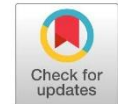


Halal certification, nutrition, dental literacy, and satisfaction among MBG recipients in Muhammadiyah school, Surabaya



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ABSTRACT

The Free Nutritious Meal Program is designed to improve the nutritional status of school children and support their health and learning processes. Program effectiveness depends not only on nutritional adequacy but also on halal food assurance and health literacy among recipients. This study aimed to analyze the association of halal certification, balanced nutrition fulfillment, and dental health literacy on student satisfaction with the Free Nutritious Meal Program at Muhammadiyah elementary school in Surabaya. An analytical observational study with a cross-sectional design was conducted using Partial Least Squares–Structural Equation Modeling analysis. The study population consisted of 216 parents or guardians of students participating in the program, and 140 respondents were selected using purposive sampling based on predefined inclusion criteria. The results showed that all constructs met validity and reliability criteria. The model demonstrated strong explanatory power ($R^2 = 0.857$). Dental health literacy showed the strongest association with satisfaction ($\beta = 0.571$; $p < 0.05$), followed by balanced nutrition fulfillment ($\beta = 0.230$; $p < 0.05$) and halal certification ($\beta = 0.170$; $p < 0.05$). These findings indicate that satisfaction with the program is associated with dental health literacy, perceptions of balanced nutrition fulfillment, and halal food assurance. Strengthening health literacy and ensuring nutritional and halal aspects may support the implementation of the program.

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Balanced nutrition fulfillment, Dental health literacy, Free nutritious meal (MBG), Halal food certification, Program satisfaction.

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INTRODUCTION

Nutritional problems in school-aged children are still a global public health issue that has a significant impact on the quality of human resources. Inadequate nutritional intake can affect children's physical growth, cognitive development, and learning ability at school. Children with poor nutritional status are known to have lower concentration and are at risk of decreased academic performance compared to children with good nutritional status (Best et al., 2010; World Health Organization, 2025).

The school feeding program is one of the strategic interventions that are widely implemented to improve children's nutritional status. This program has been proven to be able to increase energy intake, improve nutritional status, and increase student attendance and participation at school (Kristjansson et al., 2022; Wang et al., 2021). Recent studies also show that school meal programs contribute to improved cognitive abilities and long-term human capital formation (Wall et al., 2022).

Globally, school meal programs have become one of the largest social interventions reaching hundreds of millions of children. However, the effectiveness of this program is greatly influenced by the quality of implementation, including food quality, community acceptance, and socio-cultural factors

(Food and Agriculture Organization of the United Nations, 2023). Therefore, program evaluation must not only focus on nutritional aspects, but also on beneficiary acceptance and satisfaction factors (Global Child Nutrition Foundation, 2019).

The Free Nutritious Meal Program (MBG) is one of the government's strategies for improving the nutritional status of school children in Indonesia. This program not only aims to meet energy and nutritional needs, but also supports improving the quality of learning and establishing healthy eating habits from an early age. Different from school meal programs in general, MBG integrates aspects of nutrition, food safety, and community social and cultural values (Albaburrahim et al., 2025).

The success of MBG implementation is closely related to community acceptance. In the Indonesian context, this acceptance is not only determined by the nutritional quality of food, but also by trust-related factors such as halal food assurance. Halal certification is an important indicator for ensuring the halal status and conformity of food products with consumers' religious values. From a consumer perspective, halal assurance can contribute to trust and perceived acceptability of food, which may subsequently be associated with satisfaction with food-related services. Therefore, halal certification provides a theoretical basis for examining its association with satisfaction with the MBG program (Rahman et al., 2023; Soon et al., 2017).

In addition, fulfillment of balanced nutrition is a major component of the MBG program. Menus that comply with the principles of balanced nutrition are expected to support children's health, growth, and learning abilities. From the perspective of program recipients, perceived nutritional adequacy may also shape perception of meal quality and health benefits. When parents or guardians perceive that the meals provided meet their children's nutritional needs, they may perceive greater value and quality of the program, which can contribute to satisfaction. Thus, fulfillment of balanced nutrition provides a theoretical basis for examining its association with satisfaction with the MBG program (Ruel & Alderman, 2013; Wall et al., 2022).

The MBG program also has potential as a medium for health education. Health literacy, particularly dental health literacy, plays a role in shaping food consumption behavior and preventing oral diseases such as caries. Individuals with better health literacy tend to be more capable of accessing, understanding, evaluating, and applying health information. In the context of MBG, parents or guardians with better dental health literacy may be better able to evaluate the oral health implications of the foods provided and understand their potential health benefits. This ability to evaluate health and apply health information may shape perceptions of the quality and value of the program, which may subsequently be associated with satisfaction. Therefore, dental literacy has a theoretical basis for examining its association with satisfaction with the MBG program (Nutbeam, 2008).

Several studies show that the success of school meal programs is influenced by contextual factors such as culture, knowledge, and community beliefs (Mideksa et al., 2024). However, research that integrates halal, nutritional, and health literacy aspects in the context of MBG is still limited.

Therefore, this study aims to analyze the association of halal certification, fulfillment of balanced nutrition, and dental health literacy with the satisfaction of MBG program recipients.

RESEARCH METHOD

Materials

This research is a quantitative study with an analytical observational design using a cross-sectional approach. The study was conducted at SD Muhammadiyah 9 Surabaya in April to May 2026 among students receiving the Free Nutritious Meal (MBG) program. The study population consisted of 216 students who received the MBG program.

The required sample size was calculated using the Slovin formula with a 5% margin of error, resulting in a minimum sample size of 140 respondents. Parents or guardians of the students were selected as respondents because they were considered appropriate informants to report their perceptions of the MBG meals received by their children and their children's responses to the program. Purposive sampling was applied based on predefined inclusion criteria, namely parents or guardians of MBG recipient students who were willing to participate and completed the questionnaire. A total of 140 parents or guardians participated in the study (Hair et al., 2021; Suharmanto, 2021).

Methods

Data were collected using a structured questionnaire consisting of four constructs: Halal Food Certification (SHM), Fulfillment of Balanced Nutrition (PGSM), Dental Health Literacy (LKGS), and Satisfaction with the MBG Program (KSTP). All items were assessed using a five-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. SHM was measured using five items assessing parents' perceptions of halal assurance, including halal certification information, halal raw materials, halal food processing, and monitoring of halal compliance. PGSM consisted of six items assessing menu variety and adequacy of nutritional components. LKGS consisted of five items assessing parents' perceptions and observations of their children's dental health knowledge and related behaviours. KSTP consisted of five items assessing children's responses to MBG meals and parents' overall satisfaction with the program. Each construct is measured using several indicators compiled based on literature and adapted to the context of the MBG program.

Data analysis was carried out using the Partial Least Squares Structural Equation Modeling (SEM-PLS) method with the help of SmartPLS software. The measurement model was evaluated for construct validity and reliability using outer loadings (> 0.70), Average Variance Extracted (AVE > 0.50), Composite Reliability (> 0.70), and Cronbach's Alpha (> 0.70). The structural model was assessed using the coefficient of determination (R^2), effect size (f^2), and path coefficient. The significance of the relationship was evaluated using bootstrapping, with a t-statistic > 1.96 and p-value < 0.05 considered statistically significant. The study was conducted in accordance with research ethics principles, and informed consent was obtained from all respondents.

RESULT AND DISCUSSION

Measurement Model Evaluation

The measurement model was evaluated to assess the reliability and convergent validity of the four constructs: Halal Food Certification (SHM), Fulfillment of Balanced Nutrition (PGSM), Dental Health Literacy (LKGS), and Satisfaction with the MBG Program (KSTP). The results are presented in Table 1. The SEM-PLS model and the estimated relationships among the constructs are presented in Figure 1.

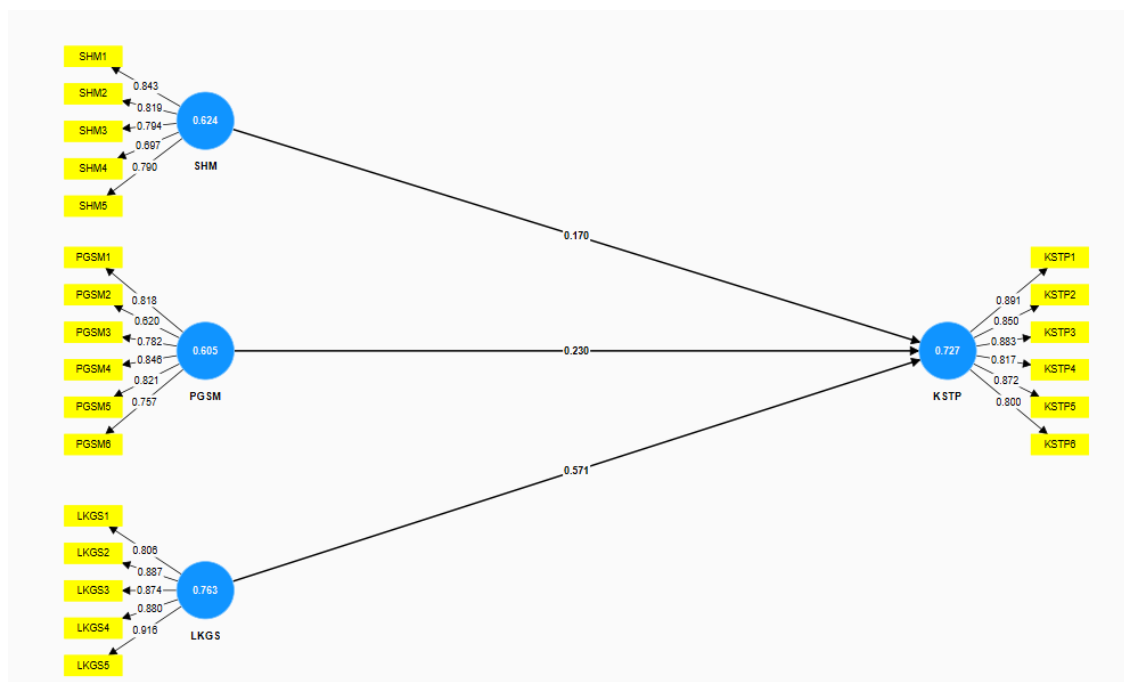


Figure 1. Model output results from SEM-PLS calculations.

Table 1. Convergent reliability and validity test results.

Construct	Cronbach's Alpha	Criteria	Information	Composite Reliability (CR)	Criteria	Information	AVE	Criteria	Information
KSTP	0.924	> 0.70	Reliable	0.941	> 0.70	Reliable	0.727	> 0.50	Valid
LKGS	0.922	> 0.70	Reliable	0.941	> 0.70	Reliable	0.763	> 0.50	Valid
PGSM	0.867	> 0.70	Reliable	0.901	> 0.70	Reliable	0.605	> 0.50	Valid
SHM	0.85	> 0.70	Reliable	0.892	> 0.70	Reliable	0.624	> 0.50	Valid

Table 1 shows that Cronbach's Alpha values ranged from 0.850 to 0.924, Composite Reliability values ranged from 0.892 to 0.941, and Average Variance Extracted (AVE) values ranged from 0.605 to 0.763. All values exceeded the recommended thresholds of 0,70 for Cronbach's Alpha and Composite Reliability and 0.5 for AVE. These results indicate adequate internal consistency and convergent validity for all constructs.

Structural Model Evaluation

The coefficient of determination results are presented in Table 2. The R^2 value for Program Satisfaction (KSTP) was 0.857, with an adjusted R^2 of 0.855. This indicates that 85.7% of the variance in program recipients' satisfaction was accounted for by dental health literacy (LKGS), balanced nutrition fulfillment (PGSM), and halal food certification (SHM) in the structural model.

Table 2. Coefficient of Determination (R^2) Results

Variabel Endogen	R-Square	R-Square Adjusted	Criteria	Information
KSTP	0.857	0.855	> 0.75	Very strong

Based on the criteria proposed by Hair et al. (2021), an R-square value above 0.75 indicates substantial explanatory power of the model.

Effect Size (f^2)

The effect size results are in Table 3. LKGS had a large effect size on KTSP ($f^2 = 0.471$), whereas PGSM ($f^2 = 0.074$) and SHM ($f^2 = 0.062$) had small effect sizes. These classifications were based on the commonly used thresholds of 0.02, 0.15, and 0.35 for small, medium, and large effect sizes, respectively.

Table 3. Effect Size Test Results (f-Square)

Variable Relationship	f-Square	Criteria	Information
LKGS → KSTP	0.471	> 0.35	Big
PGSM → KSTP	0.074	0.02–0.15	Small
SHM → KSTP	0.062	0.02–0.15	Small

Path Coefficient

The path coefficient results are presented in Table 4. All three hypothesized relationships showed positive path coefficients, with the largest coefficient observed for the relationship between dental health literacy (LKGS) and program satisfaction (KSTP).

Table 4. Path coefficient test results (path coefficients).

Variables Relationship	Path Coefficient β	Direction	Influence Power
LKGS → KSTP	0.571	Positive	Strong
PGSM → KSTP	0.23	Positive	Moderate
SHM → KSTP	0.17	Positive	Weak

Significance Test (Bootstrapping)

The bootstrapping results are presented in Table 5. All hypothesized relationships were statistically significant, as indicated by t-statistics exceeding 1.96, p-values below 0.05, and 95% confidence intervals that did not include zero.

Table 5. Results of the bootstrapping process.

Variable Relationship	Path Coefficient	T-Statistic	Confidence Interval	P-Value	Information
LKGS → KSTP	0.571	10.553	0.458-0.687	< 0.001	Significant
PGSM → KSTP	0.23	4.058	0.110-0.342	< 0.001	Significant
SHM → KSTP	0.17	3.793	0.078-0.255	< 0.001	Significant

Dental Health Literacy and Program Satisfaction

The findings of this study showed that dental health literacy was relatively more strongly associated with program satisfaction than the other variables examined. Theoretically, this relationship can be understood through the concept of health literacy, which states that individuals with a high level of health literacy tend to have a better ability to access, understand, evaluate, and apply health information (Nutbeam, 2008; Sørensen et al., 2012). In the context of MBG, this ability may help parents evaluate the relationship between food consumption, oral health, and the potential health benefits of the program. Therefore, dental health literacy provides a theoretical basis for its association with satisfaction with the MBG program.

More specifically, oral health literacy includes an individual's ability to understand the relationship between food consumption patterns, oral hygiene, and the risk of diseases such as dental caries. In the context of MBG, this aspect is relevant because the program provides food that may influence students' dietary patterns and oral health. Without adequate dental health literacy, consuming nutritious foods may still be associated with oral health problems if appropriate preventive behaviors are not practiced. Recent studies have shown that parental dental health literacy is associated with children's dental oral health status, including the incidence of dental caries and dental care behavior (Alzahrani et al., 2025; Wu et al., 2024). These findings support the relevance of dental health literacy in parents' evaluation of a school-based meal program that is closely related to children's dietary and oral health.

The role of health literacy in this research also indicates that the program has potential as a means of school-based health education. This program not only functions as a nutritional intervention, but may also serve as a promotive and preventive medium for developing healthy eating habits and oral health behaviors from an early age. Individuals with good health literacy tend to be better able to understand and apply health information in everyday life the benefits of programs, and apply them in everyday life (Global Child Nutrition Foundation, 2019; Zhang et al., 2025). In this context, better dental health literacy may help parents recognize the health benefits of the program and evaluate the relevance of the meals and health information provided, which may be associated with their satisfaction with the MBG program.

Balanced Nutrition Fulfillment and Program Satisfaction

In addition, the results of this study showed a positive and significant association between balanced nutrition fulfillment and satisfaction with the MBG program. The relationship can be understood from the role of nutritional adequacy and food acceptability in school feeding programs. Programs that provide menus that are diverse, nutritious, and appropriate to children's needs may support the acceptance and perceived quality of school meals (Global Child Nutrition Foundation, 2019; Syahril, 2024).

In implementing MBG in Indonesia, preparing a balanced nutritional menu is one of the main components regulated in the technical guidelines for program implementation, including adequate energy, protein, and micronutrients according to the needs of school-aged children (Badan Gizi Nasional, 2024). Previous research has also shown that food quality in school meal programs is associated with children's nutritional intake, health, and learning outcomes (Best et al., 2010; Wall et

al., 2022). Therefore, when parents perceive that the meals provided meet their children's nutritional needs, they may perceive greater value and quality in the program, which may contribute to satisfaction.

However, perceived nutritional quality may not necessarily correspond to the objectively measured nutrient composition of the meals. Parents' nutritional knowledge and expectations may also shape their evaluation of the meals provided. The relatively smaller contribution of balanced nutrition fulfillment compared with dental health literacy may therefore indicate that nutritional adequacy is one of several dimensions involved in parents' evaluation of the MBG program. In addition, school meal acceptance may be influenced by other factors, including menu variety, food quality, taste, quantity, and the eating environment (Cohen et al., 2021; Santana et al., 2023).

In the context of MBG implementation, several challenges include maintaining consistent food quality, providing menu variations, and ensuring equitable food distribution between schools. Studies have shown that the success of school meal programs is also influenced by program management, including food quality monitoring and distribution logistics (Mideksa et al., 2024). Therefore, improving the MBG program requires not only appropriate menu planning but also sustainable management and monitoring systems.

Halal Food Certification and Program Satisfaction

Meanwhile, halal certification showed a positive and significant association with satisfaction with the MBG program. This relationship can be understood through the role of halal assurance in establishing confidence and reducing uncertainty in food consumption. In the Indonesian context, halal status is relevant to parents' evaluation of food provided to their children because it provides assurance that the food complies with applicable halal requirements. Halal certification may therefore contribute to the food provided and, subsequently, to satisfaction with the program (Anas et al., 2023; Nizar et al., 2024). Previous research has also reported a positive relationship between halal certification and customer satisfaction in Muslim-oriented food services (Abdou et al., 2024; Suhartanto et al., 2019; Sumadi, 2022).

This finding is consistent with research indicating that halal is an important trust factor in food consumption, particularly among Muslim consumers (Rahman et al., 2023). Additionally, halal assurance has been associated with perceptions of food quality and safety, which may contribute to positive consumer evaluations (Rahman et al., 2023; Soon et al., 2017). Recent evidence from Indonesia also indicates that information access and service performance are relevant to consumers' evaluation of halal certification services (Fauziah et al., 2026; Ismail, 2024). Thus, the observed association between halal food certification and MBG satisfaction may reflect the role of assurance and confidence in parents' evaluation of the meals provided.

The relatively smaller contribution of halal food certification compared with dental health literacy should not be interpreted as indicating that halal assurance is unimportant. Rather, within the variables examined in this study, halal assurance represents one of several dimensions contributing to parents' perceptions of the MBG program. Clear information regarding halal status and continued compliance with halal requirements may remain relevant to maintaining public confidence in school meal provision.

Integrated Implications for MBG Implementation

The findings of this study can be interpreted within the multidimensional nature of the MBG program. Satisfaction may reflect not only the nutritional characteristics of meals but also parents' ability to understand health-related information and their confidence in the food provided. In this study, dental health literacy, balanced nutrition fulfillment, and halal food certification represent complementary dimensions related to health information, nutritional adequacy, and halal assurance.

Practically, the findings suggest that the provisions of nutritious food may be complemented by dental health education and healthy eating education for students and parents. Schools can also support program implementation by monitoring food quality, providing health education, and involving parents in program evaluation. Clear information regarding the halal status of meals may further support confidence in the program.

At the policy level, the findings may support a more comprehensive approach to MBG implementation that integrates nutritional adequacy, health education, and halal assurance. However, the implications should be considered within the context and limitations of this study.

Limitations

This study has several limitations. First, the cross-sectional design limits causal interpretation, so the findings should be understood as associations. Second, the use of parents or guardians as respondents may introduce reporting bias because they reported their children's responses. Future studies should consider longitudinal designs, direct assessments of students, and additional factors such as food service quality, socioeconomic characteristics, and food consumption behavior.

CONCLUSION

Halal authentication in meat-based food products is critically important, as meat ingredients are highly susceptible to adulteration, species substitution, and cross-contamination during processing, distribution, and storage. Processed meat products often undergo heating, seasoning, extraction, or emulsification, which eliminates the possibility of visual identification. Therefore, scientific approaches—such as DNA analysis, species-specific protein detection, and chemical profiling—serve as essential tools to verify the authenticity of animal species and detect the presence of non-halal components within complex food matrices. Despite ongoing challenges, including DNA and protein degradation due to thermal processing and limited laboratory capacity, technological advancements such as biosensors, CRISPR-based detection, and multimodal analytical methods have significantly improved the sensitivity and reliability of halal verification in meat products. Overall, the implementation of halal authentication methods in processed meat products plays a crucial role in strengthening the Halal Assurance System (SJPH). With more rigorous scientific oversight, the meat processing industry can uphold product integrity, enhance consumer trust, and improve the competitiveness of halal products in both national and global markets.

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