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Analysis of Factors Affecting The Success of Nutrition Improvement Programs for Primary School Children

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Abstract: The high rate of malnutrition in Indonesia, especially stunting in children, is caused by economic constraints, lack of nutrition education, and limited access to health services, which have an impact on children's growth, cognitive development, and academic achievement. The success of primary school nutrition improvement programs is influenced by factors such as community involvement, policy support, and parents' and teachers' understanding of nutrition, although they still face implementation challenges that need to be overcome for long-term effectiveness. This research method uses a quantitative approach with surveys and statistical analysis to examine the factors that affect the success of the nutrition improvement program in grade 1 elementary school students in three schools in Purworejo District. With 106 respondents, data were analyzed using Pearson correlation, and linear regression through SPSS 27. The results of the t-test showed that the factors that affect the success of the nutrition improvement program have a significant influence on the success of the program (t count = 5.164; Sig. = 0.000 < 0.05). In addition, the results of the F test (F count = 26.666; Sig. = 0.000) confirmed that the regression model used was statistically significant so that the independent variables together affected the success of the program. The success of school nutrition programs relies on collaboration between parents, teachers, schools, and the government to improve nutritional knowledge and food availability. Policy support, including healthy food subsidies and training, is essential for ensuring the program's long-term sustainability.

Keywords: Children; Education; Malnutrition; Nutrition Improvement

Introduction

The high rate of malnutrition in Indonesia is a significant public health problem, affecting a wide range of demographics, including children, pregnant women, and older adults. The prevalence of stunting among children is very high at 21.6%, indicating chronic nutritional deficiencies that can hinder their growth and development (Khalida et al., 2024). In addition, malnutrition among older adults in institutionalized settings ranges from 6.5% to 48.3%, with severe deficiencies in essential nutrients such as protein and calcium (Dewiasty et al., 2024). Pregnant women also face challenges, with high rates of anemia and chronic energy deficiencies exacerbated by economic and educational barriers (Suparji et al., 2024).

Key Factors Contributing to Malnutrition such as economic constraints where limited financial resources hinder access to nutritious food. Lack of knowledge about nutrition, especially in remote areas, affects

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dietary choices. Unequal access to quality health care exacerbates the problem of malnutrition. Consequences of Malnutrition such as Stunting that affect children's growth and future potential (Khalida et al., 2024). Anemia, which is a high prevalence among women of childbearing age, has an impact on maternal health. Waste, which is acute malnutrition in children, is related to insufficient protein intake (Zulfiana et al., 2023). This shows that the role of nutrition in children's growth and development has a very important role.

Nutrition plays a crucial role in the health and development of elementary school children, affecting their physical, cognitive, and emotional well-being. A balanced diet is essential for promoting healthy growth, improving learning ability, and reducing the risk of chronic diseases. The following section highlights the importance of nutrition for young learners. Adequate nutrition supports optimal growth and development, helps maintain a healthy weight and prevents obesity (Shakir & Shakeel, 2024). School feeding programs have been shown to increase food intake, with at least 388 million children benefiting from daily meals globally (Plakida et al., 2023). A balanced diet increases children's resistance to disease and increases their physical capacity (Plakida et al., 2023).

Proper nutrition is associated with improved cognitive function, which is essential for learning and academic performance. Educational interventions have shown that increased nutritional knowledge correlates with healthier food choices and better academic outcomes (Barros, 2023; Mogre et al., 2024). Building healthy eating habits in childhood can lead to lifelong benefits, reducing the risk of chronic diseases such as diabetes and heart disease (Barros, 2023; Shakir & Shakeel, 2024). Nutrition education initiatives have shown significant improvements in children's understanding of healthy eating, which can influence their dietary choices into adulthood (Mogre et al., 2024).

This shows the importance of the role of nutrition in child development, so the high rate of malnutrition must be addressed immediately. Conversely, inadequate nutrition can lead to adverse effects, including poor academic performance and increased susceptibility to health problems. Malnutrition significantly impacts children's health and learning achievement, leading to detrimental effects on their physical, cognitive, and emotional development. Research shows that malnutrition is closely linked to poor academic performance, impaired concentration, and a variety of health problems, which collectively inhibit children's potential to succeed in educational settings. Malnutrition can lead to severe health problems, including stunted growth, weakened immune systems, and increased susceptibility to infections (Akhtar, 2023). Nutritional deficiencies during critical growth periods can result in long-term health problems, including non-communicable diseases in adulthood (Akhtar, 2023).

Studies show a strong correlation between malnutrition and impaired cognitive abilities, with malnourished children showing lower academic achievement (Kirolos et al., 2022). Malnutrition affects neurodevelopment, leading to difficulties in concentration and learning, which are essential for academic success (Hamdan & Al-Jarrah, 2024; Kirolos et al., 2022). Factors such as low family incomes, inadequate nutritional knowledge, and poor living conditions exacerbate malnutrition among children, especially in developing countries (Amoadu et al., 2024). Overcoming these socio-economic challenges is very important to improve children's nutritional status and educational outcomes (Amoadu et al., 2024). While the adverse effects of malnutrition on health and learning are well documented, some argue that interventions that focus solely on nutrition can ignore broader socioeconomic factors that also play an important role in children's development and educational success. Therefore, a nutrition improvement program for children is needed.

Educational strategies such as programs that use engaging teaching methods, such as interactive diet education, have shown a positive impact on children's eating habits (Shakir & Shakeel, 2024). Integration with physical education by combining nutrition education with physical activity, as seen in the PJOK program, significantly improves students' nutritional knowledge and healthy eating habits (Siddik et al., 2024). Involving parents in nutrition education initiatives is essential to strengthen healthy eating practices at home (Shakir & Shakeel, 2024; Siyamsih, 2024). Community support such as programs that engage the wider community, including local health services, can improve access to nutritional resources and support for families (Nursiah et al., 2024). The influence of the child's home environment, including the caregiver's nutritional knowledge, directly affects food choices and overall health (Siyamsih, 2024). The availability of nutritious food and educational materials at home is essential for fostering healthy eating habits among children (Nurusyaikha et al., 2023).

The success of nutrition improvement programs in elementary school children is influenced by various factors, such as the availability of healthy food, parents' and teachers' understanding of nutrition, policy support, and socio-economic conditions. Although the program aims to improve children's health and academic achievement, challenges in its implementation are still found, including limited resources and

community participation. Thus, this study aims to analyze the factors that affect the success of nutrition improvement programs and identify challenges and opportunities in its implementation. By understanding these factors, it is hoped that this program can be more effective and sustainable in improving the health of Indonesian children.

Method

This study uses a quantitative approach to analyze the factors that affect the success of the nutrition improvement program in Purwerejo elementary school children by sampling three elementary schools in Purworejo District, namely: SD Negeri 1 Cangkreplor, SD Negeri 2 Cangkreplor, and SD Negeri Purworejo. Data is collected through surveys and statistical analysis of various indicators that reflect the effectiveness of the program. The research respondents were 106 students consisting of 1st grade elementary school students with the following inclusion and exclusion criteria.

The inclusion criteria in this study include: grade 1 elementary school students involved in nutrition improvement programs; have a parent or guardian willing to participate; have complete health data; students are also expected not to have a medical condition that limits participation; and able to understand the questionnaire given.

Exclusion criteria include: students who do not participate in nutrition programs; have a medical condition that affects nutritional results; parents/guardians who are unwilling to give consent; students who are unable to meet the availability of data or; already experiencing severe malnutrition will also be excluded from this study.

The analysis method in this study uses a quantitative approach with descriptive and inferential statistical techniques processed using SPSS 27. Descriptive analysis is used to describe the characteristics of respondent data, such as frequency, mean, and standard deviation of the variables tested. Furthermore, Pearson correlation analysis was carried out to measure the relationship between factors that affect the success of nutrition improvement programs and program outcomes, such as children's nutritional status and academic achievement. To determine the influence of these factors on the success of the program, a linear regression was used that tested the contribution of each independent variable to the dependent variable.

Independent variables (X) that factors affecting the success of nutrition improvement programs include: Nutrition knowledge of parents and teachers, availability of healthy food in schools, parental support, socioeconomic status, and school and government policies. The dependent variables (Y) that measure the success of nutrition improvement programs include children's nutritional status, student attendance levels, academic achievement, disease frequency, and involvement in physical activity.

Result and Discussion

Based on the data presented, the majority of indicators had a fairly high average value, indicating that respondents gave a good assessment of factors that affect children's welfare. Academic achievement had the highest average (4.36) with a median of 5.00, which indicates that most respondents gave high scores on this indicator. Involvement in physical activity also had a high score with a mean of 4.38 and the highest total score (464), indicating that physical activity is considered an important factor in children's well-being.

On the other hand, school and government policies had the lowest average score (3.92), although the median remained 4.00, which means that there was variation in respondents' perception of the policy. This shows that school and government policies may not be fully optimal in supporting children's welfare. In addition, the frequency of disease had the highest mode (5), which indicated that many respondents considered that this factor had a great influence on children's welfare.

Table 1. Descriptive Analysis

Indicator	N	Mean	Median	Mode	Min	Max	Sum
	Valid						
Nutrition knowledge of parents and teachers	106	4.11	4.00	4	3	5	436
Availability of healthy food	106	4.15	4.00	5	3	5	440
Parental support	106	4.13	4.00	4	3	5	438
Socioeconomic status	106	4.29	4.00	5	3	5	455
School and government policies	106	3.92	4.00	5	1	5	415
Children's nutritional status	106	4.22	4.00	4	1	5	447
Student attendance levels	106	4.17	4.00	4[a]	1	5	442
Academic achievement	106	4.36	5.00	5	2	5	462
Disease frequency	106	4.26	4.00	5	1	5	452
Involvement in physical activity	106	4.38	5.00	5	2	5	464

Overall, factors such as socioeconomic status, parental support, and the availability of healthy foods received positive ratings with an average above 4.00. However, there are still aspects that need to be improved, especially in terms of school and government policies that play an important role in creating a more supportive environment for children.

Table 2. Reliability test

Variable	Cronbach's Alpha	Result Test
The success of nutrition improvement programs (Y)	0.790	reliable
Factors affecting the success of nutrition improvement programs (X)	0.781	reliable

The results of the reliability test using Cronbach's Alpha showed that the two variables in this study had a value above 0.7, namely 0.790 for the success variable of the nutrition improvement program (Y) and 0.781 for the variable of factors that affect the success of the nutrition improvement program (X). Because the value of Cronbach's Alpha is greater than 0.7, both variables are declared reliable, which means that the measurement instruments used in this study are consistent in measuring the concept in question. Thus, the results of the study are trustworthy and have a good level of reliability to be used in further analysis.

Based on the results of the validity test using Pearson correlation, all indicators in this study have a correlation value above 0.7, with a significance level of 0.000 ($p < 0.05$), which indicates that all indicators are declared valid. The highest correlation value was found in disease frequency (0.765) and availability of healthy food (0.757), which showed a very strong relationship with the variables measured. Meanwhile, other indicators such as nutritional knowledge of parents and teachers (0.715), parental support (0.713), and socioeconomic status (0.703) also have a high and significant correlation. These results indicate that all indicators used in this study are statistically valid in measuring the concept in question, so that they can be used for further analysis.

Table 3. Validity test with Pearson Correlation

Indicator	Pearson Correlation	Sig. (2-tailed)	Result Test
Nutrition knowledge of parents and teachers	0.715**	0,000	valid
Availability of healthy food	0.757**	0,000	valid
Parental support	0.713**	0,000	valid
Socioeconomic status	0.703**	0,000	valid
School and government policies	0.708**	0,000	valid
Children's nutritional status	0.720**	0,000	valid
Student attendance levels	0.752**	0,000	valid
Academic achievement	0.737**	0,000	valid
Disease frequency	0.765**	0,000	valid
Involvement in physical activity	0.724**	0,000	valid

Normality test

Based on the results of the normality test using a histogram, the distribution of the data shows a curve shape that resembles a normal distribution with a symmetrical bell-shaped curve pattern. This indicates that the majority of the data is distributed around the middle value with less frequency at the extreme values. There is no significant skewness to the right or left, and the distribution top is not too pointed or too flat, indicating that the assumption of normality is met. Thus, the data can be considered normally distributed and can be used for further parametric analysis.

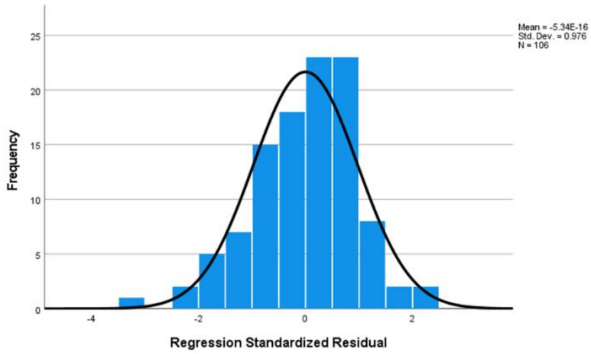

Figure 1. Normality test histogram

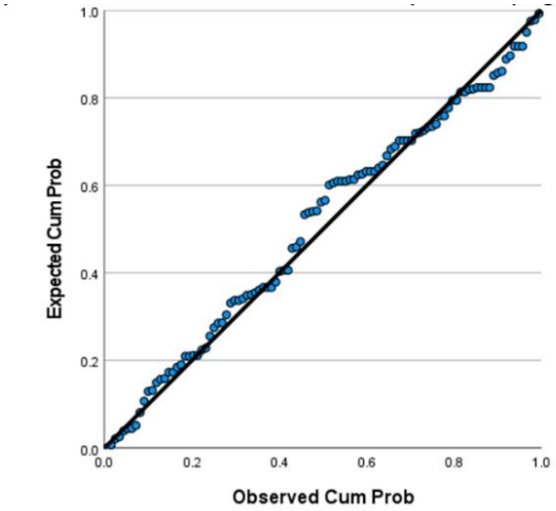

Figure 2. Normal P-P Plot Regression

The normality results shown through the normal P-P plot also support that the data is normally distributed. The dots on the chart tend to follow and intersect with diagonal lines, without any noticeable pattern of deviation. If there is a slight deviation, the distribution is still within reasonable limits and does not show a specific pattern that indicates data abnormalities. Thus, these results further reinforce that the assumption of normality has been met, so that statistical analysis that requires normally distributed data can be performed accurately.

Heteroscedasticity Test

Based on the results of the analysis using the scatterplot in Figure 3, the pattern of the distribution of points looks random and does not form a specific pattern, either narrowing, widening, or curved patterns. The dots are evenly distributed above and below the zero axis on the Y axis without any noticeable concentration in a particular area. This shows that there is no heteroscedasticity in the regression model, so the assumption of homoscedasticity is met.

Thus, the regression model used in this study can be considered valid and reliable, as it fulfills one of the important classical assumptions in linear regression. When no heteroscedasticity occurs, the variance of the residual remains constant, which means that the results of the regression analysis can be used for statistical inference more accurately.

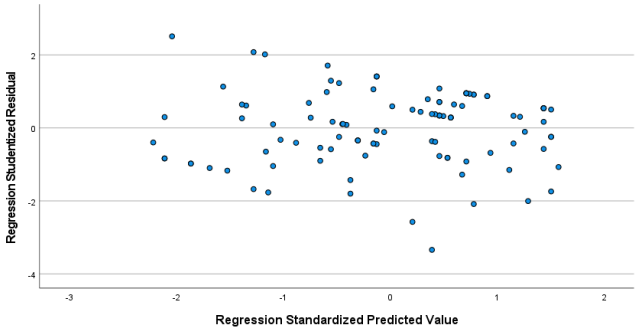

Figure 3. Scatterplot

Table 4. Multicollinearity

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant) Factors affecting the success of nutrition improvement programs	1.000	1.000

a. Dependent Variable: The success of nutrition improvement programs

Based on the results of the analysis of the multicollinearity test shown in the table, the Tolerance value is 1,000 and the Variance Inflation Factor (VIF) is also 1,000 for the variables factors affecting the success of nutrition improvement programs. A VIF value below 10 and a Tolerance value above 0.1 indicates that there is no multicollinearity problem in the regression model used. Multicollinearity occurs when there is a very high linear relationship between independent variables, which can interfere with the results of regression analysis. However, in this study, the values obtained showed that the independent variables did not have excessive correlation with each other, so the regression model used could be considered stable and valid for further analysis.

Table 5. Test t-coefficient

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	11.244	1.982		5.673	0.000
	Factors affecting the success of nutrition improvement programs	0.492	0.095	0.452	5.164	0.000

a. Dependent Variable: The success of nutrition improvement programs

Based on the results of the t-test, the calculated t-value for the variable factors affecting the success of nutrition improvement programs was 5.164, which was greater than the critical value of 1.98. In addition, the

significance value (Sig.) is 0.000, which is below 0.05. This shows that the independent variable has a significant effect on the dependent variable, namely the success of the nutrition improvement program.

In addition, the regression coefficient (B) value of 0.492 indicates that every increase in one unit in the factors affecting the success of the nutrition improvement program will increase the success of the program by 0.492 units, assuming the other variables remain constant. Thus, the results of this t-test prove that independent variables have a significant and positive influence on program success, so that they can be used in regression analysis for decision-making and policy recommendations.

Table 6. F Test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	201.455	1	201.455	26.666	0.000[b]
	Residual	785.686	104	7.555		
	Total	987.142	105			

a. Dependent Variable: The success of nutrition improvement programs
b. Predictors: (Constant). Factors affecting the success of nutrition improvement programs

Based on the results of the F test in the ANOVA table, the F value is calculated as 26.666 with a significance level (Sig.) of 0.000. Since the significance value is below 0.05, it can be concluded that the regression model used is statistically significant, so that the independent variables (factors affecting the success of nutrition improvement programs) together have a significant influence on the dependent variable (the success of nutrition improvement programs).

Table 7. Determination Test

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change
1	0.452[a]	0.204	0.196	2.749	0.204

a. Predictors: (Constant). Factors affecting the success of nutrition improvement programs
b. Dependent Variable: The success of nutrition improvement programs

Based on the results of the determination test in the Model Summary table, the R value of 0.452 indicates that there is a strong relationship between the independent variable (factors affecting the success of nutrition improvement programs) and the dependent variable (the success of nutrition improvement programs). An R Square (R^2) value of 0.204 shows that 20.4% variability in the success of the nutrition improvement program can be explained by the factors that affect the success of the program. Meanwhile, the remaining 79.6% was explained by other variables that were not included in this model.

In addition, the Adjusted R Square value of 0.196 is slightly lower than the R Square, which indicates that after adjusting for the number of variables in the model, the contribution of independent variables remains significant. The Std. Error of the Estimate value of 2.749 shows how far the model's prediction deviates from the actual data. Overall, although the model has a significant influence, there are other factors outside the model that also play a role in determining the success of the nutrition improvement program.

Based on the results of the analysis of this study, the independent variable (X) which includes the nutritional knowledge of parents and teachers, the availability of healthy food in schools, parental support, socioeconomic status, and school and government policies, all have an influence and correlation on the success of the nutrition improvement program in elementary school children (dependent variable Y).

Nutrition Knowledge of Parents and Teachers

Good knowledge of healthy diets and the importance of balanced nutrition can increase awareness and practices that support nutrition improvement programs. Parents and teachers who understand the importance of nutrition will be more likely to implement a healthy diet in children's daily lives. Parents' and teachers' nutritional knowledge is essential for the success of nutrition improvement programs, as it directly affects children's dietary behavior and overall health outcomes.

Other research suggests that both groups play an important role in shaping children's eating habits, and that their understanding of nutrition may improve the effectiveness of educational interventions. The following sections outline this relationship. Parents' nutritional knowledge significantly impacts their children's dietary choices, promoting healthier eating habits (Gvamichava et al., 2023). Programs that empower parents with nutritional information have been shown to improve children's nutrition and lifestyle outcomes (Mohammed Abdallateif et al., 2022). Involving parents in school nutrition programs fosters a supportive environment for

children, improving the sustainability of the program (Rai & Niraula, 2023).

Teachers are essential in providing nutrition education in schools, but their own knowledge gaps can hinder effective teaching (Gutkowska et al., 2024). Studies reveal that teachers' perceptions of nutrition programs can affect their implementation and overall success of these initiatives (Rai & Niraula, 2023). Teacher training in nutrition can lead to improved student outcomes, as they are key facilitators of healthy eating habits in school settings (Huye et al., 2024).

Availability of Healthy Food in Schools

The frequency and quality of healthy food provided in school canteens play a big role in supporting students' nutritional intake. With the availability of enough healthy food, it will be easier for children to obtain the nutrients needed for optimal growth and development. The availability of healthy food in schools significantly affects the success of nutrition improvement programs. Access to nutritious food is essential for fostering healthy eating habits among students, which in turn affects their overall health and academic performance.

Various studies highlight the importance of the school nutrition environment and the role of local governments, parents, and school staff in improving these programs. More than half of school-age children's calorie intake comes from school meals, making it an important setting for nutritional interventions (Langner et al., 2024). Schools with strong nutrition programs, such as the Healthy Schools program in the Netherlands, show increased food intake when healthy food options are available (Vonk et al., 2024).

Effective nutrition programs require cooperation between school staff, parents, and local governments to ensure the availability of healthy food (Sobczyk et al., 2024). Programs that actively engage parents tend to produce better outcomes in terms of student nutrition and dietary behavior (Rai & Niraula, 2023). Recent changes in nutrition standards have improved access to healthier options in schools, but ongoing efforts are needed to sustain these improvements (Merlo et al., 2023). Implementing changes in the school environment, such as providing taste tests and improving food palatability, can improve the selection and consumption of these healthy foods (Merlo et al., 2023).

Parent Support

Parents' participation in nutrition programs in schools and their willingness to provide nutritious meals at home show a strong influence on the success of the program. Supportive parents will strengthen the implementation of the program and ensure the sustainability of healthy eating outside the school environment. Parental support plays an important role in the success of nutrition improvement programs, as evidenced by various studies. Effective parental involvement improves children's nutritional knowledge and practices, leading to better health outcomes.

Several other similar studies mention programs that educate parents about nutrition significantly improve their knowledge and skills, which in turn benefits their children's eating habits. For example, community service programs show a marked improvement in mothers' understanding of balanced nutrition, leading to an improvement in nutritional status in toddlers (Situmeang et al., 2024). Parental support is a key component of the social environment that influences the implementation of nutrition programs. A study in China found that parental involvement contributed to 59.5% success in nutrition improvement initiatives in schools (Xin & Hashim, 2024).

Several other studies are consistent in stating that parental nutrition education directly affects children's health metrics. Research shows that parents who receive nutrition education positively affect their baby's BMI and metabolic health (Wozniak et al., 2022). Involving parents in the administration of nutrition programs fosters a collaborative environment. Parental involvement in planning and monitoring nutrition initiatives increases the effectiveness of early childhood education programs (Ambari et al., 2021).

Socioeconomic Status

Families with higher incomes and better parental education levels tend to have greater access to nutritious food and better understand the importance of nutrition for children. This creates more supportive conditions for the success of nutrition improvement programs. Socioeconomic status (SES) significantly affects the success of nutrition improvement programs, as evidenced by various studies. Higher SES is associated with better nutrition knowledge and dietary practices, while lower SES is often correlated with barriers to accessing healthy food and nutrition education. This relationship underscores the need for targeted interventions that take into account socioeconomic disparities.

Another consistent study states that wealthier families tend to have better nutritional knowledge and adherence to dietary guidelines (Mathur et al., 2024). Children from lower SES backgrounds show gaps in knowledge and poorer eating habits, leading to a double burden of malnutrition (Mathur et al., 2024).

School and Government Policy

Supportive policies, such as healthy food subsidies or nutrition counseling, can accelerate program implementation and ensure more equitable access to

good nutrition. Proactive policies create an environment that supports the long-term success of nutrition improvement programs. The success of nutrition improvement programs in schools is significantly influenced by school and government policies. Effective policies can improve the nutritional environment, promote healthier food choices, and ensure the sustainability of programs. The following sections outline key aspects of how these policies impact nutrition programs.

Other research states that policies that set nutritional standards for meals and snacks in schools have been shown to increase access to healthier options, leading to increased consumption among students (Merlo et al., 2023). Involving local communities and stakeholders in the development and implementation of nutrition programs fosters a supportive environment, increasing program effectiveness (Fathi et al., 2024). Long-term funding and political support are critical to the sustainability of nutrition programs. Programs often fail within two years due to inadequate funding and lack of political will (Fathi et al., 2024). Effective monitoring of nutrition policies ensures compliance with standards and allows for timely adjustments, which is essential for maintaining program integrity (Alonge et al., 2024).

Overall, these five factors are interrelated and contribute to the creation of an environment that supports the success of nutrition improvement programs, with a positive impact on the nutritional health of elementary school children.

Conclusion

Based on the results of the analysis of this study, it can be concluded that independent variables, such as nutritional knowledge of parents and teachers, availability of healthy food in schools, parental support, socioeconomic status, and school and government policies, have a significant influence on the success of nutrition improvement programs in elementary school children. Each of these factors plays a role in creating an environment that supports the success of the program, both at the individual, family, school, and community levels. Thus, the success of a nutrition improvement program depends on the interaction between these factors, which mutually support and strengthen the effectiveness of its implementation. The implications of this study show that the success of nutrition improvement programs in elementary school children is highly dependent on the involvement of various parties, such as parents, teachers, schools, and the government. Increasing the nutritional knowledge of parents and teachers, the availability of healthy food in schools, and parental support in providing healthy food at home can strengthen the implementation of nutrition programs. In addition, supportive policies, such as healthy food subsidies and training for teachers and parents, are essential to create an environment that supports the long-term success of the program. Therefore, closer collaboration between all stakeholders is needed to overcome barriers and ensure equitable access to good nutrition for children.

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The authors declare no conflict of interest.

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