in the low risk category if the mother gave birth at the age of 20-35 years and would be high risk if the mother gave birth under the age of 20 years and above 35 years. Most mothers had low risk with a percentage of 78,7% in cases and 81,3% in controls. While mothers who had a high risk were at a presentation of 21,3% in cases and 18,7% in controls. The results showed that maternal age at childbirth did not have a significant relationship with the incidence of stunting in Maros Regency. This research is supported by the research of Sobrino *et al.* (2017) in his literature review research which found that maternal age was not independently associated with the incidence of stunting.

This can be explained by the fact that the most respondents married and gave birth at the age of 20-30 years. Several studies have found that maternal age at childbirth can affect the incidence of stunting in toddlers. Higher maternal age at first pregnancy has a protective effect against stunting. However, if a mother marries, becomes pregnant and gives birth at a young age, this can have a negative impact on the child's growth and development, potentially leading to stunting. Research shows that children whose parents are less than 20 years old or more than 35 years old have the highest proportion of stunted newborns (Sari & Sartika, 2021). Physiologically, mothers who are <20 years old are still in the process of growing both height and body. This situation does not support women to get pregnant because they are still growing their own bodies and physiologically supporting the group of mothers aged <20 years are still in the process of growth both in height and body. This situation does not support women to become pregnant because it is still in the growth period of its own body as well as supporting the growth of the fetus. While pregnancies that are too old (>35 years old) tend to be risky because the mother's health begins to decline and there is a greater chance of experiencing complications during childbirth until the growth of the fetus. Meanwhile, pregnancies that are too old (>35 years) tend to be risky because the mother's health begins to deteriorate and has a greater chance of experiencing complications during childbirth (Ilmi Idrus *et al.,* 2023).

Nutritional status is significantly associated with stunting and is a risk factor for stunting in Maros Regency. Mothers who are underweight or overweight (fat to obese) are at risk of stunted foetal growth, reduced food supply to the foetus, and are fatal to the foetus, even at risk of giving birth to babies with low birth weight (Mulianingsih *et al.*, 2021). Research by Felix-Beltran *et al.* (2021) found that among stunted children, 53.3% had mothers who were overweight/obese. Research by Supadmi *et al.* (2024) also stated that an increase of one unit on the BMI scale was shown to reduce the likelihood of stunting by 3%. However, it is important to consider the influence of maternal height in addition to BMI, as taller mothers tend to have fewer stunted children. Maternal height has a significant relationship with the incidence of stunting, where short mothers have a higher risk of stunting (Amaha & Woldeamanuel, 2021).

Abnormal BMI is also associated with poor nutritional status in the mother. This is because the nutritional status of the foetus during pregnancy is closely related to the nutritional condition of the mother during pregnancy. Abnormal maternal BMI is also associated with LBW in infants, which can adversely affect the nutrition and growth of the child. Previous research has identified that childhood undernutrition in the early years has important effects on adult health outcomes such as obesity and non-communicable diseases and that individuals with poor foetal growth or stunting in the first years of life have important effects on adult health. They tend to gain excess weight in adolescence, putting them at higher risk of developing nutrition-related diseases. In addition, poor nutrition in early childhood can be an important driver of obesity in low- and middle-income countries (Kozuki *et al.,* 2015).

The effect of child factors on the incidence of stunting

Based on the results of the study, the number of male and female infants who experienced almost the same number indicated that stunting could occur in male and female infants. This study is in line with research conducted by Samuel *et al.* (2022) showing the results of interaction analysis of stunting showed no difference in predictors between boys and girls. Our study found that the prevalence of stunting between males and females did not have a significant difference in the distribution of stunting in males and females. Therefore, our findings do not confirm previous studies that state that males have a greater risk of stunting than females. Risk factors for stunting in female and male infants are almost the same, although there are some variations based on biological, socio-cultural, and environmental factors.

Similarly, the incidence of LBW also did not confirm a significant relationship with the incidence of stunting. This study is in line with research conducted Trisiswati, Mardhiyah & Maulidya (2021) found that there was no relationship between LBW and the incidence of stunting. The results of this study can be explained that the incidence of LBW did not occur much in infants, this was supported by the fact that most mothers had good nutritional status (BMI> 18.5). This confirms that mothers during pregnancy pay more attention to nutrition and nutrition during pregnancy. Mothers with a first pregnancy usually pay more attention to nutrition and nutrition during pregnancy so that it can prevent babies from having LBW. Maternal health status has a great influence on the condition of the foetus and affects the first 1000 days of life. LBW is usually associated with poor maternal nutrition during pregnancy. LBW children are accompanied by inadequate food consumption, inadequate health services, and frequent infections during infancy and result in short stature (Trisiswati *et al.*, 2021).

Our results also found that child birth order was not a risk factor for stunting in Maros Regency. This study is supported by research conducted by Elifiana & Ferdi (2022), which states that short birth spacing is not a cause of stunting, because there are other factors that are modified. Our study found that first- and second-born infants had a high frequency of stunting, at 16% and 18% respectively. First- and second-born children have a higher risk of stunting than children with a higher birth order. First and second children are children born to mothers, most of whom do not have sufficient knowledge about stunting, are young and married at an early age, causing babies to not receive adequate care and nutrition during their growth period. In addition, a high number of unwanted births can also cause a lack of attention and care from parents, which can affect the growth and development of children. Our research found that 37.3% of respondents were married between the ages of 13-19 years old, which is an

age when they are still teenagers and below the standard age of marriage in Indonesia. An investigation by Chaveepojnkamjorn *et al.* (2022) showed serious health problems among teenage mothers, possibly stemming from unwanted pregnancies, poverty, low education and inappropriate maternal socio-economic factors. Adolescent nutrition before pregnancy needs to be considered to prepare for the nutritional needs required during pregnancy.

Exclusive breastfeeding and history of infectious diseases in under-two were found to have a significant relationship and influence on the incidence of stunting. This study is in line with research conducted by Safaah *et al.* (2022), Sudirman *et al.* (2024), and Hadi *et al.* (2021) who found that children who are exclusively breastfed have a lower incidence of stunting than children who are not exclusively breastfed. Exclusive breastfeeding provides the nutrients needed for optimal growth and development of infants so that it can reduce the risk of stunting (Safaah *et al.*, 2022; Sudirman *et al.,* 2024).

The results showed that many stunted infants did not receive exclusive breastfeeding. Some of the reasons given by respondents were that there was little breast milk, the mother had to work, the child had difficulty breastfeeding because the nipple did not come out, and the mother did not want to give breast milk to her baby. The same thing was also conveyed by Miranti *et al.* (2020) the reason mothers do not exclusively breastfeed their children is because breast milk did not come out when the child was born, so the baby was given formula milk instead. The importance of exclusive breastfeeding in the first six months of life is that breast milk contains all the essential nutrients needed for the physiological growth and development of the infant, thereby improving the health outcomes of the infant. (Azizah *et al.*, 2022).

The history of an infectious disease factor describes the condition of a child who has experienced a recurrence of an infectious disease within a certain time interval. In this study, it was found that there was a significant effect of a history of infectious disease on the incidence of stunting. Nubatonis, Olin & Wali (2022) in his research found that there was a significant effect of a history of infectious diseases on the incidence of stunting in under-fives. The study also found that most of the stunted infants experienced diarrhoea and ARI. Suhartanti, Mawaddah, & Marwan (2023) research also found a relationship between the history of infectious diseases and the incidence of stunting in toddlers where in her research she found that diarrhoea and ARI were dominant in children. Most of the under-two in Maros Regency grew up with parents who smoked. In addition, poor ventilation conditions can also cause dust and smoke from burning garbage to enter the house which can have a negative impact on the health of infants. One of the reasons given by the health department is the increased air pollution due to the prolonged dry season in 2023. Many of the Infants also experienced diarrhoea, which can be caused by inappropriate complementary feeding practices, and the availability of clean water where some respondents admitted that to get drinking water, they took from well water which was then cooked using firewood. In addition, the habit of giving children fast food that is usually sourced from outside snacks can potentially make children contaminated by bacteria, causing diarrhoea. Mothers who have knowledge of infectious disease prevention will have awareness in providing better health services to their children and better infectious disease prevention treatment (Muslimin *et al.,* 2023).

The effect of household factors on the incidence of stunting

Cigarette smoke exposure and family income were found to have a significant relationship and influence on the incidence of stunting. The results show that exposure to cigarette smoke is a significant risk factor for stunting. Toddlers who were exposed to cigarette smoke during pregnancy and after birth were 12.364 times more at risk than those who were not exposed to cigarette smoke. This study is in line with research conducted by Muchlis *et al.* (2023) and Astuti, Handayani & Astuti (2020) which found that exposure to cigarette smoke in infants can cause stunting. Research Astuti *et al.* (2020) show that exposure to cigarette smoke as soon as possible more than 3 hours per day increases stunting events by 10.316 times, but exposure to cigarette smoke from the environment does not provide a significant effect against prevalence of stunting.

Research Muchlis *et al.* (2023) proved that the child whose father has smoking intensity and high probability has a higher chance to have stunting by 3,47%, and the effect is higher if the smoker is disclosed. The risk increases if the second is the parents. Exposure to cigarette smoke for under-fives is certainly very dangerous for children's health. Cigarette smoke can interfere with the immune system of infants, which is still not perfect, and can interfere with the growth and development of children. Even a little cigarette smoke exposed to infants can damage the lungs of infants who are still developing. Therefore, it is very important for parents to keep their children away from places exposed to cigarette smoke, ensure a smoke-free environment, and not approach children when they are smoking (for parents who smoke), at least parents do not smoke in the house and they pay attention to their hygiene after smoking and before approaching their children.

In addition, the results found that family income was a risk factor for stunting in Maros Regency. Infants from families with low income were 7.250 times more likely to be stunted compared to infants with sufficient income. The multivariate test results also showed that family income had a significant effect on the incidence of stunting in Maros Regency with an effect size of 22.590 times. This study is in line with research conducted by Rahma & Mutalazimah (2022) who found that families with incomes below the minimum wage were 6.625 times more likely to have stunted children.

Rahayuwati *et al.* (2023) also found a relationship of family income and the incidence of stunting. Low income will affect the quality and quantity of food consumed by the family. Low income levels and poor purchasing power make it possible to overcome eating habits in some ways that hinder the effectiveness of improving nutrition, especially for children, vitamins and minerals, thereby increasing the risk of malnutrition. Limitations like these will increase the risk of stunting among family members. Our study also found that as many as 36.7% of respondents admitted that they had experienced food difficulties in the past year which could affect nutritional recharging, especially in under-fives.

Low Economic status has a dominant influence on the incidence of stunting in children. The purpose of household consumption increases household food security. This decision shows the strong influence of the family on the incidence of stunting. Families whose socio-economic conditions are not accompanied by a large number of children will not only result in a lack of attention and love for children, but even basic needs such as food, clothing and shelter will not be met, which puts them in danger of perishing (Sumiati, Arsin & Syafar, 2020).

CONCLUSION

Based on the research objectives, we found that maternal nutritional status, maternal knowledge, exclusive breastfeeding, history of childhood infectious diseases, exposure to cigarette smoke, and family income are risk factors for stunting among under-two children in Maros Regency. The results of testing the probability of stunting incidence showed that those born with poor maternal nutritional status, those who did not receive exclusive breastfeeding, those who had a history of infectious diseases, those who were exposed to cigarette smoke, and those with low family income had a high probability of having a stunted child if they get these conditions. Therefore, programs that aim to reduce the incidence of stunting need to pay attention to the economic aspects of the family and provide appropriate support to families with low income to ensure access to adequate nutrition and necessary health.

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Conflict of interest

The authors declare no conflict of interest in this study.

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