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The impact of socio-economic factors and nutritional status on fast food consumption, soft drinks, and adolescent brain health in Bandar Lampung

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ABSTRACT

Background: Adolescence is a critical period for physical and cognitive development, yet research linking socio-economic factors, nutritional status, and brain health in Indonesian adolescents remains limited.

Objective: This study aimed to evaluate the associations between socioeconomic factors, consumption of fast food and sugary drinks, nutritional status, and brain health among high school students at SMA N 9 Bandar Lampung.

Methods: An analytical observational cross-sectional study was conducted involving 68 Grade X–XI students selected via simple random sampling. Data were collected via questionnaires assessing nutritional status, consumption patterns, nutrition knowledge, brain health, and family socioeconomic characteristics, and analyzed using Spearman's correlation and logistic regression.

Results: Malnutrition status was associated with reduced combined consumption frequency (OR=0.178) and fast food frequency (OR=0.423). Nutrition knowledge significantly influenced nutritional status (OR=0.486). Socioeconomic factors, specifically pocket money, strongly influenced purchasing decisions.

Conclusion: Socioeconomic factors and nutrition knowledge are associated with consumption behaviors related to adolescents' nutritional status and brain health. Holistic interventions involving nutrition education and financial access are required

KEYWORDS

Adolescents, Brain health, Consumption patterns, Fast food, Sugary drinks

INTRODUCTION

Adolescence represents a critical window of neurodevelopment, characterized by significant synaptic plasticity and the establishment of lifelong behavioral trajectories. During this transitional phase, the interplay between socioeconomic determinants and nutritional status becomes a pivotal driver of both physical health and cognitive maturation. However, in rapidly urbanizing regions of developing nations, such as Bandar Lampung, Indonesia, this period is increasingly compromised by an "obesogenic" environment. This shift is marked by the proliferation of fast food and sugar-sweetened beverages (SSBs) products dense in saturated fats and additives but nutrient-poor driven by aggressive media marketing, peer influence, and notably, the increasing financial autonomy of adolescents through pocket money availability[1].

Emerging evidence indicates that the consequences of these dietary shifts extend beyond metabolic health**.** While the link between high-sugar, high-fat diets and rising obesity rates is well-established, a growing body of literature suggests a deleterious impact on the adolescent brain. Excessive consumption of ultra-processed foods has been correlated with neuroinflammation and impairments in hippocampal function, manifesting as deficits in memory, concentration, and academic performance[2,3]. Local studies corroborate this, indicating that adolescents with frequent fast-food intake face

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a two- to three-fold increase in the risk of cognitive impairment compared to their peers. This is particularly concerning given recent national data from the Indonesian Ministry of Health, which reports a sharp escalation in adolescent obesity prevalence in major urban centers, paralleling the widespread adoption of instant meal patterns. Conversely, nutritional literacy appears to serve as a protective factor, fostering selective dietary behaviors that safeguard both nutritional status and cognitive health[4].

Despite the global recognition of these risks, a critical epistemological gap remains within the Indonesian context. Existing research has predominantly focused on the physical anthropometric outcomes of dietary habits, largely overlooking the cognitive dimensions. Furthermore, the specific role of socioeconomic variables unique to the urban Indonesian context such as the direct influence of discretionary allowance (pocket money) on food choices and subsequent brain health has not been adequately explored.

The present study aims to elucidate the complex interplay between socioeconomic factors, nutritional status, and consumption patterns, specifically examining their cumulative impact on brain health. By focusing on adolescents in Bandar Lampung, this research offers a novel, contextualized analysis of how financial accessibility and nutritional status interact to influence cognitive well-being. Ultimately, the findings are intended to serve as a strategic evidence base for developing targeted, multi-dimensional health interventions and policies appropriate for the rapidly shifting demographic landscape of Indonesia.

METHODS

Design

The study used a cross-sectional design conducted at SMA Negeri 9 Bandar Lampung from May to June 2025. The research site was purposively selected based on factors such as easy access to fast food and soft drinks and being dominated by students from middle to upper socioeconomic backgrounds. The study population comprised Grade X and XI students, selected via simple random sampling with inclusion criteria: (1) students in Grade X or XI, and (2) voluntary participation with signed informed consent. The exclusion of participants with eating disorders was implemented to minimize confounding bias.

Sample Size

The required sample size was calculated using the formula by Lemeshow et al[5] for the proportion of the population with low fruit and vegetable intake.

$$n = \frac{Z^2\left(1-\frac{\alpha}{2}\right)P(1-P)}{d^2}$$

n: Minimum number of subjects

$Z^2\left(1-\frac{\alpha}{2}\right)$: 95% confidence interval (α = 0.05) = 1.96

P: Proportion of low fruit and vegetable intake among 15–19 year-olds = 96.4%[6].

d: Tolerable margin of error = 0.05

$$n = \frac{Z^2\left(1-\frac{\alpha}{2}\right)P(1-P)}{d^2} = 53{,}3$$

The minimum sample size for a population with a 96.4% low fruit and vegetable intake prevalence is 53. To account for potential drop-outs or data anomalies, an additional 30% was added, resulting in a final sample of 68 subjects.

Data Types and Collection Methods

Data were gathered using a comprehensive self-administered questionnaire designed to capture a broad range of sociodemographic, dietary, and behavioral variables relevant to the study's objectives. The instrument was structured into three primary blocks of information. First, demographic and socioeconomic characteristics were recorded, including student identity (age, gender, class track), anthropometric measurements (height and weight), and family background details such as household size, parental education, occupation, and monthly income. These variables provided the necessary context for analyzing socioeconomic disparities.

Second, the study assessed dietary behaviors and consumption patterns. Participants reported the frequency of their fast food and packaged beverage intake, categorized into "frequent" (daily to 3–4 times/week), "rare" (1–2 times/week or less), or "never." To gain deeper insight into dietary quality, specific habits were explored, including the most consumed types of fast food (e.g., meat products vs. snacks), the co-consumption of carbonated drinks with meals, and the primary sources of nutritional information (e.g., social media, family, or peers).

Third, to evaluate brain health, the study utilized a structured questionnaire developed ad hoc for this research, featuring items adapted from literature on adolescent cognitive development and mental well-being. Given the non-clinical setting, this instrument was designed to capture subjective functional indicators, specifically the frequency of memory lapses (e.g., forgetting names or places) and perceived stress levels, alongside protective factors such as engagement in cognitively stimulating activities (e.g., reading, puzzles). The conceptual validity of these items rests on their ability to reflect daily cognitive complaints and lifestyle behaviors associated with brain function in a school-based population[7]. For the purpose of analysis, these variables were aggregated to form a composite brain health index to determine their specific associations with nutritional status to determine their specific associations with nutritional status.

Data Collection Procedure

All students received an explanation of the study's purpose and guidance on questionnaire completion. Height and weight were measured using validated, reliable equipment (GEA digital scale, Elitech stadiometer, both Indonesian products). Nutritional status was subsequently determined by calculating Body Mass Index (BMI)[8,9] and converting it into BMI-for-age Z-scores (BAZ) using the World Health Organization (WHO) 2007[9].

Data Processing and Analysis

Data were processed through coding, entry, and cleaning to ensure accuracy. Cleaned data were analyzed using Microsoft Excel 2019 and SPSS 25.0. Descriptive analysis summarized sample characteristics, consumption frequency, and respondents' knowledge. For inferential analysis, Spearman's rank correlation was employed to assess bivariate relationships. This non-parametric test was selected due to the non-normal distribution of the data and the ordinal nature of the variables. Frequency data were recoded into ordinal variables: Q1 (Low), Q2 (Medium), and Q3 (High) to allow for the analysis of consumption trends. This approach enables the identification of patterns across different levels of intake. Statistically significant results ($p < 0.05$) are indicated by the symbol (*). In the regression models, consumption patterns and brain health outcomes were treated as dependent variables, while socioeconomic factors (pocket money, parental income) and nutritional status served as independent predictors. This approach allowed for the identification of significant risk factors while controlling for confounding variables.

Ethics

Ethical clearance was granted by the Poltekkes Kemenkes Tanjung Karang Research Ethics Committee (No. 462/KEPK-TJK/VIII/2025), and informed consent was obtained from all respondents.

RESULTS AND DISCUSSIONS

Table 1 presents the socio-demographic and anthropometric characteristics of the 68 respondents. The sample was predominantly female (60.3%), with the majority classified as having normal nutritional status (73.5%). This gender dis-

Table 1. Socio-Demographic Characteristics and Anthropometric Data of Respondents

Category	Variable	n	(%)	Mean ± SD	Range
Gender	Male	27	39.7	-	-
	Female	41	60.3	-	-
Nutritional Status	Underweight Obese	7	10.3	-	-
	Normal	50	73.5	-	-
	Overweight	10	14.7		
	Obese	1	1.5		
	Parental Income				
	< Rp 3.000.000	22	32.4		
	Rp 3.000.000 - 5.000.000	26	38.2		
	> Rp 5.000.000	20	29.4		
Anthropometry	Age (years)	68		14.99 ± 0.47	14-17
	Height (cm)	68		160.0 ± 8.76	142 - 183.4
	Weight (kg)	68		55.56 ± 14.29	36 - 102.5
Financial	Pocket Money (IDR)	68	-	24.632 ± 13.876	10k - 100k

tribution aligns with previous observations that female adolescents often demonstrate higher participation rates in health-related surveys, potentially due to greater body awareness. Regarding socioeconomic background, the largest proportion of parents (38.2%) reported a monthly income between IDR 3,000,000 and IDR 5,000,000. Consistent with studies showing that middle-income families have better access to nutritious food despite facing some constraints[10]. This middle-income profile suggests that while families have reasonable access to nutritious food, economic constraints may still influence dietary choices.

Anthropometric measurements reflect the rapid physical development characteristic of middle adolescence, with a mean age of 14.99 ± 0.47 years. A period marked by accelerated physical growth and cognitive development, as show in early adolescent nutrition epidemiology[11]. The respondents displayed considerable variability in physical stature, with a mean height of 160.0 ± 8.76 cm and weight of 55.56 ± 14.29 kg. This wide range in weight, spanning from 36 kg to 102.5 kg, highlights significant disparities in nutritional status within the cohort, where deviations from the norm (underweight or overweight/obese) may signal underlying health or dietary issues[12]. Furthermore, financial autonomy varied substantially; daily pocket money averaged IDR 24,632 ± 13,876, with a range of IDR 10,000 to IDR 100,000. This disparity in purchasing power is a critical variable, as it directly impacts adolescents' ability to access independent food choices in their school environment.

Relationship Between Nutritional Status, Pocket Money, and Gender with Consumption Habits

Recent research demonstrates that nutritional status, pocket money, and gender have distinct relationships with fast food and sweetened beverage consumption habits among adolescents. Nutritional status shows a significant association with fast food and sweet beverage consumption frequency. Adolescents with higher nutritional status (overweight/obesity) tend to consume fast food and sugary drinks more[13-15]. High fast food consumption, rich in calories, sugar, and saturated fat, contributes to obesity risk and other health problems[16]. Low nutrition knowledge also increases the tendency toward fast food consumption, whereas good nutrition knowledge can reduce unhealthy consumption behavior[17,18].

Pocket money is associated with fast food and sweetened beverage consumption frequency, whereby adolescents with

Table 2. Correlation Analysis Between Nutritional Status, Pocket Money, Gender and the Frequency of Packaged Drink and Fast Food Consumption

Variable	Frequency of Packaged Drink Consumption				Frequency of Fast Food Consumption			
	Q1	Q2	Q3	P-Value	Q1	Q2	Q3	P-Value
Nutritional Status								
Underweight	0	5	2		0	6	1	
Normal	1	25	24	0.549	0	28	22	0.008*
Overweight	0	7	3		0	9	1	
Obesity	0	0	1		0	1	0	
Total	1	37	30		0	44	24	
Pocket Money								
< 10.000	0	6	0		0	6	0	
10.000 – 18.000	0	6	5	0.048*	0	10	1	0.002*
>18.000	1	25	25		0	28	23	
Total	1	37	30		0	44	24	
Gender								
Male	0	18	9	0.108	0	19	8	0.165
Female	1	19	21		0	25	16	
Total	1	37	30			44	24	

The sign (*) indicates a statistically significant value ($p < 0.05$); Q1 = Low; Q2 = Medium; Q3 = High.

Table 2 continuation. Correlation Analysis Between Nutritional Status, Pocket Money, Gender and the Frequency of Packaged Drink and Fast Food Consumption

Variable	Types of Fast Food					Consumption of Fast Food Together with Carbonated Drinks		
	Burger/ Pizza	Fried Chicken	Instant Noodle	Snack	P-Value	Yes	No	P-Value
Nutritional Status								
Underweight	1	2	2	2		1	6	
Normal	2	12	23	12	0.977	23	27	0.028*
Overweight	0	3	4	3		2	8	
Obesity	0	0	0	1		0	1	
Total	3	17	29	18		26	42	
Pocket Money								
< 10.000	0	0	3	3		1	5	
10.000 – 18.000	0	0	8	3	0.024*	4	7	0.395
>18.000	3	17	18	12		21	30	
Total	3	17	29	18		26	42	
Gender								
Male	2	4	15	6	0.963	11	16	0.735
Female	1	13	14	12		15	26	
Total	3	17	29	18		26	42	

Variable	Weekly Fast Food Consumption				Frequency of Fast Food Consumption			
	Q1	Q2	Q3	P-Value	Social Media	Television	Article/ Blog	Friends/ Family
Nutritional Status								0.021*
Underweight	0	6	1		4	1	1	1
Normal	0	27	23	0.327	39	1	3	7
Overweight	0	8	2		4	0	0	6
Obesity	0	1	0		1	0	0	0
Total	0	42	26		48	2	4	14
Pocket Money								0.916
< 10.000	0	5	1		5	1	0	0
10.000 – 18.000	0	7	4	0.002*	7	0	1	3
>18.000	0	30	21		36	1	3	11
Total	0	42	26		48	2	4	14
Gender								0.495
Male	0	16	11	0.086	20	2	1	4
Female	0	26	15		28	0	3	10
Total	0	42	26		48	2	4	14

The sign (*) indicates a statistically significant value ($p < 0.05$); Q1 = Low; Q2 = Medium; Q3 = High.

larger allowances tend to purchase unhealthy foods and beverages more frequently[19,20]. However, some studies found this relationship is not always consistent, as family and environmental factors also influence consumption patterns[15]. Greater pocket money increases access to fast food, but its effect can be mediated by family habits and marketing promotion. Gender does not always show a significant relationship with fast food and sweetened beverage consumption habits. However, some research found that males tend to consume fast food and sugary beverages more frequently, whereas females more often choose healthy foods and eat breakfast. These differences are also influenced by physical activity and taste preferences.

Relationship Between Nutritional Status, Pocket Money, and Gender with Brain Health and Mental Health

Nutritional status has a significant correlation with brain health ($p = 0.031$), supporting findings that diets rich in omega-3 fatty acids, antioxidants, and vitamins support cognitive function and prevent cognitive decline in adolescents[21]. Pocket money correlates significantly with mental health ($p = 0.049$), consistent with evidence that income affects stress and anxiety levels; the more pocket money available, the greater access to healthy lifestyles that can reduce anxiety and improve mental well-being[22]. Gender is significantly related to brain-stimulating physical activities ($p = 0.049$) and sports activities ($p < 0.001$); males tend to exercise more, which contributes positively to brain and mental health[11]. Regular physical activity increases blood flow to the brain, supporting cognitive function and mental health, consistent with the relationship between nutritional status, pocket money, gender, and self-control in food/beverage consumption ($p = 0.025$). The availability of financial resources affects dietary control, where greater access can either reduce or increase the risk of nutritional disorders such as obesity and diabetes depending on food choices[23].

Determinants of Dietary Behaviors and Public Health Implications

Logistic regression analysis (Table 4) revealed that nutritional status is a significant predictor of dietary behaviors. Malnutrition status was associated with a 57.7% reduction in the likelihood of frequent fastfood consumption (OR=0.423; 95% CI: 0.208–0.863) and a significantly lower probability of co-consuming fast food with carbonated beverages (OR=0.178; 95% CI: 0.034–0.937). These findings suggest that undernourished adolescents may exercise greater caution regarding high-calorie, nutrient-poor combinations, potentially as a compensatory mechanism to improve dietary quality[24]. Conversely, adolescents with better nutritional status (normal/overweight) appear more prone to these "obesogenic" behaviors, likely driven by uninhibited dietary choices.

Furthermore, nutritional status significantly influenced access to information sources (OR=0.486; 95% CI: 0.285–0.828). Adolescents with malnutrition were less likely to access quality nutrition information from authoritative sources (e.g., seminars, health literature), instead relying on mass media or peers. This informational deficit highlights a critical vulnerability: those most in need of dietary guidance are often the least equipped with reliable knowledge, reinforcing the cycle of poor nutritional choices[12].

Financial autonomy, proxied by pocket money, emerged as a dominant structural driver of consumption. While the decision to purchase (OR=1.333) did not reach statistical significance due to wide confidence intervals, the allocationof funds toward fast food frequency (OR=0.295) and specific food types (OR=0.363) was significant. This indicates that once purchasing power is established, it heavily dictates the intensity and quality of consumption. Adolescents with higher disposable income are more likely to prioritize convenience and taste over health, often depleting their budget on low-value foods[25]. Although nutrition knowledge (OR=0.747) showed a trend toward influencing spending, its effect was not statistically significant, suggesting that without structural interventions (e.g., pricing strategies), knowledge alone is insufficient to override the economic accessibility of fast food.

Brain Health as a Potential Protective Factor The study explored the novel association between brain health and nutritional status. The analysis indicated a potential protective role of better brain health against malnutrition (OR=0.529). However, this result warrants a nuanced interpretation, as the confidence interval (95% CI: 0.278–1.007) approaches unity, indicating borderline statistical significance. While not definitive, this trend aligns with neurocognitive theories proposing that optimal brain function—specifically executive functions like impulse control and decision-making—facilitates healthier dietary choices[27]. Conversely, cognitive impairments may exacerbate poor eating habits, creating a bidirectional relationship where poor diet compromises brain health, which in turn fuels further dietary degradation[21].

Implications for Public Health Policy These findings underscore that adolescent dietary behaviors are shaped by a complex interplay of biological (nutritional status), economic (pocket money), and cognitive (brain health) factors. Single-vector interventions are likely to fail. Instead, a multi-dimensional strategy is required to given the dominance of pocket money in driving consumption, policies such as taxes on sugar-sweetened beverages or subsidies for nutrient-dense foods in school canteens could alter the economic landscape, making healthy choices more financially attractive[29].

Nutrition education must move beyond general knowledge to target specific groups particularly undernourished adolescents who lack access to quality information focusing on practical skills to navigate the modern food environment. Inte-

Table 3. Correlation Analysis Between Nutritional Status, Pocket Money, Gender and Brain Health, Mental Health, Physical Activity, and Self-Control in Food and Beverage Consumption

Variable	Q1	Q2	Q3	P-Value	Q1	Q2	Q3	P-Value
	Brain-stimulating activities				Sports activities			
Nutritional Status								
Underweight	6	1	0		5	1	1	
Normal	12	26	12	0.031*	14	25	11	0.516
Overweight	4	4	2		4	5	1	
Obesity	0	1	0		1	0	0	
Total	22	32	14		24	31	13	
Pocket Money								
< 10.000	1	4	1		2	2	2	
10.000 – 18.000	5	5	1	0.435	4	4	3	0.049*
>18.000	16	23	12		18	25	8	
Total	22	32	14		24	31	13	
Gender								
Male	7	13	7	0.230	10	14	3	0.762
Female	15	19	7		14	17	10	
Total	22	32	14		24	31	13	
	Brain-stimulating activities				Sports activities			
Nutritional Status								
Underweight	2	4	1		3	3	1	
Normal	8	25	17	0.946	30	13	7	0.735
Overweight	1	5	4		7	3	0	
Obesity	0	0	1		0	0	1	
Total	11	34	23		40	19	9	
Pocket Money								
< 10.000	1	2	3		5	1	0	
10.000 – 18.000	1	7	3	0.712	7	3	1	0.311
>18.000	9	25	17		28	15	8	
Total	11	34	29		40	19	9	
Gender								
Male	3	11	13	0.049	9	12	6	0.000*
Female	8	23	10		31	7	3	
Total	11	34	23		40	19	9	

The sign (*) indicates a statistically significant value ($p < 0.05$); Q1 = Low; Q2 = Medium; Q3 = High.

Table 4. Logistic Regression Analysis: Influence of Status and Money on Consumption and Health

Predictor	Outcome Variable	OR	95% CI	Significance
Nutritional Status	Fast Food Frequency	0.423	0.208 – 0.863	Significant
(Malnutrition)	Fast Food + Soda	0.178	0.034 – 0.937	Significant
	Info Source Access	0.486	0.285 – 0.828	Significant
Pocket Money	Fast Food Frequency	0.295	0.182 – 0.763	Significant
	Type of Fast Food	0.363	0.205 – 0.951	Significant
	Purchase Decision	1.333	0.640 – 2.778	Not Significant[a]
	Brain-Health Knowledge	0.747	0.488 – 1.145	Not Significant[a]
Brain Health	Nutritional Status	0.529	0.278 – 1.007	Borderline[b]

OR = Odds Ratio; CI = Confidence Interval. a Confidence interval crosses 1.0, indicating no statistical significance at $p<0.05$. b Confidence interval approaches 1.0, indicating borderline significance requiring cautious interpretation. Model diagnostics (e.g., Hosmer-Lemeshow, Nagelkerke R2) were not available for this analysis.

grating brain health promotion (e.g., omega-3 supplementation, cognitive training) into nutrition programs could offer a novel pathway to improve dietary decision-making capabilities. Future research should prioritize longitudinal designs to unravel the causal pathways of the neuro-nutritional nexus and evaluate the long-term efficacy of these integrated interventions.

CONCLUSIONS

This study found that adolescent nutritional status and pocket money significantly influenced fast food and sweetened beverage consumption, with overweight or obese adolescents and those with greater allowances more likely to make unhealthy dietary choices. While nutrition knowledge provided some protective effect, economic factors and accessibility were stronger determinants. Gender differences were more apparent in physical activity patterns than in dietary habits, with males being more active. Furthermore, better brain health was linked to a lower risk of malnutrition, highlighting the need to support cognitive development alongside nutrition interventions. These findings underscore the importance of integrated public health strategies that address socioeconomic conditions, strengthen nutrition education, and promote healthy lifestyles for adolescents.

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