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EPIDEMIOLOGY OF 4P SNACK CONSUMPTION BEHAVIOR IN CHILDREN AS AN EARLY RISK FACTOR FOR NON-COMMUNICABLE DISEASES

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ABSTRACT
Snacking behavior among elementary school students contributes substantially to daily energy intake and may increase the risk of consuming foods high in sugar, fat, and food additives such as preservatives, colorings, flavor enhancers, and sweeteners (4P). The school food environment and family economic factors are assumed to influence such behavior. This study aimed to analyze the effect of pocket money and purchase location on 4P snacking behavior among elementary school students. A quantitative cross-sectional design was applied involving 23 fourth-grade students at SDN Karangrejo VI Jember by total sampling. Data were collected using structured questionnaires assessing pocket money categories, snack purchase locations, and 4P snacking behavior scores, which have been validated and are reliable. Data were analyzed using univariate and bivariate analysis with chi-square tests. The results showed that most students received IDR 6,000–10,000 as daily pocket money (57%) and predominantly purchased snacks at the school canteen (60%). The highest proportion of 4P snack consumption was 1–2 times per week (56.5%). Statistical analysis indicated no significant association between pocket money (p=0.231) or purchase location (p=0.366) and 4P snacking behavior. These findings suggest that children's snacking behavior is influenced by more complex and interacting factors.

Keywords: elementary school; food additives; pocket Money; purchase location; snacking behavior

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INTRODUCTION

The consumption of unhealthy snacks among primary school children is one of the behavioural determinants contributing to an increased risk of non-communicable diseases in the future. The consumption of foods high in sugar and fat has been linked to an increase in Body Mass Index and the likelihood of obesity in children, which are major risk factors for non-communicable diseases such as diabetes and metabolic disorders (Rousham et al., 2022). Research indicates that snacks and street food contribute significantly to children's daily energy intake, particularly from foods high in sugar, fat, and salt (Gage et al., 2021; Shriver et al., 2017). Such dietary patterns can establish eating habits that persist into adolescence and adulthood, thereby increasing the likelihood of future overweight and degenerative diseases. Epidemiological studies also indicate that the availability of energy-dense, high-fat/sugar snacks is associated with an increased prevalence of overweight or obesity among schoolchildren (Muhimah & Farapti, 2023; Yaslina, Millia Anggraini, 2015).

A study in the United States reported that over 95% of children aged 2–11 years consume snacks daily, with snacks accounting for 27% of total daily energy intake (Shriver et al., 2017). Other research indicates that school-aged children consume snacks on average 2–3 times per day, particularly during school hours and after lessons (Gage et al., 2021). The majority of children aged 2–12 years (over 80%) regularly consume snacks, with consumption most frequently occurring in school and home settings. The snacks consumed are generally processed foods high in sugar, fat, and salt, which contribute significantly to children's total daily energy intake (Kane et al., 2023). The high prevalence of snacking behaviour is also supported by the school environment. The school

food environment indicates that over 70% of schools provide access to unhealthy snacks, either through school canteens or vendors around the school (França et al., 2022). An analysis of food availability in the school environment shows that around 60–90% of products sold in canteens and around schools are processed foods of low nutritional quality (Araújo et al., 2025). Based on snacking habits at school, it was found that the reason pupils bought snacks was because of the tasty flavour (savoury, sweet, spicy) for 43 pupils (63.2%), with the types of snacks being: iced drinks 20.6%, factory-packaged foods 52.9% and plastic-wrapped items 33.8%, as well as foods with condiments (chilli sauce, chilli powder, soy sauce) at 26.5%, with the most frequently visited snacking locations being the school canteen or kiosk at 75% (Aini, 2019). This is reinforced by Sartika et al. (2025), who found that half of primary school children in Bekasi City frequently consume snacks; only 30% of pupils do not buy snacks at school, and 75% of pupils are accustomed to buying snacks in plastic packaging. Nearly 80% of pupils buy snacks from two or three food vendors, such as school canteens, street vendors, and food stalls. This study demonstrates how school-age children are in close proximity to food vendors offering a wide variety of snacks, which can increase the risk of obesity (Sartika et al., 2025).

The school environment is one of the key settings that shapes the way children make food choices. The concept of the school food environment suggests that the food choices children make depend not only on their personal preferences, but are also influenced by the types of food available and easily accessible around the school. This environment includes school canteens, street vendors, and shops around the school offering various types of snacks (Araújo et al., 2025; França et al., 2022). Research by França et al (2022) indicates that food sold around schools generally has low nutritional content and is subject to insufficient safety oversight, meaning children are more likely to purchase and consume unhealthy food (França et al., 2022). Epidemiological research in Indonesia indicates that the availability of energy-dense snacks high in sugar and fat is associated with overweight status among schoolchildren (Muhimah & Farapti, 2023). This situation suggests that the school food environment acts as an environmental determinant that can reinforce exposure to the risks of unhealthy food consumption from an early age. A school environment filled with unhealthy snacks and lacking sufficient regulations can make it easier for pupils to become accustomed to buying food that is poor for their health (Kane et al., 2023). This necessitates that the management of the school food environment, particularly the school canteen, become a key focus of health promotion efforts (Murphy et al., 2024). Based on observations conducted at Karangrejo 06 State Primary School (SDN), the food and snacks that are widely available and frequently consumed by children often contain the 4Ps (preservatives, colourings, flavour enhancers, and sweeteners). 4P snacks are also increasingly common and easily found in other school environments and are often the students' choice when filling their free time, whether during breaks, before entering the classroom, or after school.

On the other hand, family economic factors, such as the provision of pocket money, also play an enabling role in children's consumption behaviour. Though the pocket money is associated with adolescents' food purchasing and snack consumption behaviors, these behaviors are also shaped by broader environmental influences, including family socioeconomic conditions, peer interactions, school environment, and community food access (Capitán-Moyano et al., 2025; Lestari & Afifah, 2024). Therefore, an epidemiological analysis of the consumption behaviour of 4P snacks (preservatives, colourings, flavour enhancers, and sweeteners) among primary school pupils is important for understanding the risk determinants of early NCD behaviour and formulating school- and family-based prevention strategies.

METHOD

This study is a descriptive observational study using a cross-sectional approach. The study used total sampling and was conducted with 23 Year 4 pupils in a primary school in Jember Regency.Data were collected using a structured questionnaire. Before the questionnaire was used,

it did validity and reliability test to ensure that the research instruments were able to measure variables accurately, precisely, and consistently so that the data obtained can be trusted, and the results are valid (the computed r exceeds the r value found in the table, that was > 0.413) and reliable (0.770).

R tabel 0,413

Correlations

		MIE_INSTAN	PERMEN_BEWARNA	PENYEDAP_RASA	PEMANIS_BUATAN	BEKAL_DARI_RUMAH	TOTAL_SKOR
MIE_INSTAN	Pearson Correlation	1	.346	.625**	.293	.160	.666**
	Sig. (2-tailed)		.106	.001	.175	.467	.001
	N	23	23	23	23	23	23
PERMEN_BEWARNA	Pearson Correlation	.346	1	.565**	.628**	.425*	.827**
	Sig. (2-tailed)	.106		.005	.001	.043	.000
	N	23	23	23	23	23	23
PENYEDAP_RASA	Pearson Correlation	.625**	.565**	1	.231	.253	.754**
	Sig. (2-tailed)	.001	.005		.289	.244	.000
	N	23	23	23	23	23	23
PEMANIS_BUATAN	Pearson Correlation	.293	.628**	.231	1	.475*	.714**
	Sig. (2-tailed)	.175	.001	.289		.022	.000
	N	23	23	23	23	23	23
BEKAL_DARI_RUMAH	Pearson Correlation	.160	.425*	.253	.475*	1	.643**
	Sig. (2-tailed)	.467	.043	.244	.022		.001
	N	23	23	23	23	23	23
TOTAL_SKOR	Pearson Correlation	.666**	.827**	.754**	.714**	.643**	1
	Sig. (2-tailed)	.001	.000	.000	.000	.001	
	N	23	23	23	23	23	23

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Item	r hitung	r tabel	Keterangan
MIE_INSTAN	0,666	0,413	Valid
PERMEN_BERWARNA	0,827	0,413	Valid
PENYEDAP_RASA	0,754	0,413	Valid
PEMANIS_BUATAN	0,714	0,413	Valid
BEKAL_DARI_RUMAH	0,643	0,413	Valid

Hasil uji reliabilitas

Reliability Statistics

Cronbach's Alpha	N of Items
.770	5

Figure 1. Validity and Reliability Test Results

The questionnaire measures the frequency of consumption of snacks containing preservatives, colourings, flavour enhancers, and sweeteners (4P). Four consumption indicators were assessed using a Likert scale. Average scores were calculated for each respondent and then categorised as:

1. Low consumption
2. High consumption

Univariate analysis was performed to describe the distribution and prevalence of 4P snack consumption behavior by the *Chi-Square* test.

RESULT

This study was conducted among 4th-grade pupils at SDN Karangrejo 06 Jember, with a total of 23 respondents. Univariate analysis was performed to describe the distribution of exposure variables (pocket money and purchase location) as well as the prevalence of 4P snack consumption behaviour as an early behavioural risk factor for non-communicable diseases:

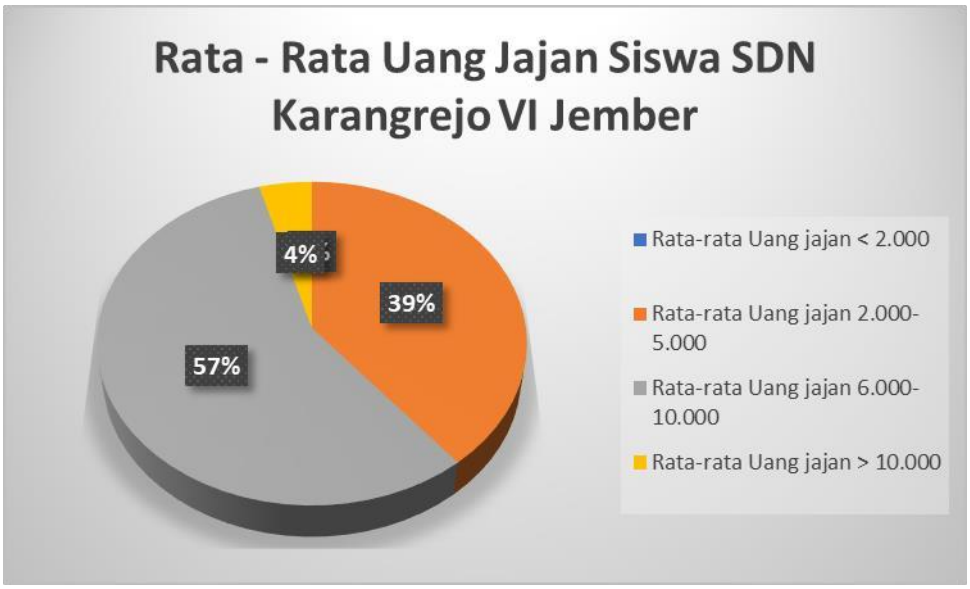

Figure 2. Average Pocket Money of Pupils at SDN Karangrejo 06 Jember

The distribution of pocket money shows that the majority of pupils (57%) receive between Rp6,000 and Rp10,000 per day, whilst 39% receive between Rp2,000 and Rp5,000, and 4% receive more than Rp10,000. No pupils received pocket money of less than Rp2,000. The locations where pupils purchase snacks within the school grounds are shown in the diagram below:

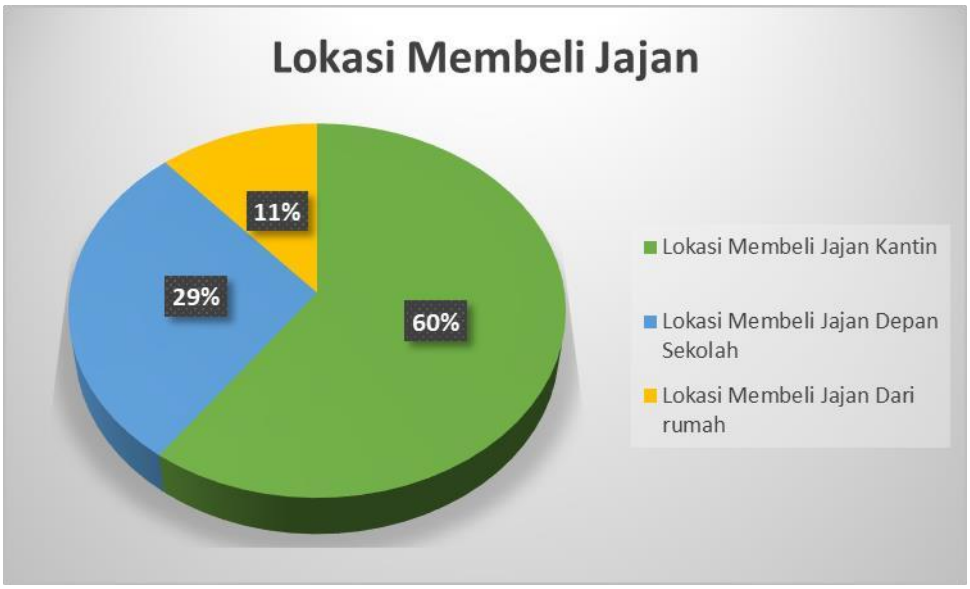

Figure 3. Pie Chart of Where Pupils Buy Snacks

Twenty-one pupils (60%) chose the canteen as the location for buying snacks, 10 pupils (29%) also bought snacks in front of the school (around the school), and only 4 pupils (11%) bought snacks at home or brought them from home. Furthermore, the data on pupils buying 4P snacks is as follows:

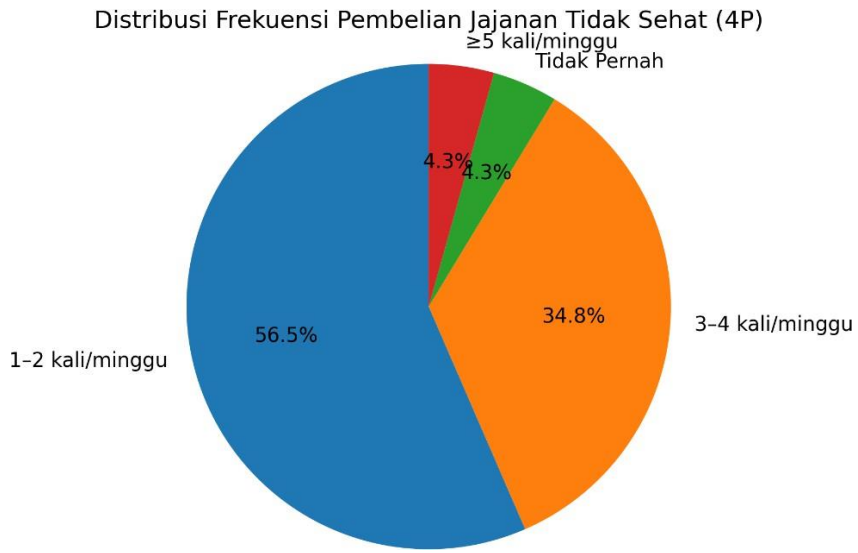

Figure 3. Frequency of students purchasing 4P snacks

The prevalence of 4P snack consumption behaviour indicates that 56.5% of pupils consume 4P snacks 1–2 times per week, 34.8% 3–4 times per week, and 4.3% more than 5 times per week. A total of 4.3% of pupils reported never consuming 4P snacks.

Table 1. Cross-tabulation of Pocket Money and 4P Snack Consumption Behaviour

Pocket Money	**Rarely buy 4P n (%)**	**Frequently buy 4P n (%)**
< Rp2,000	1 (100.0)	0 (0.0)
Rp2,000–5,000	6 (66.7)	3 (33.3)
Rp6,000–10,000	5 (41.7)	7 (58.3)
> Rp10,000	0 (0.0)	1 (100.0)

Based on Table 1, a bivariate analysis was conducted to identify associations between exposure variables and 4P snack consumption behaviour. The cross- tabulation showed that pupils with a pocket money allowance of Rp6,000–Rp10,000 had a higher proportion in the 'frequent 4P snack consumption' category (58.3%) compared to other pocket money categories. However, the results of the *chi-square* test showed that this association was not statistically significant ($\chi^2 = 4.298$; p = 0.231).

Table 2.
Cross-tabulation of Purchase Location with 4P Snack-Buying Behaviour

Place of Purchase	Rarely buy 4P n (%)	Frequent 4P purchases n (%)
Canteen	11 (52.4)	10 (47.6)
In front of the school	1 (100.0)	0 (0.0)
From home	0 (0.0)	1 (100.0)

Table 2, pupils who bought snacks in the canteen showed a relatively balanced distribution between the 'frequent' and 'infrequent' categories of 4P consumption. The *chi-square* test results also showed no significant association between the location of purchase and 4P snack consumption behaviour ($\chi^2 = 2.008$; p= 0.366). From the data above, the statistical test results regarding the influence of pocket money and purchase location on primary school pupils' 4P snack-buying behaviour are as follows:

Table 3.
Chi-Square Test Results

Independent Variables	Statistical Test	χ^2 Value	p-value	Notes
Pocket money	Chi-Square	4.298	0.231	Not significant
Place of purchase	Chi-square	2.008	0.366	Not significant

The results of the *chi-square* test, overall, indicate that although there are variations in the proportion of 4P snack consumption based on pocket money and purchase location, this relationship is not statistically significant in this study.

DISCUSSION

This study aimed to analyse the epidemiological aspects of 4P snack consumption behaviour as an early behavioural risk factor for non-communicable diseases (NCDs) among primary school pupils. The results of the analysis show that the exposure variables of pocket money and purchase location do not have a statistically significant association with 4P snack consumption behaviour. Nevertheless, the distribution patterns and cross-tabulations reveal certain trends that are important to discuss in the context of behavioural risk determinants and school health promotion.

Pocket Money as a Risk Enabling Factor

Cross-tabulation indicates that the proportion of pupils who consume 4P snacks more frequently is relatively higher in the groups with pocket money of Rp6,000– Rp10,000 and >Rp10,000 compared to groups with lower pocket money. However, the results of the chi-square test did not show a statistically significant association. These findings suggest that pocket money may act as *an enabling factor* for access to unhealthy snacks, but is not the sole determinant of consumption behaviour. From a behavioural epidemiology perspective, individual economic factors often interact with environmental and social factors in shaping consumption patterns. Adolescents' food choices are influenced not only by purchasing power, such as pocket money, but also by family socioeconomic conditions, peer influence, school food environments, food accessibility, knowledge, attitudes, and media exposure (Capitán-Moyano et al., 2025; Daly et al., 2022). Recent evidence from Indonesia also showed that snack consumption among school-aged children was associated with knowledge and attitudes toward snack selection, while pocket money alone did not necessarily determine snack consumption behavior (Lestari & Afifah, 2024). This means that even increased purchasing power has the potential to increase exposure to unhealthy snacks; consumption decisions among primary school children remain influenced by parental supervision, social norms, and the availability of food in the school environment.

Differences in results compared to the studies (Salbila et al., 2023) and (Ponimin et al., 2019), which found a significant association between pocket money and snack consumption behaviour, can be explained by differences in respondent characteristics and variations in the distribution of pocket money. In this study, the homogeneity of the respondents and the relatively small sample size likely limited the variation in exposure, meaning that the association was not statistically detected. In the context of early-life NCD risk, these findings suggest that restricting pocket money alone is insufficient to control the consumption of unhealthy snacks. Prevention efforts need to consider a multilevel approach that includes strengthening the school food environment and family education.

Purchase Location and School Food Environment Exposure

Based on the research results, the majority of pupils purchase snacks in the school canteen. However, statistical tests indicate that the location of purchase does not have a significant effect on 4P snacking behaviour. These findings suggest that the presence of the school canteen as the primary location for purchasing snacks does not automatically determine whether pupils' snacking behaviour is healthy or not. These findings also confirm that the physical location of purchase is not a protective factor if the quality of the food available continues to be dominated by snacks high in sugar, fat, and food additives. The concept *of the school food environment* suggests that the impact of the school environment on children's eating patterns is determined more by the quality and type of food available than simply by the place of purchase (França et al., 2022). This is further reinforced by research findings indicating that the majority of food available in school

environments is still dominated by nutritionally poor processed products, meaning that the location of purchase alone is insufficient as a protective factor (Araújo et al., 2025).

Furthermore, the research findings are supported by a national study indicating that school canteens in Indonesia are still dominated by snacks high in sugar, fat, and food additives, with limited oversight regarding food quality and safety (Khaerunisa et al., 2025). Another study reported that more than half of the snacks sold in primary school canteens fall into the category of unhealthy snacks, meaning that pupils remain at risk of consuming 4P snacks even when purchases are made within the school (Hidayati et al., 2019). If school canteens have not yet implemented the principles of a healthy canteen, then purchasing within the school does not automatically reduce the risk of consuming unhealthy snacks. Within the framework of environmental epidemiology, this situation indicates that the risk exposure stems from the quality of the food environment itself, rather than from geographical location alone. Furthermore, children's snacking behaviour is heavily influenced by routines and temporal contexts, particularly during school break times (Kane et al., 2023). In a situation where almost all pupils purchase snacks at the same location, variations in snacking behaviour become limited, making the influence of the purchase location difficult to detect statistically. This may explain why, in this study, the purchase location did not show a significant association with 4P snacking behaviour.

4P Consumption Behaviour as an Early Risk Factor for Non-Communicable Diseases

The prevalence of 4P snack consumption is still observed among the majority of pupils, indicating exposure to the risk of unhealthy eating behaviour from primary school age. From a public health epidemiological perspective, the consumption of foods high in sugar, fat, and energy during childhood has been identified as a behavioural risk factor contributing to an increased risk of obesity and metabolic disorders later in life. A systematic review indicates that the consumption of unhealthy foods and beverages in children is associated with an increase in body mass index (BMI) and the risk of overweight, which are key determinants of non-communicable diseases (Rousham et al., 2022). Furthermore, epidemiological studies in school settings also indicate that the availability and consumption of high-energy, high-sugar, and high-fat snacks are associated with overweight status among schoolchildren (Muhimah & Farapti, 2023).

Eating behaviours formed during childhood tend to persist into adolescence and adulthood (tracking of dietary behaviour), thereby increasing the long-term risk of cardiometabolic diseases (Craigie et al., 2011). Consequently, the prevalence of 4P snack consumption behaviour among primary school pupils remains relevant as an early risk indicator for non-communicable diseases, even though this study found no significant association with specific exposure variables. This risk is multifactorial and influenced by the interaction of economic, social, and school food environment factors, which in social epidemiology are known as the structural and environmental determinants of health behaviour.

Implications for the Prevention of Non-Communicable Diseases

From a primary prevention perspective, the results of this study suggest that interventions cannot be focused solely on individual factors such as limiting pocket money. Within the framework of non-communicable disease (NCD) prevention, behavioural risk factors such as unhealthy dietary patterns are key determinants that need to be addressed through policy and environmental approaches (World Health Organization, 2026). Therefore, modifying the school environment through the strengthening of healthy canteen policies and the regulation of the types of snacks sold is a more relevant strategy than an individual-focused approach alone.

The dominance of snack purchases in school canteens in this study indicates that canteens are a strategic point for intervention. Systematic evidence suggests that school-based environmental interventions, such as healthy canteen policies and restrictions on the sale of unhealthy foods, are more effective and sustainable in improving children's dietary patterns than individual educational approaches alone (França et al., 2022). This approach aligns with the principles *of health-promoting schools*, which position schools as the primary setting for health promotion.

Furthermore, family involvement also plays a crucial role in controlling exposure to the risks of unhealthy eating behaviours. Studies indicate that parental supervision and healthy feeding practices are associated with reduced consumption of high-energy foods among children (Blaine et al., 2017). Consequently, early NCD prevention strategies must integrate interventions at the individual, family, and school environment levels simultaneously. From an epidemiological perspective, the consumption behaviour of 4P snacks among primary school pupils can be understood as a multifactorial determinant of early-life NCD risk. Consequently, environment- and family-based promotive and preventive approaches are key to reducing long-term risk exposure and supporting efforts to improve population health.

CONCLUSION

This research determines that there ii no significant statistical relationship between the amount of pocket money and where purchases are made regarding the snacking habits of primary school students. Nonetheless, the results show that unhealthy snacking habits are widespread, suggesting possible early exposure to behaviors that might lead to non-communicable diseases (NCDs). While pocket money could serve as a means for obtaining unhealthy snacks, children's eating habits are also shaped by broader factors related to their environment and social context, such as parental guidance, the influence of peers, knowledge, attitudes, and the food options available at school.

The prevalence of snack purchases in school canteens indicates that the presence of unhealthy food choices in educational settings continues to play a role in shaping poor dietary habits among children. As a result, efforts to prevent the risk of NCDs in school-aged kids should not simply focus on individual-level strategies like restricting pocket money. Instead, they must encompass comprehensive interventions that address family education, promote healthy school canteen practices, and enhance the overall food environment in schools. It is crucial to bolster both health promotion and prevention tactics by fostering collaboration among educational institutions, families, and health organizations to minimize prolonged exposure to poor dietary behaviors and encourage healthier lifestyle choices from a young age.

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