October – December, 2025
Original Article
DOI: http://dx.doi.org/10.30867/action.v10i4.3008

AcTion: Aceh Nutrition Journal
Pages: 1166 – 1174 | p-issn 2527-3310; e-issn 2548-5741

Analysis of energy and nutrient adequacy in two menu variants of the free nutritious meal (MBG) program for adolescents in Makassar City

Analisis kecukupan energi dan zat gizi dua varian menu program makan bergizi gratis (MBG) untuk remaja di Kota Makassar

Faramitha[1*], Hendrayati[2], Nadimin[3]

[1] Department of Nutrition, Makassar Ministry of Health Polytechnic, South Sulawesi, Indonesia.
E-mail: mitha@poltekkes-mks.ac.id
[2] Department of Nutrition, Makassar Ministry of Health Polytechnic, South Sulawesi, Indonesia.
E-mail: hendrayati@poltekkes-mks.ac.id
[3] Department of Nutrition, Makassar Ministry of Health Polytechnic, South Sulawesi, Indonesia.
E-mail: nadimin@poltekkes-mks.ac.id

***Correspondence Author:**
Department of Nutrition, Makassar Ministry of Health Polytechnic, Jalan. Paccerakkang No.14, Paccerakkang, Kec Biringkanaya, Kota Makassar, South Sulawesi, Indonesia.
E-mail: mitha@poltekkes-mks.ac.id

Article History:
Received: November 14, 2025; Revised: November 25, 2025; Accepted: December 10, 2025; Published: December 19, 2025.

Publisher:
Politeknik Kesehatan Aceh
Kementerian Kesehatan RI

Abstract

The Free Nutritious Meal (MBG) Program is a national initiative aimed at meeting students' balanced nutritional needs. However, evidence on the adequacy of energy and nutrient intake from MBG menus for adolescents is limited. This study aimed to analyze the energy and nutrient adequacy of two MBG menu variants with and without milk based on the Recommended Dietary Allowances (RDA) for adolescents aged 16–18 years in Makassar. This cross-sectional study was conducted from August to September 2025 in four high schools that implemented the MBG program. Researchers conducted composite sampling of four daily menu items. Data were collected through menu observation and nutrient analysis using NutriSurvey. Univariate analyses were performed. The results indicated that the menu with milk provided 742 kcal (28% RDA) and 34.9 g of protein (46.5% RDA), whereas the menu without milk provided 610 kcal (23% RDA) and 28.4 g of protein (38% RDA). Both menus supplied more than 50% of the RDA for iron, but the carbohydrate contributions remained below 25% of the RDA. The low carbohydrate contribution suggests the need to adjust staple food portions in the MBG menu guidelines. In conclusion, the addition of milk improved the energy and protein adequacy of the MBG menus. The optimization of nutrient-dense local foods is recommended to support program sustainability and balanced nutrition in schools.

Keywords: Adolescents, energy intake, MBG program, nutritional requirements, school feeding

Abstrak

Program Makan Bergizi Gratis (MBG) merupakan upaya nasional untuk memenuhi kebutuhan gizi seimbang peserta didik. Namun, informasi mengenai kecukupan energi dan zat gizi pada menu MBG bagi remaja masih terbatas. Penelitian ini bertujuan menganalisis kecukupan energi dan zat gizi dua varian menu MBG disertai dengan susu dan tanpa susu yaitu berdasarkan Angka Kecukupan Gizi (AKG) remaja usia 16–18 tahun di Kota Makassar. Penelitian menggunakan desain cross-sectional, berlangsung pada Agustus–September 2025 di empat sekolah menengah atas pelaksana MBG. Peneliti melakukan analisis cuplikasi dari empat menu harian. Pengumpulan data dilakukan melalui observasi menu dan perhitungan kandungan gizi menggunakan Nutrisurvey. Analisis dilakukan secara univariat. Hasil menunjukkan bahwa menu dengan susu menyediakan 742 kkal (28% AKG) dan 34.9 g protein (46.5% AKG), sedangkan menu tanpa susu memberikan 610 kkal (23% AKG) dan 28.4 g protein (38% AKG). Kedua menu memenuhi lebih dari 50% AKG zat besi, tetapi karbohidrat masih berada di bawah 25% AKG. Rendahnya kontribusi karbohidrat mengindikasikan perlunya penyesuaian porsi makanan pokok dalam pedoman menu MBG. Kesimpulan, bahwa penambahan susu meningkatkan kecukupan energi dan protein pada

menu MBG. Optimalisasi pangan lokal tinggi gizi direkomendasikan untuk mendukung keberlanjutan program serta pemenuhan gizi seimbang di sekolah.

Kata Kunci: Asupan energi, kebutuhan gizi, MBG, pemberian makanan di sekolah, remaja

Introduction

Adequate nutrition during adolescence is a critical indicator of future human resource quality. Adolescence is characterized by increased energy and macro- and micronutrient requirements due to accelerated physical growth and cognitive development (Ninh et al., 2025). Insufficient energy and nutrient intake during this period may result in decreased learning concentration, easy fatigue, and impaired immune function (Lisa et al., 2025). Therefore, providing nutritious food in the school setting is an important strategy to support the fulfillment of adolescents' nutritional needs.

The Free Nutritious Meal Program (*Program Makan Bergizi Gratis*, MBG) is one of Indonesia's national priority programs that has been gradually implemented since 2024. The program aims to provide one balanced nutritious meal per day for students from primary to secondary education levels, targeting approximately 25–30% of the daily energy requirements (National Food Agency [Bapanas], 2024). MBG menus generally include sources of carbohydrates, animal- and plant-based side dishes, vegetables, fruits, and milk. However, variations in food composition and portion sizes across schools often lead to inconsistencies in energy and nutrient contributions, highlighting the need for data-driven evaluations to objectively assess nutritional adequacy (Liz Martins et al., 2021).

Most existing studies on MBG in Indonesia focus on primary school children, while evidence regarding energy and nutrient adequacy among senior high school adolescents remains limited. Recent policy reviews indicate that school feeding programs have the potential to improve students' attendance, nutritional status, and academic achievement. However, MBG implementation faces challenges related to financing, governance, food quality, and safety. Consequently, more quantitative studies are needed among adolescents to objectively measure energy and nutrient adequacy (Octawijaya et al., 2023). This gap is particularly important given that adolescents have higher nutritional requirements and consumption patterns than younger school-aged children (Ratnasari et al., 2019).

Anemia in adolescent girls remains a significant public health challenge in South Sulawesi. Government efforts through iron–folic acid supplementation (*tablet tambah darah*, TTD) have not achieved optimal results, with national coverage among adolescent girls reaching only 31.3% in 2021. South Sulawesi ranked seventh, with a coverage rate of 44.8% (Rimbawan et al., 2023). This low coverage suggests a persistently high risk of anemia among adolescents in the region. Several barriers to adherence to TTD consumption have been reported, including forgetfulness (26.3%), unpleasant taste or odor (26.2%), perceived lack of necessity (17.2%), and side effects after consumption (11.3%) (Man et al., 2024). Inadequate iron intake may impair cognitive performance and immune function and increase the risk of pregnancy complications later in life (Nabilla et al., 2022). These conditions underscore the urgency of evaluating the energy and nutrient adequacy of school meal programs to help prevent anemia and improve the nutritional status of adolescents.

Numerous studies indicate that the effectiveness of school feeding programs is strongly influenced by menu quality, portion adequacy, and the appropriate targeting of age groups. School meal programs in Asian countries have been shown to improve energy and protein intake; however, outcomes largely depend on how well the menu composition aligns with adolescents' physiological needs (Wang et al., 2021). During adolescence, energy requirements increase substantially compared with childhood, and inadequate portion planning or nutrient composition may result in suboptimal contributions despite the implementation of programs (Di Prima et al., 2022). This highlights the importance of quantitatively evaluating MBG

menus to ensure that interventions produce tangible improvements in the nutritional status and academic performance of senior high school students.

The inclusion of milk in the MBG menu remains a subject of debate. Milk contributes to increased energy and protein intake; however, it poses potential risks of milk protein allergy and lactose intolerance among some adolescents (Kai Kang, 2019; Milić et al., 2023). In addition, the availability of processed milk products in the market largely depends on non-local raw materials, which may affect cost efficiency and program sustainability in some regions. Therefore, objective assessments are needed to evaluate the effectiveness of milk inclusion in MBG menus and explore opportunities for substituting part of the nutritional requirements with more adaptable local food sources, such as fish, tempeh, tofu, and legumes (Ghani Nurfaizi & Romadlon, 2024).

Considering these gaps, this study aimed to evaluate the adequacy of energy and nutrient intakes from the Free Nutritious Meal Program (MBG) menus with and without milk addition, based on the Indonesian Recommended Dietary Allowances (RDA) for adolescents in Makassar City. The findings are expected to provide a stronger scientific basis for developing appropriately targeted MBG menus and support policy development, ensuring that the provided meals not only meet energy and nutrient adequacy but are also safe, feasible, and sustainable. Furthermore, the results are anticipated to encourage the use of local food resources as key components for strengthening national nutrition security.

Methods

This study employed a descriptive quantitative design with a cross-sectional observational approach to evaluate the adequacy of the energy and nutrient content of the Free Nutritious Meal Program (MBG) menus based on the Recommended Dietary Allowances (RDA) for adolescents. The study was conducted in August and September 2025 at four senior high schools in Makassar City SMA Negeri 2, SMA Negeri 3, SMA Negeri 5, and SMA Negeri 10 which were purposefully selected as MBG-implementing schools. The study objects consisted of four MBG menus served with and without milk:

Data were collected through direct observation of the menu composition. The energy and nutrient contents were calculated using food exchange conversion methods based on the Indonesian standard food composition guidelines. All food items were converted into exchange units and analyzed using the NutriSurvey software to estimate the energy, protein, fat, carbohydrate, and iron content. The results were compared with the 2020 Recommended Dietary Allowance (RDA) for adolescent males and females aged 16–18 years (2,650 and 2,100 kcal/day, respectively), with the MBG targeting 25–30% of the daily energy requirements.

The data were presented in tabular form and analyzed descriptively to determine adequacy levels and suitability categories (Adequate or Inadequate), including comparisons between MBG menus with and without milk to assess the additional nutritional contribution of milk. Analyses were conducted separately for male and female adolescents to account for sex-specific differences in nutritional requirements of adolescents.

This study had several methodological limitations. Nutrient analysis using NutriSurvey provides estimated values and is not equivalent to direct laboratory-based chemical analyses. In addition, nutrient adequacy calculations were based on observed portion sizes rather than the actual consumption by students, which may affect the accuracy of the estimated contributions to daily requirements.

Result and Discussion

The energy and nutrient adequacy of the Free Nutritious Meal Program (MBG) menus were analyzed in four senior high schools in Makassar City using two menu variations at Makassar State Senior High School (SHC): MBG with milk and MBG without milk. Nutrient assessment was performed using the NutriSurvey application based on food exchange conversions and compared with the Recommended Dietary Allowances (AKG) for adolescents aged 16–18 years according to the Indonesian Ministry of Health (2020).

Tabel 1. Total intake and percentage adequacy (%) of energy, protein, fat, carbohydrates, and iron among male adolescents

MBG Menu Group	Energy; kcal (% RDA)	Protein; g (% RDA)	Fat; g (% RDA)	Carbohydrates; g (% RDA)	Iron; mg (% RDA)
With Milk					
SHC 2	748.9 (28.26)	41.6 (55.47)	30.3 (35.65)	77.2 (19.30)	6.1 (55.45)
SHC 3	721.0 (27.21)	24.9 (33.20)	27.7 (32.59)	94.8 (23.70)	5.7 (51.82)
SHC 5	791.7 (29.88)	36.2 (48.27)	30.1 (35.41)	95.0 (23.75)	6.3 (57.27)
SHC 10	706.6 (26.66)	36.9 (49.20)	20.6 (24.24)	95.8 (23.95)	5.8 (52.73)
Without Milk					
SHC 2	617.0 (23.28)	35.2 (46.93)	22.5 (26.47)	67.6 (16.90)	5.9 (53.64)
SHC 3	589.0 (22.23)	18.5 (24.67)	19.9 (23.41)	87.8 (23.70)	5.7 (51.82)
SHC 5	659.8 (24.90)	29.8 (39.73)	22.3 (26.24)	85.4 (21.35)	6.1 (55.45)
SHC 10	574.7 (21.69)	29.9 (39.87)	12.8 (15.06)	86.2 (21.55)	5.6 (50.91)

Based on the 2020 RDA, male adolescents require 2.650 kcal of energy, 75 g protein, 85 g fat, 400 g carbohydrates, and 11 mg iron daily.

Tabel 2. Total intake and percentage adequacy (%) of energy, protein, fat, carbohydrates, and iron among female adolescents

MBG Menu Group	Energy; kcal (% RDA)	Protein; g (% RDA)	Fat; g (% RDA)	Carbohydrates; g (% RDA)	Iron; mg (% RDA)
With Milk					
SHC 2	748.9 (35.66)	41.6 (64)	30.3 (43.29)	77.2 (25.73)	6.1 (40.67)
SHC 3	721 (34.44)	24.9 (38.31)	27.7 (39.57)	94.8 (31.60)	5.7 (38)
SHC 5	791.7 (37.70)	36.2 (55.69)	30.1 (43)	95 (31.67)	6.3 (42)
SHC 10	706.6 (33.65)	36.9 (56.77)	20.6 (29.43)	95.8 (31.93)	5.8 (38.67)
Without Milk					
SHC 2	617 (29.38)	35.2 (54.15)	22.5 (32.14)	67.6 (22.53)	5.9 (39.33)
SHC 3	589 (28.05)	18.5 (28.46)	19.9 (28.43)	87.8 (31.60)	5.7 (38)
SHC 5	659.8 (31.42)	29.8 (45.85)	22.3 (31.86)	85.4 (28.47)	6.1 (40.67)
SHC 10	574.7 (27.37)	29.9 (46)	12.8 (18.29)	86.2 (28.73)	5.6 (37.33)

Based on the 2020 RDA, female adolescents require 2.100 kcal of energy, 65 g protein, 70 g fat, 300 g carbohydrates, and 15 mg of iron per day.

Tables 1 and 2 show the differences in energy and nutrient intakes between the MBG menus with and without milk, reflecting the sex-specific physiological requirements that influence the contribution levels of certain nutrients. Among male adolescents, menus with milk met only 26.66–29.88% of the energy RDA, whereas among female adolescents, they met 33.65–37.70% of the energy RDA. Menus without milk provided lower contributions to both groups. These findings indicate that the current MBG program is more aligned with the needs of female adolescents, while male adolescents remain at risk of inadequate energy intake if they rely solely on MBG as their main school meal. This finding is consistent with that of Nogueira et al. (2021), who reported that increased energy requirements during male adolescent growth necessitate greater nutritional interventions.

The inclusion of milk contributed more optimally to energy and macronutrient adequacy, reinforcing the role of milk in the MBG as a supportive component of adolescents' daily intake (Vilhar et al., 2023). Overall, adding milk significantly increased the energy, protein, and fat intakes compared with menus without milk. This aligns with Zelalem Zestaw (2022), who reported a 6–8% increase in energy intake following milk provision in school feeding programs in Ethiopia. The protein and iron contributions of both menu variations met ≥25% of the RDA, indicating that MBG side dishes positively support adolescent nutrition and anemia prevention. However, carbohydrate contributions in both menus failed to reach the 25% RDA target, suggesting the need to increase the staple food portions. This pattern is consistent with the findings of Nogueira et al. (2021), who found that school menus are often

low in carbohydrates because of limited staple food portions.

Energy Intake

Data from Tables 1 and 2 indicate that adding milk to the MBG menu increased the total energy intake by approximately 110–132 kcal compared with menus without milk. This increase is primarily attributable to the inclusion of 200 ml of UHT milk, which provides approximately 130 kcal and 7 g of protein, thereby contributing significantly to the energy content of school meals (Campmans-Kuijpers et al., 2016; Vilhar et al., 2023). These results are consistent with Wiley (2023), who reported that providing milk twice weekly in school feeding programs increased energy intake by 6–8% of the RDA.

Nevertheless, for male adolescents with an average daily energy requirement of 2.650 kcal, the MBG portions remain relatively low. This finding aligns with Ayogu et al. (2018), who reported that school meals in several developing countries often fail to meet one-third of the daily energy requirements due to limited staple food portions. Increasing carbohydrate-rich foods, such as rice, bread, or local tubers, may represent a more proportional strategy to meet adolescents' daily energy needs. Adequate carbohydrate intake is associated with improved learning concentration and physical endurance among students (Triyanti & Kusharisupeni, 2022a).

Protein Intake

All MBG menus provided protein intake exceeding 25% of the RDA for both male and female adolescents, with the highest contributions observed in menus that included milk. Menus with milk contributed 33.20–55.47% of the RDA for males and 38.31–64% for females, while menus without milk remained within adequate ranges (24.67–46.93% for males and 28.46–54.15% for females). These findings suggest that MBG provides substantial support for the daily protein requirements of adolescents.

The combination of animal-based (meat, poultry, fish, and eggs) and plant-based (tofu and tempeh) side dishes offers a more balanced essential amino acid profile. Milk further enhances the intake of high-quality proteins with high digestibility and bioavailability. Milk protein contains branched-chain amino acids, including leucine, which play crucial roles in protein synthesis and muscle tissue development during adolescence (Sanjulián et al., 2025). Therefore, integrating milk into MBG menus may be an effective strategy for improving protein quality and supporting the nutritional status of adolescents (Dougkas et al., 2019). However, considerations regarding logistical sustainability and lactose intolerance risk should be addressed in future MBG implementations.

Fat Intake

Fat intake from MBG menus with milk contributed 24.22–35.65% of the RDA among male adolescents and 29.43–43.29% among female adolescents, highlighting milk's role as a major fat source compared with menus without milk. Fat serves as a dense energy source and facilitates the absorption of fat-soluble vitamins A, D, E, and K (FAO & WHO, 2023). Increased fat intake in menus containing milk also reflects the contribution of animal-based side dishes used in the MBG menus.

However, attention must be paid to fat quality. Fats derived from cooking oils and meats, which are often high in saturated fatty acids, should be balanced with unsaturated fat sources, such as marine fish, legumes, and seeds. Unsaturated fats, particularly omega-3 fatty acids from marine fish, support cardiovascular health, cognitive function, and adolescent development (Santi-Cano et al., 2020). Thus, the fat composition of MBG menus should adhere to healthy dietary principles by limiting saturated fat and increasing unsaturated fat sources. This approach is consistent with the potential utilization of the abundant local fish resources in eastern Indonesia, particularly in South Sulawesi.

Carbohydrate Intake

School nutrition guidelines recommend that a single school meal provide approximately 25–30% of daily energy needs with a balanced macronutrient distribution: 50–65% of energy from carbohydrates, 10–15% from protein, and 20–30% from fat. The imbalance observed in MBG menus particularly the low contribution of carbohydrates relative to protein and fat suggests misalignment with these principles and may compromise short-term energy availability during school hours (FAO & WHO, 2023).

The average carbohydrate intake in both MBG menu variations remained below 25% of the RDA. Among male adolescents, contributions

ranged from 16.90% to 23.95% of the RDA, whereas among female adolescents, they ranged from 22.53% to 31.93% of the RDA. This indicates inconsistent adherence to the MBG energy contribution guidelines, especially among men with higher energy requirements. Insufficient carbohydrate intake directly reduces the total menu energy and may impair learning endurance and physical performance. Carbohydrates are the primary energy source for the brain and muscles, and inadequate intake is associated with decreased concentration, increased fatigue, and suboptimal academic performance (Triyanti & Kusharisupeni, 2022b).

Beyond quantity, improving the carbohydrate quality of MBG menus is essential. Substituting white rice with complex carbohydrate sources, such as sweet potatoes, taro, cassava, or brown rice, may provide a more stable energy release and increase dietary fiber intake. This finding aligns with Arshad et al. (2025), who noted that budget constraints and an emphasis on high-protein side dishes often result in insufficient carbohydrate portions in school feeding programs. Therefore, revising staple food portions should be prioritized to achieve a macronutrient balance consistent with adolescents' physiological needs.

Iron (Fe) Intake

Iron intake in both MBG menu variations showed relatively high adequacy, reaching 50.91–57.27% of the RDA among male adolescents and 37–42% among female adolescents. These differences reflect higher iron requirements among adolescent girls, resulting in lower percentage contributions despite similar absolute intake. The findings indicate that menu planning prioritized animal-based side dishes, such as poultry, fish, and beef, which are rich sources of heme iron.

Heme iron has higher and more stable absorption rates than non-heme iron, making animal-based foods particularly effective in increasing total iron intake and bioavailability in adolescents (Skolmowska & Głąbska, 2019). This is especially relevant for preventing anemia among adolescent girls who experience increased iron loss during menstruation and rapid growth. Several studies have shown that increased consumption of iron-rich animal foods, including meat, liver, and fish, plays a crucial role in preventing iron-deficiency anemia in adolescent girls (Domellöf & Sjöberg, 2024).

These findings are consistent with international evidence demonstrating that school feeding interventions incorporating animal-based foods improve iron adequacy and reduce the risk of anemia among school-aged children and adolescents (Rimbawan et al., 2023). Given the high prevalence of anemia among adolescents in South Sulawesi and suboptimal TTD coverage, iron contributions from the MBG program are strategically important for school-based anemia prevention. Therefore, incorporating animal-based side dishes into MBG menus represents an appropriate strategy to enhance micronutrient quality and support iron-deficiency anemia prevention in schools (Malhotra et al., 2023).

Considerations for Milk Provision in the MBG Program

The addition of milk to the Free Nutritious Meal Program (MBG) positively contributes to increased energy, protein, and calcium intake; however, its implementation must consider consumption safety and sustainability. Some adolescents experience lactose intolerance or milk protein allergies, which may cause gastrointestinal disturbances ranging from bloating and diarrhea to abdominal pain (Darma et al., 2024a). As an alternative, energy and protein adequacy can be optimized through local food sources, such as fish, eggs, tempeh, tofu, and legumes, which provide high-quality protein and essential micronutrients, including iron and omega-3 fatty acids, and are more affordable and accessible at the local level (Khusun et al., 2022).

The diversification of local foods supports regional food security and enhances the sustainability of school feeding programs. The use of local food ingredients has been shown to maintain nutritional quality, reduce operational costs, and improve student acceptance of school menus. Several studies have indicated that local foods particularly fish, legumes, tempeh, tofu, and eggs are more economically efficient and better accepted than imported foods such as milk or processed meats (Mahmudiono et al., 2020).

Milk use in MBG programs may still be recommended on a limited basis, such as once or twice a week, specifically for students without a history of milk allergy or lactose intolerance (Darma et al., 2024b). This moderate approach is considered effective in maintaining menu variety without significantly increasing costs and supporting long-term program sustainability.

Conclusion

This study demonstrates that the inclusion of milk in the Free Nutritious Meal Program (MBG) menus improves energy, protein, and fat adequacy compared with menus without milk, bringing them closer to the adolescent RDA standards in Makassar City. However, both menu variations exhibited a major shortfall in carbohydrate contribution, failing to reach the minimum 25% RDA threshold, indicating the need to adjust staple food portions to achieve a balanced energy distribution. The iron content in both menus exceeded 50% of the RDA, underscoring the importance of animal-based side dishes in MBG menus.

From a practical perspective, increasing the proportion of carbohydrate sources and optimizing local food utilization, such as fish, eggs, tempeh, mung beans, and tubers, are necessary to improve nutritional quality and program sustainability. Milk remains a recommended menu component with simple monitoring for allergies or lactose intolerance.

Acknowledgments

The authors express their gratitude to the South Sulawesi Provincial Education Office, school principals, teachers responsible for the Free Nutritious Meal Program (MBG), and all students at Makassar State Senior High School 2, Makassar State Senior High School 3, Makassar State Senior High School 5, and Makassar State Senior High School 10 for their support and participation in this study. Appreciation is also extended to Poltekkes Kemenkes Makassar for financial support through the 2025 Distinguished Basic Research Grant scheme and to the Health Research Ethics Committee for granting ethical approval for this study. The authors also thank all the enumerators who assisted with data collection in the field.

References

Arshad, M. T., Maqsood, S., Altalhi, R., Shamlan, G., Mohamed Ahmed, I. A., Ikram, A., & Abdullahi, M. A. (2025). Role of dietary carbohydrates in cognitive function: A review. *Food Science & Nutrition, 13*(7). https://doi.org/10.1002/fsn3.70516

Ayogu, R. N. B., Eme, P. E., Anyaegbu, V. C., Ene-Obong, H. N., & Amazigo, U. V. (2018). Nutritional value of school meals and their contributions to energy and nutrient intakes of rural school children in Enugu and Anambra States, Nigeria. *BMC Nutrition, 4*(1). https://doi.org/10.1186/s40795-018-0216-0

Campmans-Kuijpers, M. J. E., Singh-Povel, C., Steijns, J., & Beulens, J. W. J. (2016). The association of dairy intake of children and adolescents with different food and nutrient intakes in the Netherlands. *BMC Pediatrics, 16*(1). https://doi.org/10.1186/s12887-015-0524-3

Darma, A., Sumitro, K. R., Jo, J., & Sitorus, N. (2024a). Lactose intolerance versus cow's milk allergy in infants: A clinical dilemma. *Nutrients, 16*(3). https://doi.org/10.3390/nu16030414

Di Prima, S., Nguyen Dinh, D., Reurings, D. D., Wright, E. P., Essink, D., & Broerse, J. E. W. (2022). Home-grown school feeding: Implementation lessons from a pilot in a poor ethnic minority community in Vietnam. *Food and Nutrition Bulletin, 43*(3), 271–302. https://doi.org/10.1177/03795721221088962

Domellöf, M., & Sjöberg, A. (2024). Iron: A background article for the Nordic nutrition recommendations 2023. *Food & Nutrition Research, 68*. https://doi.org/10.29219/fnr.v68.10451

Dougkas, A., Barr, S., Reddy, S., & Summerbell, C. D. (2019). A critical review of the role of milk and other dairy products in the development of obesity in children and adolescents. *Nutrition Research Reviews, 32*(1), 106–127. https://doi.org/10.1017/S0954422418000227

Food and Agriculture Organization of the United Nations, & World Health Organization. (2023). *Fats and fatty acids in human nutrition* (Food and Agriculture Organization of the United Nations, Ed.). Food and Agriculture Organization of the United Nations.

Ghani Nurfaizi, N., & Romadlon, F. (2024).

Analysis of dairy supply chain practices and their impact on food loss in Banyumas Regency, Indonesia. *Jurnal Teknologi dan Manajemen Agroindustri, 13*, 152–165. https://doi.org/10.21776/ub.industria.2024.013.02.3

Kai kang, O. S. So. (2019). Effects of milk and milk-product consumption on growth among children and adolescents aged 6–18 years. *Advances in Nutrition, 10*, 250–251.

Khusun, H., Februhartanty, J., Anggraini, R., Mognard, E., Alem, Y., Noor, M. I., Karim, N., Laporte, C., Poulain, J.-P., Monsivais, P., & Drewnowski, A. (2022). Animal and plant protein food sources in Indonesia differ across socio-demographic groups: Socio-cultural research in protein transition in Indonesia and Malaysia. *Frontiers in Nutrition, 9*. https://doi.org/10.3389/fnut.2022.762459

Lisa, L., Merli, M., Puji, P., Nova, N., Rahma, R., Annisa, A., Gina, G., Reva, R., & Marniati, M. (2025). Edukasi gizi seimbang untuk meningkatkan kesehatan dan konsentrasi belajar anak sekolah dasar. *Zona: Jurnal Pengabdian Masyarakat, 2*(2), 195–206. https://doi.org/10.71153/zona.v2i2.162

Martins, M. L., Rodrigues, S. S. P., Cunha, L. M., & Rocha, A. (2021). School lunch nutritional adequacy: What is served, consumed and wasted. *Public Health Nutrition, 24*(13), 4277–4285. https://doi.org/10.1017/S1368980020004607

Mahmudiono, T., Nindya, T. S., Rachmah, Q., Segalita, C., & Wiradnyani, L. A. A. (2020). Nutrition education intervention increases fish consumption among school children in Indonesia: Results from behavioral based randomized control trial. *International Journal of Environmental Research and Public Health, 17*(19), 1–15. https://doi.org/10.3390/ijerph17196970

Malhotra, U., Roy, M., Sontakke, M., & Choudhary, P. (2023). A recent paradigm on iron absorption, prevalence, and emerging dietary approaches to eradicate iron deficiency. *Food Bioengineering, 2*(1), 53–63. https://doi.org/10.1002/fbe2.12042

Milić, D., Novaković, T., Tekić, D., Matkovski, B., Đokić, D., & Zekić, S. (2023). Economic sustainability of the milk and dairy supply chain: Evidence from Serbia. *Sustainability, 15*(21). https://doi.org/10.3390/su152115234

Ninh, N. T., Pham, C. T. K., Nguyen, N. T. T., Pham, T. T. T., Dao, H. T. L., Vu, L. P., Tran, M. T., & Mai, Q. Van. (2025). Nutritional practices among ethnic minority high school students in mountainous regions, Vietnam. *International Journal of Environmental Research and Public Health, 22*(7). https://doi.org/10.3390/ijerph22071021

Nogueira, T., Ferreira, R. J., da Silva, V. D., Pinto, M. L., Damas, C., & Sousa, J. (2021). Analytical assessment and nutritional adequacy of school lunches in Sintra's public primary schools. *Nutrients, 13*(6). https://doi.org/10.3390/nu13061946

Octawijaya, I. H., Kondo, M., Hori, A., & Ichikawa, M. (2023). Parent willingness to pay for school feeding programs in junior high schools in Malang Regency, Indonesia. *Nutrients, 15*(14). https://doi.org/10.3390/nu15143212

Ratnasari, D., Purniasih, L., Program Studi Ilmu Gizi, & Fakultas Ilmu Kesehatan. (2019). Status gizi dan pola konsumsi makanan anak usia sekolah (7–12 tahun) di Desa Karangsembung. *Jurnal Ilmiah Gizi dan Kesehatan (JIGK), 1*(1).

Rimbawan, R., Nurdiani, R., Rachman, P. H., Kawamata, Y., & Nozawa, Y. (2023). School lunch programs and nutritional education improve knowledge, attitudes, and practices and reduce the prevalence of anemia: A pre-post intervention study in an Indonesian Islamic boarding school. *Nutrients, 15*(4). https://doi.org/10.3390/nu15041055

Sanjulián, L., Fernández-Rico, S., González-Rodríguez, N., Cepeda, A., Miranda, J. M., Fente, C., Lamas, A., & Regal, P. (2025). The role of dairy in human nutrition: Myths and realities. *Nutrients, 17*(4). https://doi.org/10.3390/nu17040646

Santi-Cano, M. J., Novalbos-Ruiz, J. P., Bernal-Jiménez, M. Á., Bibiloni, M. D. M., Tur, J. A., & Martin, A. R. (2020). Association of adherence to specific Mediterranean diet components and cardiorespiratory fitness in young adults. *Nutrients, 12*(3). https://doi.org/10.3390/nu12030776

Skolmowska, D., & Głąbska, D. (2019). Analysis of heme and non-heme iron intake and iron dietary sources in adolescent menstruating females in a national Polish sample. *Nutrients, 11*(5). https://doi.org/10.3390/nu11051049

Triyanti, T., & Kusharisupeni, K. (2022a). Carbohydrate intake is associated with learning concentration among high school students in Jember Regency, East Java Province, Indonesia. *Indonesian Journal of Public Health Nutrition, 2*(2). https://doi.org/10.7454/ijphn.v2i2.5756

Triyanti, T., & Kusharisupeni, K. (2022b). Carbohydrate intake is associated with learning concentration among high school students in Jember Regency, East Java Province, Indonesia. *Indonesian Journal of Public Health Nutrition, 2*(2). https://doi.org/10.7454/ijphn.v2i2.5756

Vilhar, E. Č., Golja, P., Starc, G., Seljak, B. K., & Kotnik, K. Z. (2023). Adequacy of energy and macronutrients intake in differently active Slovenian adolescents. *BMC Nutrition, 9*(1). https://doi.org/10.1186/s40795-023-00708-x

Wang, D., Shinde, S., Young, T., & Fawzi, W. W. (2021). Impacts of school feeding on educational and health outcomes of school-age children and adolescents in low- and middle-income countries: A systematic review and meta-analysis. *Journal of Global Health, 11*, 1–27. https://doi.org/10.7189/jogh.11.04051

Wiley. (2023). Dairy consumption and dietary energy intake in children and adolescents. *Journal of School Health, 93*(2), 93–96. https://doi.org/10.1111/josh.13038

Zelalem Zestaw, E. W. S. K. Y. C. (2022). School feeding contributed valuable dietary energy and nutrients despite suboptimal supply to school-age children and adolescents at primary schools in Addis Ababa, Ethiopia. *Nutrition, 102*. 111693. https://doi.org/10.1016/j.nut.2022.111693