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Nutritional Literacy as An Effect Modifier on Undernutrition Incidence among Poor Urban Family in Semarang City

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Abstract

Poverty is the root cause of malnutrition. The Gunung Brintik area, Randusari Village, Semarang City is a pocket of poverty in the center of Semarang City with a poor population of 28.48% and a prevalence of undernutrition of 60%. This study was conducted to analyze the risk factors for undernutrition and analyze maternal nutritional literacy as a modifying effect of undernutrition events in toddlers. The study was conducted with a cross-sectional design involving 97 toddlers in the Mount Brintik RW III and IV areas of Randusari Village, Semarang City. The results showed that 12 variables had associations with the incidence of malnutrition in toddlers, namely gender, history of IMD, history of immunization, history of infectious diseases, energy intake, protein intake, fat intake, carbohydrate intake, maternal education, father's education, family opinions, and nutritional literacy. The results of the multivariate analysis showed an interaction between family income and nutritional literacy as an interaction variable (p-value: 0.044). OR adjusted family income and nutritional literacy to the incidence of undernutrition obtained OR = 2.37 (1.07-9.38). Families that are economically able but have less nutritional literacy are 2.37 times more likely to have under-five children who are undernourished than families that are economically capable and have good nutritional literacy.

Introduction

Poverty and undernutrition are the main agenda of national development and are targets of the Sustainable Development Goals (SDGs) (UN, 2023). The problem of poverty and undernutrition is a population problem, especially in developing countries. Poverty is at the root of the problem of undernutrition. The impact of undernutrition in the long term is the decline in the quality of human resources (Kassie & Workie, 2020). Therefore, overcoming the problem of poverty and undernutrition needs to be done comprehensively.

Gradually from year to year, Indonesia has been able to reduce the prevalence of malnourished toddlers. During the period 2016 to 2019, Indonesia was able to reduce the prevalence of malnutrition in toddlers from 17.83% to 16.29%. Based on the results of the Indonesian Nutritional Status Study (SSGI), stunting prevalence also shows a downward trend, from 24.4% in 2021 to 21.6% in 2022. The decline in the prevalence of malnutrition and stunting achieved by the Indonesian nation shows a positive trend, but the decline is not following the SDGs target. The stunting prevalence target is 14% by 2024. Therefore, Indonesia has the challenge of reducing stunting by 10.4% in the next three years (Ministry of Health, 2022).

The challenge of efforts to reduce the problem of undernutrition and stunting is not only the responsibility of the central government. Provincial and district/city governments must also take responsibility for reducing stunting. Central Java Province

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has shown a significant downward trend in stunting, from 27.68% in 2019 to 20.9% in 2021. Semarang City also showed a positive stunting reduction trend, from 26.01% in 2019 to 21.3% in 2021. However, the reduction in stunting at the provincial level of Central Java and Semarang City still has not reached the SDGs target of 10.4% (Ministry of Health, 2022).

Reducing stunting is not only the responsibility of the government but also the responsibility of all elements of society. Research has proven that poverty is at the root of the problem of undernutrition (Panda *et al*., 2020; Rahman *et al*., 2021; Siddiqui *et al*., 2020). This means that efforts to reduce stunting must focus on alleviating and empowering poor families. Socioculturally, poor families in rural areas still have better access to food than poor urban families. Social care in rural communities is a social capital that supports poor families to access food from the surrounding environment. This is often not owned by poor families in urban areas(Rochmayani, 2018; Sabale *et al*., 2021).

Undernourished risk factors consist of direct causes, namely low nutrient intake and the incidence of infectious diseases (Fitzpatrick *et al*., 2019). Indirect causes, namely nutritional parenting, household food availability, maternal education, and nutritional literacy (Tekile *et al*., 2019). Mount Brintik is one of the pockets of poverty in the Randusari Village area of Semarang City. Most residents in the Mount Brintik area are stigmatized related to their work as beggars on the streets. Based on monograph data from Randusari Village, the community of Gunung Brintik residents live in RW 3 and RW 4 with 653 families. Based on the integrated database, 28.48% of families in Gununug Brintik are categorized as poor families. A preliminary study conducted at posyandu RW 04 on March 12, 2021, showed a fairly high prevalence of undernutrition. As many as 21 out of 35 (60%) toddlers fall into the category of malnutrition status.

The government has made various efforts to overcome malnutrition. Poverty alleviation and assistance for poor families is one of the sensitive efforts made by the government to support the reduction of malnutrition problems (Sabale *et al*., 2021). Nutrition education also continues to be carried out to improve the nutritional literacy of the community, especially in the target of mothers under five. Good nutritional literacy is a capital for accelerating the reduction of malnutrition problems. Mothers with good nutritional literacy have a higher chance of finding solutions to fulfilling the nutrition of their toddlers. This study was conducted to find evidence that nutritional literacy is a very important modifier. This evidence can then be used as a basis for the development of undernutrition reduction programs, especially in the urban poor.

Method

This research is quantitative research with a cross-sectional design. The study population was toddlers in the Gunung Brintik area, Randusari Village, Semarang City. The Mount Brintik area covers 2 RW areas, namely RW III and IV in Randusari Village, Semarang City. This population was chosen because of its existence in the center of Semarang City, Central Java Province, with the background of almost 30% of the population included in the category of poor villages. Samples were taken from all toddlers living in the Mount Brintik area, Semarang City, with as many as 97 respondents. Data collection will be carried out for 2 weeks in June 2023. Informed consent was obtained from all research subjects, namely by mothers of toddlers. The research has received an ethical clearance assessment from the Health Research Ethics Commission of Semarang State University, with registration number 042/KEPK/EC/2023.

Data on the nutritional status of toddlers are taken from the results of anthropometric measurements carried out in Posyandu activities in June 2023 at the research site. Determination of nutritional status is carried out using the weight index according to age. Interviews were conducted with respondents of mothers under five to obtain data on early breastfeeding initiation history, exclusive breastfeeding history, immune history, history of infectious diseases, energy, and nutritional intake, maternal education, mother's employment status, father's education, status of social assistance recipients, family income, number of families, and nutritional literacy.

The nutritional literacy instrument in this instrument covers 3 domains, namely: Functional nutrition literacy (FNL), Interactive nutrition literacy (INL), and Critical nutrition literacy (CNL). FNL domains include themes about the capability to understand nutritional terms and the capability to understand the nutritional message conveyed. INL domains include themes about capabilities to access nutritional information and motivation, and self-belief to do things based on the advice received. CNL domains include themes about the capability to sort out true and false nutritional information and the capability to promote healthy eating in other people. These instruments have been tested for validity and reliability. There are a total of 21 nutritional literacy question items, all of which are valid with grades Cronbach's alpha FNL= 0.73, INL= 0.70, and CNL= 0.71(Dewi *et al*., 2023). Data were processed and analyzed univariately, bivariately, and multivariately. The univariate analysis uses frequency distribution analysis, the bivariate analysis uses the chi-square test, and while multivariate analysis uses multiple logistic regression analysis.

Result And Discussion

Mount Brintik as a research location is part of Randusari Village, South Semarang District, Semarang City. Randusari Village consists of 6 RW (Neighbourhood) areas, where Mount Brintik is located in RW 3 and 4. Gunung Brintik has 653 households, of which 28.48% are categorized as poor families. This region has characteristics as an enclave of urban poverty. This is because the research location is only about 2 km from the Semarang mayor's office. Geographically, the research location is on a hill adjacent to the cemetery complex. Poverty and limited housing land cause many people of Gunung Brintik to live in the middle of the cemetery area.

The distribution of respondent characteristics in this study is shown in Table 1. Based on Table 1, it is known that the number of respondents who have undernourished status is 34 (35.1%) respondents. Meanwhile, the number of respondents who had normal nutritional status was 63 (64.9%) respondents. When viewed from the distribution of gender, male respondents have a higher percentage, namely 51.5%, compared to women with a percentage of 48.5%. Furthermore, for the mother's last level of education, it is known that 53.6% of mothers have taken higher education, namely graduating from high school and college (S1, S2, and S3).

Table 1. Distribution of Respondent Characteristics

Variable	Freq.	Pct. (%)
Nutritional status		
Less	34	35,1
Normal	63	64,9
Gender		
Man	50	51,5
Woman	47	48,5
IMD History		
No	52	53,6
Yes	45	46,4
History of exclusive breastfeeding		
No	41	42,3
Yes	56	57,7
Immunization history		
Incomplete	31	32,0
Complete	66	68,0
History of infectious diseases		
Yes	31	32,0
No	66	68,0
Energy intake		
Less	26	26,8
Enough	40	41,2
More	31	32,0
Protein intake		
Less	29	29,9
Enough	34	35,1
More	34	35,1
Fat intake		
Less	26	26,8
Enough	34	35,1
More	37	38,1
Carbohydrate intake		
Less	28	28,9
Enough	43	44,3
More	26	26,8
Mother's education		
Low	45	46,4
High	52	53,6
Mother's employment status		
Work	40	41,2
Housewives	57	58,8

Variable	Freq.	Pct. (%)
Father's education		
Low	45	46,4
High	52	53,6
Social aid beneficiary status		
Yes	48	49,5
No	49	50,5
Family income		
Less	33	34,0
High	64	66,0
Number of family members		
> 4	48	49,5
≤ 4	49	50,5
Nutritional literacy		
Bad	30	30,9
Good	67	69,1

Source: Primary Data, 2023

Similar to the last level of education of fathers, it is known that 53.6% of fathers have also taken higher education, namely graduating from high school and college (S1, S2, and S3). Then, for the employment status of mothers, as many as 41.2% of working mothers and 58.8% of mothers as housewives. Furthermore, families who received social assistance (social aid) and did not receive social assistance also had a balanced proportion, namely 49.5% of families receiving social assistance and 50.5% of families not receiving social assistance. Then, family income is categorized based on Semarang City MSEs, which is IDR 2,800,000. Families who have an income less than equal to Rp 2,800,000 are as much as 34%. While families who have an income of more than Rp 2,800,000 are 66%. Furthermore, judging from the number of family members, families with more than 4 members are 49.5% and those less than equal to 4 are 50.5%. Then, the nutritional literacy variable consists of good and bad literacy categories. The number of respondents who had good literacy was 30.9% and respondents with poor literacy was 69.1%.

The bivariate analysis in this study is shown in Table 2. Based on statistical tests using the Chi-Square test, it is known that 12 variables have associations with the incidence of malnutrition in toddlers, namely 1) gender, 2) history of IMD, 3) history of immunization, 4) history of infectious diseases, 5) energy intake, 6) protein intake, 7) fat intake, 8) carbohydrate intake, 9) maternal education, 10) father's education, 11) family opinion, and 12) nutritional literacy. The sex variable was statistically shown to have an association with the incidence of undernutrition indicated by a p-value of less than 0.05. The indicator of strength of the relationship used is PR, the sex variable has a PR of 2.61 (IK 95% 1.36-4.99). That is, toddlers of the male sex have a risk of 2.61 times more to experience undernutrition than women. This is in line with previous research which states that sex variables are proven to have an association with the incidence of undernutrition, where male toddlers have more risk of experiencing less nutrition than women (Dabar *et al*., 2020; Jeyakumar *et al*., 2019). Other studies have also found that boys are 1.9 and 1.8 times more likely to be stunted and underweight than girls. This can partly be explained since boys are more prone to health disparities than girls in the same age group. (Gebre *et al*., 2019).

The IMD history variable was statistically proven to have an association with the incidence of undernutrition in toddlers. This is evidenced by a p-value of less than 0.05. The indicator of relationship strength used is PR where this variable has a PR of 2.08 (IK 95% 1.12-3.86). That is, toddlers who did not have IMD at birth had a risk of 2.08 times to experience undernutrition than toddlers who succeeded in IMD. This is in line with research that proves that early initiation of breastfeeding is a significant factor and estimates the likelihood of wasting (Satapathy *et al*., 2021). Studies conducted in Indonesia show that the higher the practice of early initiation of breastfeeding, the lower the malnutrition rate in a province (Laksono & Chalidyanto, 2021). A baby is said to have early initiation of breastfeeding if he has been breastfed within an hour of his birth. The breast milk consumed by newborns during the first few days – called colostrum – is very rich in nutrients and antibodies and acts as the child's first 'vaccine', providing important protection against illness and death. (Laksono & Chalidyanto, 2021).

Immunization history variables are statistically proven to have an association with the incidence of undernutrition in toddlers. This is evidenced by a p-value of less than

0.05. The indicator of relationship strength used is PR, where this variable has a PR of 2.39 (IK 95% 1.42-4.03). That is, toddlers with a history of incomplete immunization have a risk of 2.39 times to experience malnutrition than toddlers with a history of complete immunization. This is also in line with previous research that explains that not getting fully immunized is a risk factor for undernutrition (Maidelwita, 2019). Toddlers who are not fully immunized for their age are more likely to be acutely malnourished than other children (Tut & Tsegaye, 2020). Immunization of children aims to reduce the risk of morbidity (pain) and mortality (death) in children. Immunization status is also an indicator of contact with health services, meaning that complete immunization status will improve new nutritional problems, so immunization status is also expected to have a positive effect on long-term nutritional status. (Fitzpatrick *et al*., 2019).

The variable history of infectious diseases has a PR value of 2.44 (IK 95% 0.98-6.05). That is, toddlers with a history of infectious diseases have a risk of 2.44 times to experience malnutrition than toddlers who do not have a history of infectious diseases. Previous research also explained that toddlers with a history of infectious diseases have a 2.81 times higher risk of experiencing malnutrition than toddlers without a history of infectious diseases (May-Kim *et al*., 2022). Toddlers with a history of the disease generally have symptoms of illness that can affect the reduction of the average protein absorbed by toddlers. The average protein lost when a child has an infection can reach about 0.6-1.2 grams per kilogram per day (Fitzpatrick *et al*., 2019). In addition, infectious diseases will also generally cause toddlers to experience a significant decrease in appetite which also has an impact on toddler weight loss (Handu *et al*., 2021). Then, the healing process against infectious diseases can also absorb proteins that should be used as material for child growth (Calder & Yaqoob, 2020; Fitzpatrick *et al*., 2019).

Variables that also have associations with the incidence of undernutrition in toddlers are energy intake, protein, fat, and carbohydrates. The four variables had PR values, for less than more categories, respectively 4.47 (IK 95% 1.69-11.82), 3.52 (IK 95% 1.61-7.67), 3.25 (IK 95% 1.56-6.77), and 2.60 (IK 95% 1.09-6.21). That is, toddlers with less intake of energy, protein, fat, and carbohydrates had a sequential risk of 4.47; 3,52; 3,25; and 2.60 times for malnutrition than toddlers with more energy, protein, fat, and carbohydrate intake. Previous research explained that toddlers with less energy intake do affect the not optimal brain development which results in the inhibition of cognitive development. This is because when energy consumption is less, the body will meet its needs by using energy reserves such as muscle and fat to continue metabolism, resulting in toddlers losing weight and becoming thinner than their peers (Dipasquale *et al*., 2020; Ozer *et al*., 2022). Intake of energy, protein, fat, and carbohydrates are factors that are directly related to the nutritional status of toddlers. In addition to having a direct impact on weight loss, lack of intake of these substances can also make toddlers easily infected with disease-causing pathogens (David *et al*., 2020; Kamil *et al*., 2021; Nakahara *et al*., 2021).

The maternal education variable has a PR value of 2.77 (IK 95% 1.49-5.16). That is, mothers of toddlers with low last education levels (not in school, graduating from elementary school, and graduating from junior high school) have a risk of 2.77 of having toddlers with less nutrition than mothers of toddlers with high last education levels (graduated from high school and college). Previous research explained that the level of education of mothers can affect parenting and the quality and quantity of intake given to toddlers (Berhe *et al*., 2019; Verma & Prasad, 2021). Mothers with a higher level of education are generally more literate about information related to nutrition in children (Gagebo *et al*., 2020). So, they provide intake according to the nutritional needs of their children. In addition, mothers with a higher level of education are considered more concerned about the availability of health facilities as the main reference when experiencing health problems (Ekholuenetale *et al*., 2020; Murarkar *et al*., 2020).

In addition to maternal education factors, the incidence of malnutrition in toddlers is also influenced by the father's education level. Based on the results of the analysis, it was found that

the PR value for the father's education variable was 2.77 (IK 95% 1.49-5.16). That is, fathers of toddlers with low last education levels (not in school, graduating from elementary school, and graduating from junior high school) have a 2.77 risk of having toddlers with less nutrition than fathers of toddlers with high last education levels (graduated from high school and college). These results are in line with previous research that states that fathers' education levels also have an association with the incidence of undernutrition (Chowdhury *et al*., 2021; Dabar *et al*., 2020). This is because the father as the head of the family can determine attitudes to regulate food intake preferences and health services used in the family. If the father as the head of this family has a high education and cares about the growth and development of his children, it can affect the level of family health, especially children (Karkappanavar *et al*., 2020).

Furthermore, a variable that also has an association with the incidence of undernutrition in toddlers is family income. The results of the analysis showed a PR value for this variable of 5.39 (IK 95% 2.85-10.17). That is, families with less income than MSEs in Semarang City have a risk of 5.39 times having undernourished toddlers than families with more income than MSEs in Semarang City. Previous research has also explained that family income levels are associated with the incidence of undernutrition (Kassie & Workie, 2020; Tekile *et al*., 2019). This can happen because families who have high-income levels tend to be able to meet nutritious food intake for the family, especially their children (Boah *et al*., 2019; Sultana *et al*., 2019). In addition, families with high incomes can also more easily access health services (Workie & Tesfaw, 2021).

The last variable that has an association with the incidence of undernutrition in toddlers is nutritional literacy. This variable has a PR value of 3.61 (2.10-6.19). That is, families with poor nutritional literacy have a 3.61 times higher risk of having undernourished toddlers than families with good nutritional literacy. Previous research also explained that good nutritional literacy levels are a protective factor against undernutrition events in toddlers (Hoteit *et al*., 2022). This is because families with a good level of literacy about nutrition are considered to have a higher awareness of the importance of nutritious food intake and good parenting for children to prevent malnutrition (Fagbamigbe *et al*., 2020; Kumeh *et al*., 2020). In addition, good literacy about nutrition also allows families to realize early when children experience symptoms of malnutrition so that it can be treated earlier (Lindberg *et al*., 2022).

Table 2. Bivariate Analysis

Variable	Undernutrition n (%)	Normal nutrition, n (%)	PR (IK 95%)	P value
Gender				
Man	25 (50,0)	25 (50,0)	2,61 (1,36-4,99)	0,001*
Woman	9 (19,1)	38 (80,9)		
IMD History				
No	24 (46,2)	28 (53,8)	2,08 (1,12-3,86)	0,014*
Yes	10 (22,2)	35 (77,8)		
History of exclusive breastfeeding				
No	18 (43,9)	23 (56,1)	1,54 (0,89-2,64)	0,178
Yes	16 (28,6)	40 (71,4)		
Immunization history				
Incomplete	18 (58,1)	13 (41,9)	2,39 (1,42-4,03)	0,001*
Complete	16 (24,2)	50 (75,8)		
History of infectious diseases				
Exist	18 (58,1)	13 (41,9)	2,44 (0,98-6,05)	0,002*
No	16 (24,2)	50 (75,8)		
Energy intake				
Less	15 (57,7)	11 (42,3)	4,47 (1,69-11,82)	<0.001*
Enough	15 (37,5)	25 (62,5)	2,91 (1,07-7,89)	0,04*
More	4 (12,9)	27 (87,1)		

Variable	Undernutrition n (%)	Normal nutrition, n (%)	PR (IK 95%)	P value
Protein intake				
Less	18 (62,1)	11 (37,9)	3,52 (1,61-7,67)	<0.001*
Enough	10 (29,4)	24 (70,6)	1,67 (0,68-4,07)	0,39
More	6 (17,6)	28 (82,4)		
Fat intake				
Less	16 (61,5)	10 (38,5)	3,25 (1,56-6,77)	<0.001*
Enough	11 (32,4)	23 (67,6)	1,71 (0,75-3,90)	0,31
More	7 (18,9)	30 (81,1)		
Carbohydrate intake				
Less	14 (50)	14 (50)	2,60 (1,09-6,21)	0,037*
Enough	15 (34,9)	28 (65,1)	1,81 (0,75-4,41)	0,26
More	5 (19,2)	21 (80,8)		
Mother's education				
Low	24 (53,3)	21 (46,7)	2,77 (1,49-5,16)	<0.001*
High	10 (19,2)	42 (80,8)		
Mother's employment status				
Work	14 (35)	26 (65)	0,99 (0,58-1,73)	0,993
Housewives	20 (35,1)	37 (64,9)		
Father's education				
Low	24 (53,3)	21 (46,7)	2,77 (1,49-5,16)	<0.001*
High	10 (19,2)	42 (80,8)		
Social aid beneficiary status				
Yes	17 (35,4)	31 (64,6)	1,02 (0,59-1,76)	0,941
No	17 (34,7)	32 (65,3)		
Family income				
Less	25 (75,8)	8 (24,2)	5,39 (2,85-10,17)	<0.001*
High	9 (14,1)	55 (85,9)		
Number of family members				
> 4	17 (35,4)	31 (64,6)	1,02 (0,59-1,76)	0,941
≤ 4	17 (34,7)	32 (65,3)		
Nutritional literacy				
Bad	21 (70)	9 (30)	3,61 (2,10-6,19)	<0.001*
Good	13 (19,4)	54 (80,6)		

Furthermore, the data analysis carried out is an interaction test. This test was conducted to determine the modification of the effect of nutritional literacy variables and family income variables on the incidence of undernutrition in urban poor families. Previous studies have explained that the incidence of undernutrition is strongly influenced by family income (Akombi *et al*., 2019; Kassie & Workie, 2020). Therefore, this interaction test was conducted to prove whether economically capable families and having good nutritional literacy contribute to a reduced risk of undernutrition events. Conversely, economically capable families, but have less nutritional literacy are associated with an increased risk of malnutrition events.

After an interaction analysis with multiple logistic regression tests in Table 3, there was an interaction between family income and nutritional literacy as an interaction variable (p-value: 0.044). It can be concluded that there is an interaction between family income and nutritional literacy in estimating the incidence of undernutrition in urban poor families. Table 3 shows the overall OR value of family income to the incidence of undernutrition, amounting to 101.91 (4.84-2147.49). However, because there is an interaction with nutritional literacy, the overall OR does not reflect the adjusted OR value of family income variables. This is because the OR value of family income has not considered nutritional literacy as an interaction variable. Therefore, to show the modification of the effect of risk factors of low-income families

Table 3. Multivariate Analysis and Interaction Test

Variable	Beta	S.E.	Wald	OR (IK 95%)	P value
IMD History	2,32	1,20	3,73	10,19 (0,97-107,52)	0,053
Immunization history	2,06	0,99	4,33	7,86 (1,13-54,79)	0,037
Energy intake (less vs more)	2,76	1,28	4,64	15,84 (1,28-195,59)	0,031
Energy intake (enough vs more)	2,64	1,23	4,58	13,94 (1,28-155,73)	0,032
Fat intake (less vs more)	1,84	1,08	2,91	6,28 (0,76-51,93)	0,088
Fat intake (enough vs more)	-1,48	1,31	1,27	0,23 (0,02-2,98)	0,259
Carbohydrate intake (less vs more)	2,59	1,38	3,51	13,35 (0,88-200,75)	0,061
Carbohydrate intake (enough vs more)	0.65	1,08	0,36	1,91 (0,23-15,76)	0,549
Mother's education	-1,84	0.93	3,94	0,16 (0,03-0,98)	0,047
Family income	4,62	1,56	8,84	101,91 (4,84-2147,49)	0,003
Nutritional literacy	4,70	1,51	9,77	110,73 (5,79-2119,07)	0,002
Family income*Nutritional literacy	-4,00	1,99	4,06	0,02 (0,00-0,89)	0,044

on the chances of malnutrition, the calculation of the OR adjusted value of family income needs to consider nutritional literacy as an interaction variable.

The results of calculating the OR adjusted value of the family by taking into account the nutritional literacy variable were obtained that the OR adjusted was 0.25 (0.03-2.41). This means that family income in respondents who have good nutritional literacy is not a significant deterrent factor to the incidence of undernutrition because it is not statistically related. Furthermore, the OR adjusted value of family income in respondents who have malnourished literacy is 2.37 (1.07-9.38). This means that family income in respondents who have malnutrition literacy is a risk factor that increases the chances of malnutrition in the family. In other words, families that are economically able, but have less nutritional literacy contribute to an increased risk of having undernourished children than families that are economically capable and have good nutritional literacy. Thus, the risk effect of undernourished family income on the incidence of malnutrition is modified by nutritional literacy as an effect modifier.

Conclusion

This study concludes that 12 variables have an association with the incidence of malnutrition in toddlers, namely: gender, history of IMD, history of immunization, history of infectious diseases, energy intake, protein intake, fat intake, carbohydrate intake, maternal education, father's education, family income, and nutritional literacy. The nutritional literacy variable was shown to be a modification of the effect on the family income variable. Economically able families, who had poor nutritional literacy contributed to an increased risk of having children who were undernourished than families who were economically capable and had good nutritional literacy. Thus, the risk effect of undernourished family income on the incidence of malnutrition is modified by nutritional literacy as an effect modifier.

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