

**ASSESSMENT OF HEALTHINESS AND THE QUALITY OF MEALS USING
MEAL QUALITY INDEX AT THE PRIMARY SCHOOL CANTEENS OF
KELANTAN**

ASNA SALIHAH BINTI ZULKIFLI

**SCHOOL OF HEALTH SCIENCES
UNIVERSITI SAINS MALAYSIA**

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CERTIFICATE

This to certify that the dissertation entitled Assessment of Healthiness and The Quality of Meals Using Meal Quality Index at The Primary School Canteens of Kelantan is the bona fide record of research work done by Asna Salihah Binti Zulkifli during the period of September 2025 to January 2026 under my supervision. I have read this dissertation and that it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation to be submitted in partial fulfillment for the degree of Bachelor of Health Science (Honours) (Nutrition).

Main supervisor,

.....

Associate Professor Dr. Foo Leng Huat

Lecturer

School of Health Sciences,

Universiti Sains Malaysia

Health Campus

16150 Kubang Kerian

Kelantan, Malaysia.

Date:

DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated and duly acknowledged. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at Universiti Sains Malaysia or other institutions. I grant Universiti Sains Malaysia the right to use the dissertation for teaching, research and promotional purposes.

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Asna Salihah binti Zulkifli

Date:

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LIST OF ABBREVIATIONS

MQI	Meal Quality Index
MDG	Malaysian Dietary Guidelines

Penilaian Kesihatan dan Kualiti Hidangan Menggunakan Indeks Kualiti Hidangan di Kantin Sekolah Rendah Negeri Kelantan

ABSTRAK

Pemakanan sihat dalam kalangan murid sekolah rendah merupakan faktor penting yang mempengaruhi kesihatan, perkembangan fizikal, dan pencapaian akademik. Namun, kualiti makanan yang disediakan di kantin sekolah sering menjadi isu kerana tidak menepati garis panduan pemakanan sihat. Kajian ini dijalankan untuk menilai tahap kesihatan dan kualiti hidangan kantin sekolah rendah di Kelantan menggunakan Meal Quality Index (MQI). Objektif utama kajian adalah untuk menilai kualiti nutrisi menu kantin serta membandingkan skor MQI antara sekolah kawasan bandar dan luar bandar. Reka bentuk kajian ini berbentuk kuantitatif dengan kaedah pensampelan rawak melibatkan sejumlah sekolah rendah di Kelantan. Data menu kantin dikumpul dan dianalisis menggunakan MQI, yang menilai komponen utama seperti buah-buahan, sayur-sayuran, protein, bijirin penuh, lemak, gula tambahan, dan natrium. Dapatan kajian menunjukkan bahawa skor MQI keseluruhan berada pada tahap sederhana, dengan kekurangan ketara pada komponen buah-buahan, sayur-sayuran. Menu di sekolah bandar didapati mempunyai skor MQI yang lebih tinggi berbanding sekolah luar bandar, walaupun perbezaan tidak signifikan pada semua komponen. Kesimpulannya, kajian ini menekankan keperluan intervensi pemakanan di kantin sekolah rendah, khususnya dalam meningkatkan penyediaan buah-buahan, sayur-sayuran, dan pilihan bijirin penuh. Hasil kajian ini diharap dapat menjadi rujukan kepada pihak sekolah, pengusaha kantin, dan pembuat dasar dalam usaha memperbaiki kualiti pemakanan murid di Kelantan.

ABSTRACT

Healthy eating among primary school children is a crucial factor influencing their health, physical development, and academic performance. However, the quality of food provided in school canteens often raises concerns as it does not always comply with healthy dietary guidelines. This study was conducted to assess the healthiness and nutritional quality of meals served in primary school canteens in Kelantan using the Meal Quality Index (MQI). The main objectives were to evaluate the nutritional quality of canteen menus and to compare MQI scores between schools located in urban and rural areas. This quantitative study employed random sampling involving several primary schools across Kelantan. Canteen menus were collected and analyzed using the MQI, which evaluates key components such as fruits, vegetables, protein, whole grains, fat, added sugar, and sodium. The findings revealed that the overall MQI scores were at a moderate level, with notable deficiencies in fruits and vegetables. Urban schools recorded higher MQI scores compared to rural schools, although not all components showed significant differences. In conclusion, this study highlights the need for nutritional interventions in primary school canteens, particularly in increasing the provision of fruits, vegetables, and whole grain options. The results are expected to serve as a reference for schools, canteen operators, and policymakers in improving the dietary quality of meals provided to schoolchildren in Kelantan.

CHAPTER 1

INTRODUCTION

1.0 Nutritional and health well-being of school aged children

An adequate and optimal nutrition is defined as an adequate intake and well-balanced diet that can support the body's needs and growth in growing populations. Such as in children and adolescents. It is regarded as an important foundation to achieve good nutritional and health well-being in their current growing years and also later in life, whereby improper and less healthy dietary intakes on growing years can increase the risk of excessive weight gain, obesity and noncommunicable diseases such as hypertension, diabetes, cardiovascular diseases and some cancers (Haines et al., 2019). Hence, a good quality and balanced dietary intakes in a day is an important determinant to achieve and ensure healthy physical growth development in growing children and adolescents during their academic years (Haapala et al., 2016). In addition, establishing persistent healthy eating and active lifestyle practices is not only important in their present years, but also it provides long-term good health and well-being in later adulthood (Marzieh Abdoli et al., 2023). Therefore, targeting vulnerable populations such as populations of school-aged years is a pivotal stage in life where significant rapid physical growth and maturation of all organs and physiological systems occur (Norris et al., 2022).

1.1 Overview of School-aged Children

According to the World Health Organization, WHO, children are individuals aged from 0-9 years old while adolescents are aged from 10-19 years old (World, 2019). However in Malaysia, primary school aged children are normally ranged from 7 to 12 years old (KPM | Pendidikan Rendah, 2024). Thus for the purpose of this study, school aged children refers to primary school children in Malaysia aged 7 to 12 years. This is the phase where growth and development occur, such as height and linear bone growth, bone mineralization, and brain and cognition (Saavedra & Prentice, 2022). During the school hours, the children rely mostly on the meals and snacks at the school canteen, making the school environment important in determining dietary practice.

1.2 Nutritional Issues of School-aged Children

The prevalence of childhood obesity has been increasing rapidly globally, including in Malaysia (Phelps et al., 2024). It is generally agreed that obesity is a complex chronic disease that can increase risk of type 2 diabetes, heart disease and some types of cancers, in which excessive weight gain in growing children may lead to development of metabolic disorders and other obesity related conditions early in life (World, 2025). Based on the current recent report, obesity prevalence in children and adolescents increased from 1990 to 2022, in 186 countries (93%) among girls and in 195 countries (98%) in boys (Phelps et al., 2024).

1.3 Nutritional Needs of School-aged Children

During childhood, primarily during primary school years, children are in a vital phase where growth and development occur. During this stage, adequate nutrition is not only crucial for growth but also contributes to their pattern and timing of puberty, adult height, muscle and fat mass and most importantly link to risk of non-communicable diseases later in life (Norris et al., 2021). The increasing prevalence of obesity among children and adolescents show that poor dietary habits during this stage of life can have significant impacts. Therefore, ensuring school-aged children receive balanced and sufficient nutrition should be a priority by public health authorities.

As a place where these children spend quite many hours of their day and consume at least one main meal there, school can be a powerful setting and environment to cultivate healthy eating behaviour (Jourdan et al., 2021). In this context, school canteens can play an important role by determining what types of foods are accessible to the students.

Apart from parents and peers, school canteens also play a significant role in shaping the dietary habits of children, particularly in settings where students rely on purchased meals during the school hours (Haines et al., 2019). Therefore, it is important for schools to offer well-balanced and quality meals to support the students' dietary needs as well as building dietary habits that can foster them to have a healthy development throughout life.

1.4 Problem Statement

The increasing prevalence of childhood overweight and obesity in Malaysia, including in the state of Kelantan, showed a growing public health concern (Chua et al., 2025). Dietary pattern of the school-aged children is one of the contributing factors in which most of them consume at least one meal at the school canteen per day. Thus, the meals served at school canteen play an important role in influencing children's dietary pattern and nutritional intake. Despite having the guidelines of healthy eating in schools, a comparative of foods sold in school canteens of primary and secondary schools had found that high fats and sugar foods were considered as the most common foods sold at the school canteens, whereas fruits and vegetables and legume-based food products were the least common sold in school (Foo & Tan, 2021). A study of nutritional status of school-aged children found that along with increase of overweight and obesity prevalence, double burden malnutrition such as micronutrient deficiencies are among the problems that rise among children and adolescents (Wrottesley et al., 2022). Apart from that, this study also revealed an increasing trend of consumption of highly processed energy-dense foods and nutrient poor foods (Wrottesley et al., 2022). In a recent study in Poland, about 40% of obese children's diet were contributed from consumption of highly processed and high-fats products, low intake of fruits and vegetables, as well as low quality diet (Kozioł-Kozakowska et al., 2020).

1.5 Significance of the Study

School age is a formative phase where rapid physical and cognitive development occur (Norris et al., 2021). These vulnerable populations need to be more focused on to support optimal growth, strengthen immune functions and increase academic performance. A study showed that mental damage that impairs students' capability and performance in school is one of the consequences of malnutrition (Om Raj Katoch, 2021). In this case, the school canteens play a major role in ensuring accessibility of quality and balanced meals to the student. Thus, the use of the Meal Quality Index, MQI in this study can be used to assess the quality of the meals and may contribute to the improvement of school food environments.

Moreover, affordability is an important but under-researched factor. Food prices can influence the meal choices of the students, especially those from low socioeconomic backgrounds, driving them to cheaper and possibly less nutritious and low quality options. To ensure effective interventions by policymakers and health authorities, a clear understanding of how pricing and nutritional quality correlate need to be achieved.

In addition, socioeconomic and environmental differences between rural and urban areas may influence the types of foods available at the school canteens thus indirectly leading to differences in students' dietary exposure and health. By including schools from both urban and rural areas, this study aims to locate any differences of nutritional quality and pricing of foods between different geographical areas.

1.6 Research Questions

1.6.1 What is the nutritional quality of meals served at the school canteen based on Malaysia Dietary Guidelines and Meal Quality Index?

1.6.2 What is the healthiness of the meals served at the school canteen based on their quality using the Meal Quality Index?

1.6.3 What are the differences in nutritional quality of school canteen meals in urban and rural areas?

1.6.4 What are the differences in the overall quality score of school canteen meals in rural and urban schools?

1.6.5 What is the relationship between the quality and pricing of the meals in primary schools of Kelantan?

1.7 Research objectives

1.7.1 General objectives

To assess the healthiness, quality and pricing of school canteen menus in primary schools in Kelantan.

1.7.2 Specific objectives

1. To assess the nutritional quality of school canteen menus based on Malaysia Dietary Guidelines and Meal Quality Index.

2. To identify the healthiness of the school canteen meals based on the quality using Meal Quality Index.
3. To assess the differences of nutritional quality of school canteen meals in urban and rural schools.
4. To assess the differences of overall meal quality score of school canteen meals in rural and urban schools.
5. To compare the meals' quality with pricing in primary schools in Kelantan.

1.8 Research Hypotheses

1.8.1 Null Hypotheses (H_0): There are no significant differences in nutritional quality of school canteen meals in urban and rural schools.

1.8.2 Alternative Hypotheses There is a significant difference in the nutritional quality of school canteen meals in urban and rural schools.

CHAPTER 2

LITERATURE REVIEW

2.1 Nutritional Concerns in School-Age Children

Childhood is a vital period for growth, cognitive development, and the establishment of lifelong dietary behaviours. The World Health Organization (WHO) highlights that children require balanced intake of macro- and micronutrients to support growth and prevent both undernutrition and diet-related non-communicable diseases (NCDs) such as obesity, diabetes, and cardiovascular disease later in life (WHO, 2023). Globally, poor dietary patterns among school-aged children are characterized by excessive consumption of energy-dense, nutrient-poor foods and insufficient intake of fruits, vegetables, and whole grains (Norris et al., 2021). In Southeast Asia, including Malaysia, similar trends have been reported, where high availability of unhealthy snacks contributes to nutritional imbalance in children (Musa et al., 2022).

The Malaysian Dietary Guidelines (MDG) advocate for balanced meals consisting of varied food groups and nutrient adequacy for children aged 7–12 years (Ministry of Health Malaysia, 2020). However, implementation gaps persist, whereby actual food consumption among primary school students often diverges from dietary recommendations. A study by Chin et al. (2022) showed that many Malaysian primary school children fail to meet recommended daily servings of fruits and vegetables, while frequently consuming deep-fried and sugar-sweetened products, which undermines dietary quality.

2.2 School Canteen Food Environment

The school food environment plays a central role in shaping dietary behaviour, as children often consume at least one substantial meal (breakfast or lunch) within the school setting. School canteens serve as primary sources of food during school hours and influence both food accessibility and choice. According to Watson et al. (2023), food availability, peer influence, and cost are significant factors affecting children's selection of meals. In Malaysia, previous research indicates that canteens are frequently stocked with high-energy snacks, sugary beverages, and limited healthy options. For example, Khor et al. (2021) found that unhealthy items appeared abundantly in urban and rural school canteens, reducing opportunities for children to make healthier choices.

Recognizing this, many countries have implemented nutrient standards for school meals, yet compliance remains inconsistent. Al-Jehani et al. (2024) emphasize the importance of monitoring and evaluating school canteen offerings to ensure alignment with national nutrition policies. In Kelantan, variations in food availability between rural and urban school canteens suggest that regional differences may further complicate efforts to improve dietary quality among students.

2.3 Meal Quality Index (MQI) as an Assessment Tool

A robust approach to evaluating the healthiness of meals involves using standardized indices that assess both nutrient composition and alignment with dietary guidelines. The Meal Quality Index (MQI) is one such tool that provides a comprehensive assessment of meal quality by integrating multiple nutritional components, such as macro- and micronutrient balance, food group diversity, and food preparation methods (Bates et al., 2023). Unlike single-nutrient evaluations, MQI offers a holistic view of food quality and enables comparison across meal types and food environments. Recent studies demonstrate the utility of MQI in evaluating school meals and its association with healthier dietary patterns. For instance, Garcia et al. (2024) reported that meals with higher MQI scores were linked to improved nutrient adequacy in school children. Additionally, integrating meal costs with MQI assessments allows researchers to explore the relationship between food affordability and food quality, a key consideration in low-income settings (Smith & Johnson, 2022). Such insights are particularly important for primary school canteens where economic constraints may influence both food choices and meal quality.

2.4 Conceptual Framework for Assessing Meal Quality in School Canteens

A conceptual framework is essential to explain the relationships between key variables examined in this study and to provide a clear structure for understanding how meal quality influences children's dietary health. In the context of school nutrition, the quality of meals consumed by children is shaped by multiple interconnected factors, including food availability, nutritional composition, affordability, and the surrounding food environment. This framework is guided by

existing nutrition and public health theories that emphasise the role of environmental exposure in shaping dietary behaviour among children (Story et al., 2021).

In this study, school canteen food offerings serve as the primary independent component of the framework. The school canteen represents a controlled food environment where children make daily food choices, often with limited alternatives. Previous studies have demonstrated that children's dietary intake is strongly influenced by the types of foods sold in school settings, particularly when meals are purchased rather than brought from home (Watson et al., 2023). Therefore, evaluating canteen meals provides an accurate reflection of students' habitual dietary exposure during school hours.

The Meal Quality Index (MQI) functions as the central analytical tool within the framework. MQI enables systematic evaluation of meals based on nutrient adequacy, food group balance, and alignment with dietary guidelines. By applying MQI scoring, meals can be categorised as high or low quality, offering an objective measure of overall healthiness rather than relying on single nutrient indicators (Garcia et al., 2024). This approach allows for meaningful comparison between meals across different schools and settings.

Meal pricing and affordability are incorporated as moderating variables within the framework. Food cost has been identified as a major determinant of food choice, particularly among children from lower socioeconomic backgrounds. Studies show that cheaper foods are often energy-dense and nutrient-poor, while healthier options tend to be relatively more expensive (Smith & Johnson, 2022). By analysing the relationship between MQI scores and meal prices, this study

aims to determine whether affordability compromises nutritional quality in primary school canteens.

Additionally, school location (urban versus rural) is included as a contextual variable.

Geographic differences may influence food availability, supplier access, and pricing structures, potentially leading to disparities in meal quality. Research in developing and middle-income countries indicates that rural schools may face greater limitations in accessing diverse and nutritious food options compared to urban schools (Al-Jehani et al., 2024).

Overall, this conceptual framework proposes that the interaction between school canteen food offerings, meal quality as measured by MQI, pricing, and school location collectively determines the healthiness of meals consumed by primary school children. The framework provides a structured basis for data collection and analysis, supporting evidence-based recommendations aimed at improving school food environments and promoting healthier dietary practices among children in Kelantan.

2.5 Research Gaps and Summary of Literature

Although extensive research has been conducted on childhood nutrition and school food environments, several critical gaps remain, particularly in relation to the assessment of meal quality in Malaysian primary school canteens. Existing literature has largely focused on general dietary intake patterns, prevalence of overweight and obesity, and compliance with dietary guidelines among school-aged children. However, fewer studies have systematically evaluated

the overall quality and healthiness of meals sold in school canteens using a standardized and comprehensive assessment tool, such as the Meal Quality Index (MQI).

Many previous studies assessing school meals relied on single nutrient indicators, food frequency questionnaires, or observational assessments of food availability. While these approaches provide useful insights, they often fail to capture the multidimensional nature of diet quality, including food group balance, nutrient adequacy, and alignment with national dietary guidelines (Bates et al., 2023). As a result, there is limited evidence on the holistic nutritional quality of meals consumed by children during school hours, particularly in the Malaysian context.

Another notable gap lies in the integration of meal pricing and affordability with nutritional quality assessment. Although food cost has been recognised as a key determinant of food choice, especially among children from lower socioeconomic backgrounds, few studies have examined whether cheaper meals offered in school canteens are nutritionally inferior. Research has shown that lower-priced foods are often energy-dense and nutrient-poor, yet empirical evidence linking meal price to meal quality within school canteen settings remains scarce (Smith & Johnson, 2022). This gap is particularly relevant in public primary schools, where students commonly rely on limited daily allowances to purchase meals.

Furthermore, limited research has explored geographical differences in school meal quality, especially comparisons between rural and urban schools. Differences in food supply chains, vendor practices, and access to fresh ingredients may result in disparities in meal quality across regions. Studies conducted in middle-income countries suggest that rural schools may face

greater challenges in offering diverse and nutritious food options compared to urban schools; however, local evidence from Malaysia, particularly in Kelantan, remains insufficient (AlJehani et al., 2024). In addition, most Malaysian studies have focused on secondary school populations or urban settings, leaving primary school children and rural areas underrepresented. Considering that dietary habits are established early in life, assessing meal quality among primary school children is essential for early intervention and long-term health promotion.

In summary, the existing literature highlights the importance of healthy school food environments but reveals significant gaps in the comprehensive evaluation of meal quality, the relationship between pricing and nutritional value, and urban–rural differences in school canteen meals. Addressing these gaps through the application of the Meal Quality Index in primary school canteens in Kelantan will contribute valuable evidence to inform school nutrition policies, improve canteen practices, and support healthier dietary behaviours among school-aged children.

2.6 Summary of Literature Review

This chapter has reviewed relevant literature related to the nutritional quality and healthiness of meals consumed by school-aged children, with a specific focus on school canteen food environments and the application of the Meal Quality Index (MQI). The literature consistently demonstrates that childhood is a critical period for growth and development, during which adequate and balanced nutrition plays a fundamental role in supporting physical health, cognitive performance, and long-term disease prevention. Poor dietary quality during this stage has been linked to increased risks of overweight, obesity, micronutrient deficiencies, and noncommunicable diseases later in life.

The review highlights that, despite the existence of national and international dietary guidelines such as the Malaysian Dietary Guidelines and World Health Organization recommendations, many school-aged children do not meet recommended dietary standards. This shortfall is largely attributed to unhealthy food environments, particularly within school canteens, where energy-dense and nutrient-poor foods are frequently more accessible than healthier alternatives. Studies reviewed indicate that food availability, taste preferences, peer influence, and cost significantly shape children's food choices during school hours.

Furthermore, the literature underscores the important role of school canteens as a key setting for dietary intervention. Since children often consume at least one main meal at school, the nutritional quality of canteen meals has a direct impact on their overall dietary intake. However, existing research suggests that compliance with healthy canteen guidelines remains inconsistent, and regular monitoring of meal quality is limited, particularly in primary schools.

The Meal Quality Index (MQI) emerges from the literature as a comprehensive and appropriate tool for assessing overall meal quality. Unlike single-nutrient or food frequency approaches, MQI evaluates meals holistically by considering nutrient adequacy, food group balance, and alignment with dietary recommendations. The application of MQI allows for objective comparison of meal quality across different settings and supports evidence-based evaluation of the healthiness of school meals.

In addition, this chapter identifies food pricing and affordability as crucial yet underexplored factors influencing meal choices and nutritional quality. The literature suggests that lower-priced foods are often associated with poorer nutritional value, which may disproportionately affect children from lower socioeconomic backgrounds. Moreover, geographical differences between urban and rural schools may further contribute to disparities in meal quality due to variations in food access, supply chains, and vendor practices.

Overall, the literature review reveals significant gaps in the comprehensive assessment of meal quality in Malaysian primary school canteens, particularly studies that integrate MQI, meal pricing, and urban–rural comparisons. These gaps justify the need for the present study, which aims to assess the healthiness and quality of meals using the Meal Quality Index in primary school canteens in Kelantan. By addressing these gaps, the study seeks to contribute valuable evidence to support improvements in school food environments, inform nutrition policies, and promote healthier eating behaviours among school-aged children.

CHAPTER THREE

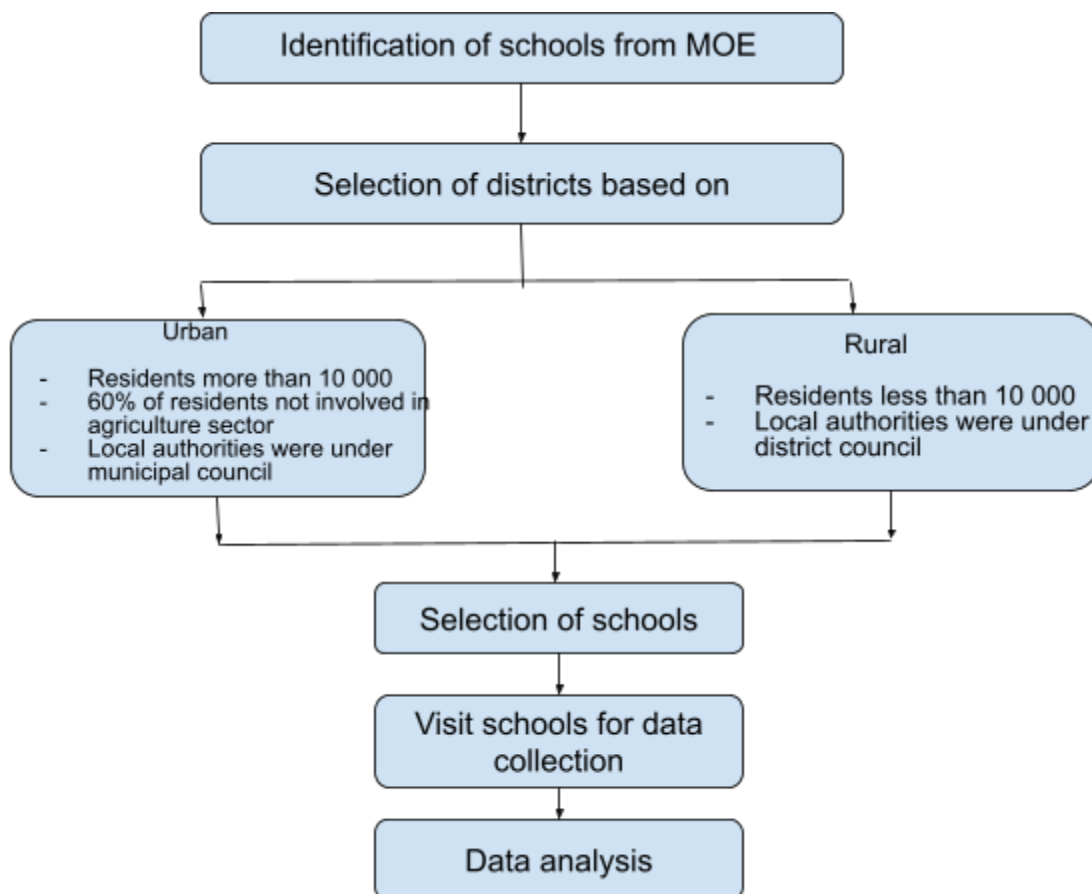
METHODOLOGY

3.1 Research Design

The study research design was a cross-sectional study aimed to assess the healthiness and quality of the meals served in the school canteen of public primary schools in Kelantan, in which prepared cooked foods served at the canteen and pre-packaged foods offered in the school canteens were collected. A list of primary schools in Kelantan was obtained from the State Department of Education, Ministry of Education, Malaysia, where 607 schools including primary and secondary schools were identified. Only schools that met the inclusion criteria of being under the Malaysia government and non-religious were valid to be included in the study. Out of those 607, a total of 402 Sekolah Kebangsaan under 10 districts of Kelantan were eligible to be included in the study. Those 10 districts were further classified into two strata which are urban and rural, followed by simple random sampling to select one district from each strata that resulted in two districts included in the first stage. Districts classification into urban and rural categories were based on the demographic and administrative criteria. Districts were classified into urban when the residents were more than 10 000, and the local authorities were administered under municipal council. On the other hand, districts were classified as rural if they had less than 10 000 residents and were administered under district council.

On the second stage, simple random sampling is used once again to select three schools from each district selected in the first stage earlier. This resulted in a total of 6 schools involved in the study. The two-stage sampling method was applied to ensure well representation of schools from both rural and urban areas in Kelantan.

Figure 3.1



3.2 Study Area

This study was conducted in two selected districts in the state of Kelantan, which are Kota Bharu, from the urban cluster and Bachok from the rural cluster. A total of six primary schools were selected to be included in the study, out of 402 Sekolah Kebangsaan primary schools under 10 District Education Office (Pejabat Pendidikan Daerah, PPD) in the state of Kelantan. Kota Bharu with higher population density with more extensive development and administrated under the Kota Bharu Municipal Council represents the urban area in Kelantan. This district served the communities with wider food choices and availability and greater access to facilities. In contrast, administered under the District Council with lower population density, Bachok represents the rural areas. The six primary schools included in this study reflect the general characteristics of their respective urban and rural settings and provide an appropriate representation of the food environment in school settings in Kelantan.

3.3 Study Criteria

3.3.1 Inclusion Criteria

1. Government primary schools that have an operational canteen during the data collection period.
2. Government primary schools that are located within the two selected districts from rural and urban areas.

3.3.2 Exclusion Criteria

1. Primary schools administered under the state government.

3.4 Sample Size Estimation

This study did not require formal sample size estimation because it did not involve any participants. Sample size was determined by the number of food menus available at each school canteen.

3.5 Sampling Method and Subject Recruitment

A two-stage cluster sampling method was used in this study to ensure that the selected schools represent both rural and urban settings in Kelantan. In the first stage, all the 10 districts were classified into two groups, urban and rural based on their population size and administrative status. One district was then randomly selected from each group (rural or urban) using simple random sampling. In the second stage, a complete list of schools in each selected district was obtained. From each district, three schools that met the inclusion criteria were randomly selected using simple random sampling that resulted in a total of six schools being included in the study. Once all eligible schools were identified and confirmed, a letter of invitation, including study information sheet like procedures and purposes of the study were given to the school principals.

3.6 Data Collection Method

The process of data collection method begins once the permission was granted by the school principal of each selected school. The data collection method is done from September 2025 until October 2025, during school days where foods are available for students to purchase. Data collection is done by observing and documenting the foods and meals served at the canteen across a number of days in order to minimise the effect of intra-day food differences. All food items sold in the school canteens on the day of data collection were recorded and listed. On top of that, all meals that were served in a plate, or a bowl, or a tray, or even in plastic packaging were photographed to capture the portion size more detailed. For meals that were assembled only when a student ordered them, it was taken and documented once the foods were portioned onto the plate and ready to be served. For pre-packaged foods, the nutritional information at the packaging was also collected. To ensure more accurate analysis, a brief interview was conducted with the canteen operators to gather information regarding ingredients used, preparation method and portioning practices.

Each item was classified as cooked meals and pre-packaged meals. All food items were observed and photographed. The cooked meals were then further categorised into several groups such as rice-based cooked dish, noodles-based cooked dish, chicken-based food, fish-based foods, sweet pastries, and snacks.

The price for each food item was recorded as listed by the canteen in the menu list.

Cross-checking was also done by asking the canteen operator regarding the price of every food item sold, as well as for the price of some foods that were not shown on the menu.

3.10 Data Analysis

Each meal was scored based on Meal Quality Index (MQI) that consists of 10 components, with 10 is the maximum score and 0 is the minimum score for each component. The ten components of the MQI are, vegetables, fruits, whole grain, protein including meat, egg and legumes, dairy, saturated fat, added sugar, sodium, energy and lastly macronutrients balance. All the foods collected were evaluated based on these 10 components that yielded a maximum score of 100.

The higher the score indicates better meal quality and lower score indicates poorer quality. This MQI used in this study was adapted from the Main Meal Quality Index, MMQI, a tool designed to assess nutritional quality and balance of a meal (Bullock et al., 2021). However, the MQI was further modified based on Malaysia Food Pyramid and Malaysian Dietary Guidelines for Children and Adolescents (2013) to make it more applicable to be used in the area of this study.

Scoring methods of the vegetables components are 10 score if the meal contains at least one or more than a serving of any kind of vegetables, 5 score for half serving and 2 or 3 score if the meal has a few slices or presence of vegetables, and lastly 0 score when the meal has no vegetables. This scoring goes the same with the fruit component. The meal scored 10 when it consisted of mainly whole grains, 5 scores when mixed with refined grain and 0 when it contained no whole grains. For dairy, 10 score for half serving of any dairy products contained in the meal, 5 score for quarter serving and 0 score when meal contains no dairy.

Saturated fat component is evaluated by its percentage, which is 10 score when its saturated fat is less than 10% of its total caloric contents. If it exceeds 10%, it is considered high, thus getting a 0 score. For added sugar, 0 score will be given if the food has more than 10 gram of added sugar per 100 gram of food, 5 score for less than and 5 gram of added sugar, and 10 score if no sugar were added. Sodium components generally get a 10 score if the meal contained less than 400 milligrams of sodium and 0 score when it contained more than 800 milligrams of sodium. The last component which is macronutrient balance is scored based on the balance of total carbohydrate, protein and fat percentage. When all of these three macronutrients are balanced, 10 scores will be given. If one of the macronutrients is out of range, 5 score will be given and 0 score for when two macronutrients are out of range, indicating that the meal is imbalanced. All the macronutrients and micronutrients of each meal were obtained from Nutritionist Pro analysis by entering the recipes and ingredients in detail.

The data gathered were entered and analysed using the SPSS statistical software program (SPSS version 30). Descriptive statistics was used to summarise the characteristics of the food items assessed, including nutritional content, pricing, and meal quality scores. Analysis of data for nutritional content of each food was conducted using Nutritionist Pro software. All ingredients of each meal were assessed by the software and yielded the total nutrients content in each meal including macronutrients and micronutrients.

CHAPTER 4

RESULTS

4.1 Descriptive Analysis

Table 4.1 below shows the total food items from rural schools and urban schools. The number of samples collected from urban schools was 79, while for rural schools was 43, showing higher availability and choices in urban schools compared to rural schools. The maximum score of Meal Quality Index (MQI) from both areas is 52, while the minimum score of the MQI are 10 and 5 for rural and urban, respectively. This result shows that there are slight differences in quality score with rural areas having a mean score of 32.12 while urban having 33.85.

Area	N	Mean MQI	Std.Deviation	Minimum	Maximum
Rural	43	32.12	1.440	10	52
Urban	79	33.85	1.096	5	52

Table 4.1

4.2 Differences of Urban and Rural Meal Quality

Table below showing the urban areas having higher median score (35) compared to rural areas with median score 33. The interquartile range of urban (29–40) is shifted upward compared to Rural (25–37), suggesting slightly better quality. However, the difference is not statistically significant since the p-value is greater than 0.05 (0.227). Thus, even when the meals in urban areas are showing healthier trends, the evidence is not strong enough to conclude a real difference.

	Rural Median (IQR)	Urban Median (IQR)	p-value
MQI	33 (25-37)	35 (29-40)	0.227

Table 4.2

4.3 Meal Quality Category

Table 4.3 presents the distribution of meal quality categories between rural and urban populations. The findings show a larger proportion of less healthy meals were from urban areas (63.8%) compared to rural areas (36.2%). Similarly, in the moderately healthy category, urban participants again formed the majority (65.3%), while rural participants accounted for 34.7%. Overall, the total distribution reflects that meals collected in urban areas made up nearly two-thirds (64.8%) of the sample, whereas rural comprised just over one-third (35.2%). These results suggest that although urban residents are more represented in both categories, the