Mal J Nutr 32 (Supplement): 051-062, 2026

Transforming University Nutrition Environments (TUNE): Initial findings on nutritional quality and vendors' perspectives of foods sold at Universiti Malaya's residential campus cafeterias

Ai Kah Ng[1,2*], Juan Carlos Algaba[3], Ruban Rao[3], Heng Yaw Yong[4,5], Wai Yew Yang[6], Thangiah Nithiah[1,2], Bala Murali Sundram[1,2,7] & N Hairi Noran[1,7]

[1]*Centre for Population Health (CePH), Department of Social and Preventive Medicine, Faculty of Medicine, Universiti Malaya, Kuala Lumpur, 50603, Malaysia;* [2]*Green@ UMHealth, Faculty of Medicine, Universiti Malaya, Kuala Lumpur, 50603, Malaysia;* [3]*Department of Physics, Faculty of Science, Universiti Malaya, Kuala Lumpur, 50603, Malaysia;* [4]*Division of Nutrition, Dietetics, and Food Science, IMU University, Kuala Lumpur, 57000, Malaysia;* [5]*Centre for Transformative Nutrition & Health, IMU University, Kuala Lumpur, 57000, Malaysia;* [6]*Department of Dietetics, Faculty of Medicine & Health Sciences, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia;* [7]*Centre for Epidemiology and Evidence-Based Practice, Faculty of Medicine, Universiti Malaya, Kuala Lumpur, 50603, Malaysia*

ABSTRACT

Introduction: Cafeteria environments within universities have a significant influence over sustainable and healthy dietary behaviours. Hence, this study aimed to understand the nutritional landscape of food options in university cafeterias and to identify the factors contributing to unhealthy food options from the perspective of food service vendors. **Methods:** Using a mixed-methods approach, 122 food options from all 12 residential campus cafeterias in Universiti Malaya (UM) were collected between October and December 2024. All food options were grouped into (i) bread, (ii) meat dishes, (iii) drinks, (iv) Western dishes, and (v) rice- or noodle-based fried food group; they were further analysed for calories, fat, saturated fat, dietary fibre, and salt using the Malaysian Food Composition Database (MyFCD) and the Singapore Food Composition Database (SFCD). Nutrient classification (high vs. low) was based on the criteria outlined in the Labelling Guidelines 2023. Additionally, food service vendors were interviewed to explore operational challenges, with data collection ceasing upon reaching thematic saturation. The interviews were then transcribed and analysed using thematic analysis. **Results:** Quantitative findings showed that there were 36 bread-based meals, 16 meat-based dishes, 18 beverages, 30 Western-style meals, and 22 rice- or noodle-based fried foods. The study also revealed an over-reliance on high-calorie, high-fat, and low-fibre foods, with limited availability of sustainable and nutritious options. Qualitative findings highlighted the influence of affordability, vendor practices, and student preferences on campus food choices. **Conclusion:** The study underscored the need for internal policy intervention, improved vendor education and sustainability practices, and increased accessibility to healthier meals on campus.

Keywords: eating environment, food choices, healthy, sustainability, university cafeteria

*Corresponding author: Dr Ng Ai Kah
Senior Lecturer, Department of Social and Preventive Medicine, Faculty of Medicine, Universiti Malaya
50603 Kuala Lumpur, Malaysia
Tel: +603-7967 4757| Faks: +603-79674975; E-mail: ngaikah@um.edu.my
doi: https://doi.org/10.31246/mjn-2025-0036

INTRODUCTION

Poor dietary choices contribute to non-communicable diseases (NCDs), including obesity and diabetes, which are rising among young adults (WHO, 2020). Therefore, food environments play a crucial role in shaping dietary behaviours, particularly in universities (Evans *et al.*, 2015; Lee *et al.*, 2021). Beyond their academic functions, universities operate as living communities, especially for young adults, that can shape lifestyle choices, including sustainable and healthy eating habits (Burrows, 2017). This makes assessing and improving nutritional offerings important for improving dietary habits and reducing the prevalence of obesity among university communities (students and staff) (Aguirre Sánchez *et al.*, 2021; Anderson *et al.*, 2021).

Malaysia faces significant dietary challenges, marked by high consumption of meat, fats, calories, salt, and sugar across all age groups (Balasubramaniam *et al.*, 2020; Ng *et al.*, 2020). These dietary patterns contribute to rising obesity rates and increasing prevalence of NCDs, such as diabetes and heart disease (IPH, 2020). A dependence on processed and fast foods, with traditional culinary practices that emphasise flavourful dishes, further exacerbates unhealthy eating habits. These dietary choices not only harm individual health (Mozaffarian, 2016) but also place a burden on the healthcare system and hinder national development (Okunogbe *et al.*, 2022).

Studies indicate that cafeteria menus often emphasise cost-effective, energy-dense foods over nutrient-rich options (Hilger, Loerbroks & Diehl, 2017; Sulaiman, Jusoh & Razak, 2013). Furthermore, the dominance of fried and processed meals highlights an urgent need for intervention in university food environments (Azhar, Vanoh & Ganggaya, 2023). In Malaysia, food insecurity among students exacerbates the reliance on cheap, high-calorie foods, impacting overall well-being and academic performance (Ramlee *et al.*, 2019). Existing cafeteria food options remain largely unregulated, with limited availability of balanced, nutritious foods. This gap highlights the need for a systematic assessment to guide evidence-based improvements.

Universities often struggle to provide nutritious menu options due to financial realities faced by food service companies. Research shows that while universities offer some healthy food choices, these options tend to be more expensive than less nutritious alternatives, potentially leading students to opt for cheaper, unhealthier meals. Economic factors can significantly shape the implementation of nutrition programmes (Tunde *et al.*, 2023). The key barriers preventing food service providers from consistently offering healthy and sustainable meals include high costs, supply limitations, and logistical challenges (Salhadi *et al.*, 2018).

This study aimed to evaluate the nutritional composition of foods served at Universiti Malaya (UM)'s residential campus cafeterias and to explore the perspectives of food service vendors on the challenges and opportunities of providing healthy and sustainable menu options. It is hypothesised that the current cafeteria food environment is dominated by energy-dense, nutrient-poor options, largely shaped by cost and operational constraints. Findings from this preliminary study are expected to provide baseline evidence for future initiatives under the Transforming University Nutrition Environments (TUNE) Project, a collaborative effort between UM, IMU University (IMU), and Universiti Putra Malaysia (UPM).

METHODOLOGY

This study was part of the TUNE project, a collaborative initiative between UM, IMU and UPM in Malaysia. The project aimed to conduct a comprehensive situational analysis and to develop evidence-based food choice architectures within university cafeteria settings. The TUNE project comprises three phases. Phase one involved focus group discussions with consumers, cafeteria operators, and university management, alongside observational assessments, to obtain in-depth, context-specific insights into perceptions of sustainable and healthy eating. Building upon these findings, phase two will focus on designing food choice architecture strategies that promote healthier and more sustainable eating practices. Phase three will implement and evaluate these interventions using the Sustainable and Healthy Eating Diet (SHED) index.

The present study reports preliminary findings from UM, using quantitative analysis of food options and qualitative interviews with food service vendors to provide a holistic understanding of the current nutritional landscape in the UM food environment. The insights gained from the present study are expected to provide a foundation for the broader aims of the TUNE Project, which will lead to the implementation and evaluation of sustainable and healthy food environment interventions across participating universities.

Quantitative phase

For the quantitative component, a universal sampling method was used to capture all food options available at UM's residential campus cafeterias between October and December 2024. Residential cafeterias were chosen due to their daily influence on UM communities, particularly students, shaping their eating habits. Additionally, they serve as a potential setting for interventions aimed at promoting healthy eating among young individuals as agents of change.

A total of 741 food options were captured over all three meal service periods. From 741 food options, there were 122 food options commonly featured in all 12 residential campus cafeterias. These food options were grouped into five categories of interest, namely (i) bread, referring to Asian-style breads such as *roti canai*; (ii) meat dishes, which included Asian-style preparations such as *ayam masak merah* and *rendang ayam*; (iii) drinks, referring to sweetened beverages and soft drinks; (iv) Western dishes, which included Western-style preparations such as chicken chop or spaghetti; and (v) rice- or noodle-based fried foods, representing Asian-style preparations such as *nasi goreng kampung* and *mee goreng*. The five food categories were selected because they reflected the way food is typically grouped by most campus food service vendors. This categorisation makes it easier to communicate and collaborate with vendors in both the current and future studies. As explained earlier, this initial grouping provides a solid foundation for the broader TUNE project, particularly for the implementation stage, where these categories can be directly applied to guide interventions and improve the healthiness and sustainability of cafeteria offerings.

Nutrient analysis assessed calories, fats, saturated fats, dietary fibre, and sodium contents using the Malaysian Food Composition Database (Tee *et al.*, 1997) and the Singapore Food Composition Database (Health Promotion Board Singapore, 2003). As the intention of this study was to document the types of food provided within the cafeterias rather than estimate individual consumption, portion sizes were not applied. Therefore, nutrients were standardised per 100

Table 1. Classification threshold used for each nutrient (Ministry of Health Malaysia, 2023)

Components	*Claim*	*Description*
Calorie	Low	<40kcal (170 kJ) per 100g (solid) or 20kcal (80kJ) per 100ml (liquids)
	High	≥40kcal (170 kJ) per 100g (solid) or 20kcal (80kJ) per 100ml (liquids)
Fat	Low	<3g per 100g (solid) or 1.5g per 100ml (liquids)
	High	≥3g per 100g (solid) or 1.5g per 100ml (liquids)
Saturated fat	Low	<1.5g per 100g (solid) or 0.75g per 100ml (liquids) and 10% of total energy of the food
	High	≥1.5g per 100g (solid) or 0.75g per 100ml (liquids) and 10% of total energy of the food
Dietary fibre	Low	<3 g per 100g (solid) or 1.5 g per 100ml (liquid)
	High	≥3 g per 100g (solid) or 1.5 g per 100ml (liquid)
Sodium	Low	<0.12g per 100g(solid) or 0.06g per 100ml (liquid)
	High	≥0.12g per 100g(solid) or 0.06g per 100ml (liquid)

g (or per 100 ml for liquids) based on food composition databases to allow consistent comparison across food items. Nutritional profiles of the five categories of interest were systematically categorised according to established nutrient content claims outlined in the Labelling Guidelines 2023 (*Garis Panduan Pelabelan,* 2023). Foods were classified into "high" and "low" based on established thresholds (Ministry of Health Malaysia, 2023) (Table 1). For calories, "low" referred to less than 40 kcal (170 kJ) per 100 g for solids or 20 kcal (80 kJ) per 100 ml for liquids and "high" when exceeding these thresholds. Fat levels were deemed "low" if below 3 g per 100 g for solids or 1.5 g per 100 ml for liquids and "high" if equal to or greater than these values. Saturated fat

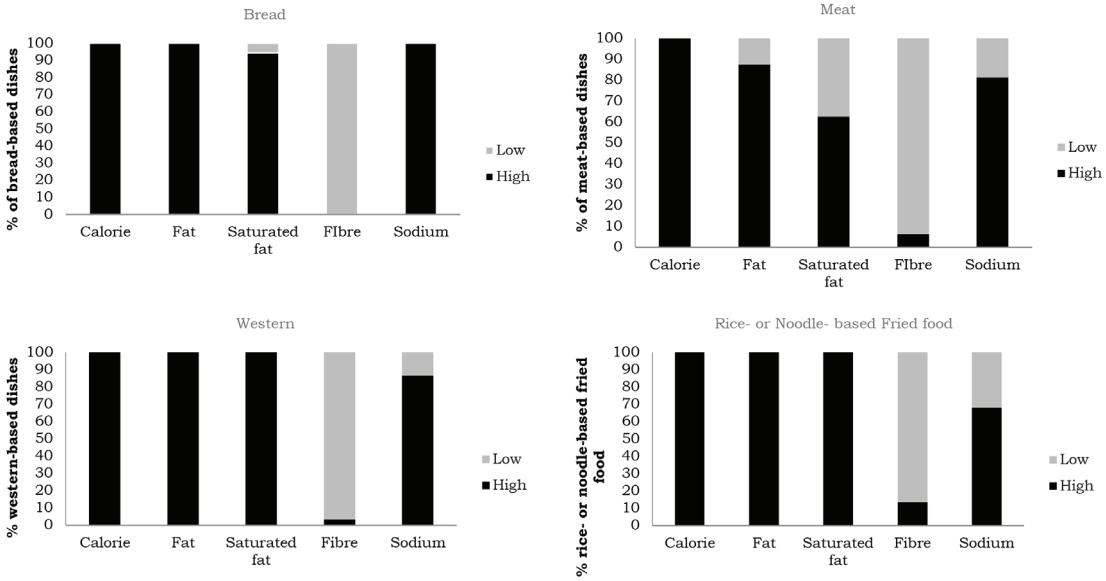

Figure 1. Profiling of nutrient composition for each food group (Bread, Meat, Western dishes, and Rice- or Noodle-based Fried Food)
"Low" and "High" category based on Labelling Guidelines 2023 (Ministry of Health Malaysia, 2023)

was "low" when below 1.5 g per 100 g (or 0.75 g per 100 ml) and accounted for less than 10% of total energy. Dietary fibre was labelled "low" when under 3 g per 100 g or 1.5 g per 100 ml and "high" when above these amounts. Sodium content was categorised as "low" when below 0.12 g per 100 g (solids) or 0.06 g per 100 ml (liquids) and "high" if equal to or above those limits. These classifications provided a basis for evaluating and comparing the nutritional quality across different food categories (Figure 1).

Qualitative phase

The qualitative component involved semi-structured interviews with food service vendors (Table 2). In this study, food service vendors referred specifically to cafeteria managers responsible for overseeing menu planning, food procurement, and day-to-day meal preparations within the university residential cafeterias. Cafeteria managers were purposively selected, as they served as decision-makers in determining the types of food offered to students, which directly aligns with the objective of identifying barriers to healthier food provision from the perspective of a service provider.

Participants were informed about the study objectives, procedures, and confidentiality policies before proceeding with the interview. The interview sessions concluded upon reaching thematic saturation, which occurred with the fifth vendor. Since there is no universal rule for determining the sample size in qualitative research, it largely depends on factors such as research focus, type of research question, available resources, and time constraints (Bekele & Ago, 2022). Thematic analysis of interview transcripts provided insights into the factors influencing vendor decisions and barriers to implementing healthier food practices.

Table 2. Semi-structured interviews with food service vendors

Items	*Prompt*
1. Menu and food preparation	• How do you decide on the ingredients for your menu items? • Do you offer options for specific dietary needs (e.g., vegetarian, low-calorie)?
2. Ingredient sourcing	• Where do you buy your ingredients from? • Are they freshly bought everyday? • Do you prioritise local suppliers? Why or why not?
3. Nutritional quality (ask if aware first)	• Are there any guidelines or standards you follow when preparing meals? • Would you follow the guidelines?
4. Challenges and limitations	• What do you understand about healthy food? • What challenges do you face in providing healthier food options?
5. Sustainability practices	• What do you understand about sustainability practices? • Are you aware of the 1st of November zero-plastic use policy?
6. Customer preferences and trends	• What are the most popular items among students?

Table 3. The top 5 foods offered for each food group

No	*Bread*	*Meat Dishes*	*Rice- or noodle-based Fried Food*	*Western dishes*	*Beverages*
1	Roti Canai	Chicken in Spicy Tomato Sauce (*Ayam Masak Merah)*	Coconut Milk Rice *(Nasi Lemak)*	Chicken Chop with Black Pepper Sauce	Pulled tea *(Teh Tarik)*
2	Kaya Butter Toast	Beef Rendang *(Rendang Daging)*	Village-style Fried Rice *(Nasi Goreng Kampung)*	Spaghetti Carbonara	Iced Milo *(Milo Ais)*
3	Tuna Sandwich	Spiced Fried Chicken *(Ayam Goreng Berempah)*	Chicken Rice *(Nasi Ayam)*	Fish and Chips	Iced Nescafe *(Nescafe Ais)*
4	Egg Mayo Bun	Spicy Squid *(Sambal Sotong)*	Mamak-style Fried Noodle *(Mee Goreng Mamak)*	Beef Burger with Fries	Rose Milk Syrup *(Sirap Bandung)*
5	Chocolate Bun	Beef in Soy Sauces *(Daging Masak Kicap)*	Fried Maggi Noodle *(Mee Maggi Goreng)*	Grilled Chicken with Mashed Potatoes	Fresh Orange Juice†

†added sugar

Ethical approval

This study was conducted in accordance with the Declaration of Helsinki and approved by the Universiti Malaya Research Ethics Committee (UM.TNC2/ UMREC_4329). Informed consent was obtained from all food service vendors involved in the study.

RESULTS

Quantitative phase

Out of a total of 122 food items categorised into the five categories of interest, there were 36 types of bread-based meals, 16 meat-based dishes, 18 beverages, 30 Western-style meals, and 22 rice- or noodle-based fried foods.

Based on Figure 1, analysis of the foods offered revealed significant nutritional disparities, underscoring the need for intervention. Generally, bread-based meals contained high saturated fat (94.4%) and lacked fibre; meat-based dishes were high in fat (87.5%) and sodium (81.3%), with limited vegetable content; Western-style meals exhibited excessive calorie density and inadequate fibre (96.7%); rice- or noodle-based fried foods were high in total fats and saturated fats, with 68.2% exceeding sodium recommendations; and beverages were predominantly sugary drinks (e.g., carbonated drinks) or sweetened beverages (e.g., *teh tarik, kopi*), contributing empty calories without nutritional benefits. Table 3 summarises the top five foods offered for each food group.

Qualitative phase

Interviews with cafeteria managers provided important information on their food preparation methods, nutrition knowledge, and difficulties they encountered in satisfying students' needs. The results are presented under six domains.

Domain 1: Menu and food preparation
Vendors said students' taste and budgetary constraints were major determinants of their menu items. Because of great demand among the students, these particular food items, such as fried chicken, instant noodles, fried rice and noodles, and sweetened drinks, dominated the menu items. One vendor explained, "Students always buy fried chicken. That's why fried chicken must be on my menu. If I don't sell it, they will go somewhere else." As for beverages, vendors also observed a strong preference for sugary drinks, as one mentioned, "Most students prefer sweet drinks like Iced Milo or Iced Pulled Tea. Rarely do they ask for plain water or fruit juice." Another vendor emphasised that affordability plays a key role in menu selection: "We try to balance the menu, but in the end, students just want food that is filling and cheap."

Domain 2: Ingredient sourcing
To save time and money, most vendors relied on frozen or prepackaged products, though some did their best to use fresh ingredients. One vendor explained, "We use frozen chicken because it is cheaper and lasts longer. If we buy fresh chicken every day, the cost becomes high and difficult to manage." Similarly, another vendor mentioned that while fresh vegetables were occasionally used, processed items dominated the menu as they were cheaper and more appealing to students. "We buy vegetables fresh, but other items like nuggets, sausages, and burger meat are all prepackaged. Students prefer this kind of food."

Domain 3: Understanding/Awareness of food service vendors towards dietary guidelines
Vendors demonstrated varying levels of awareness when asked about dietary guidelines. A few vendors were aware of dietary recommendations such as those outlined in the Ministry of Health's Malaysian Dietary Guidelines (*Panduan Diet Malaysia*), but they admitted that they were not proactively following them. One vendor openly stated, "I'm not really sure about the nutritional content of the food I sell. I just cook it according to regular recipes." Another vendor, when asked about adherence to dietary guidelines, said, "I've heard about the Malaysian Dietary Guidelines, but I've never really read them. Even students never asked about healthy food, so I don't really care." However, when asked if they would be willing to follow the nutritional guidelines, opinions were divided. Some vendors expressed openness to change if there was a demand, with one stating, "If the university provides guidelines and has assistance in terms of costs, I can try." Others were less convinced, arguing that students prioritised taste over health.

Domain 4: Challenges in providing healthier food options
One of the biggest challenges cafeteria suppliers encountered when delivering nutritious food was the comparatively high cost of fresh produce, which was often perceived to provide lower returns when compared to fried and processed items. One vendor noted, "If I use healthier ingredients, the price of food will become expensive. Later, students won't want to buy it." Another vendor emphasised that fried foods were more profitable, explaining, "Fried food is more profitable because the cost of ingredients is low and it is easy to sell. If I sell boiled or grilled food, it won't sell as much."

Domain 5: Sustainability practices
A few vendors possessed knowledge about sustainable procedures. Of those suppliers that were interviewed, some expressed interest in waste reduction and environmentally friendly materials,

but operational considerations generally took precedence. Several of the vendors did not know that the university had a policy effective November 1st regarding waste and sustainable food practices. One vendor admitted, "I didn't even know the university had a policy about food waste and environmentally friendly materials. Until now, we've just been throwing away our trash like normal." Another vendor acknowledged the importance of reducing waste but faced difficulties due to student behaviour and cost concerns, stating, "I'm interested in reducing waste, but students often don't finish their food."

Domain 6: Customer preferences and trends

Food service vendors, when asked about the food preferences of students, reported that the most purchased items were fried rice, fast food, and other high-calorie dishes. One vendor said, "Fried rice is the best-selling food. It's cheap and filling, so many students buy it." Another vendor highlighted the demand for fast food, explaining, "Students like food that is tasty and quick to prepare."

DISCUSSION

This study highlighted a significant nutritional imbalance in which the predominance of high-fat, high-sodium foods mirrors findings from other university cafeteria studies (Hilger *et al.*, 2017; Naim & Rahman, 2020), emphasising the urgent need for healthier meal options (Gesteiro *et al.*, 2022, Hazreen *et al.*, 2022). Often, nutritional balance takes a backseat when designing menus because of convenience, cost, and student demands for affordable meals (Aziz *et al.*, 2019; Powell, Durham & Lawler, 2019). Moreover, high-quality proteins and fresh vegetables are considered expensive and logistically challenging to work with. When it came to procuring ingredients, a small percentage of food service vendors showed concern about whether ingredients were locally sourced or imported, and placed emphasis on ensuring the freshness of ingredients procured daily. This finding aligns with research showing that university food service vendors, constrained by logistics, depended on processed and prepackaged foods, thus reducing access to fresh, nutrient-rich options (Bidin *et al.*, 2024).

Food service vendors showed varying awareness of dietary guidelines, with only a few familiar with the Malaysian Dietary Guidelines (*Panduan Diet Malaysia*) and even fewer applying them in daily menu planning or food preparation. Consequently, meals often lacked fibre-rich and micronutrient-dense foods such as fruits, vegetables, legumes and whole grains, while emphasis was placed instead on the amount served and food presentation. The possible explanation for such an observation could be due to inconsistencies in nutrition education on dietary guidelines across university dining venues (Dahl *et al.*, 2024). Moreover, operational priorities, such as cost control and consumer preference, may have further contributed to the limited integration of dietary guideline principles in menu offerings (Salhadi *et al.,* 2018). There is also limited enforcement of nutrition-related standards within food service contracts, in which adherence to dietary guidelines is optional rather than mandatory (Mclsaac *et al.,* 2019). Besides, limited storage capacity further restricts the use of perishable, healthier ingredients (Wetherill *et al.,* 2019).

In this study, food service vendors' awareness of sustainability initiatives remained low, leading to minimal adoption of environmentally friendly practices in food procurement and waste management (Naim & Rahman, 2020).

According to Naim & Rahman (2020), many food service vendors in Malaysian universities do not have effective waste management procedures since they lack proper training and support from the university administration, although they are quite aware of food wastage issues. This awareness gap is consistent with this study's finding. Moreover, vendors often operate under a tight budget and operational constraints due to their small-scale operation (Salhadi *et al.,* 2018). This may lead them to prioritise cost efficiency and profitability over environmental considerations. Without proper training for them or integration of sustainability criteria into procurement policies, sustainability remains a secondary concern for food service vendors. This highlights a systemic issue rather than a purely individual matter. Thus, a more structured, top-down approach, combined with continuous food service vendor capacity-building, is essential to bridge the gap between awareness and sustainable practices.

The widespread consumption of processed and fried foods among university communities, especially students, is supported by Aziz *et al.* (2019), who found that university students in Malaysia tend to favour foodstuffs based on convenience and taste rather than nutrition. Aziz *et al.* (2019) showed that the eating habits of students are largely based on desires for high-calorie meals and fast food, though there is also a slowly increasing trend towards healthier eating alternatives, as some students reportedly look for fruits, salads, and vegetarian choices when available. Thus, behavioural interventions, such as nudging healthier choices, could promote sustainable dietary habits among university communities, especially students (Colombo *et al.*, 2020).

A key strength of this study was its mixed-method approach, which enhanced the applicability of findings for internal policy development and actionable recommendations to improve university food environments. Besides, the categorisation of food items was standardised and determined based on quantitative values, expressed per 100 g of food. The parameters included calories (kcal/100 g), fat (g/100 g), saturated fat (g/100 g), fibre (g/100 g), and sodium (mg/100 g). This standardisation was applied to ensure consistency and comparability across different food items. Furthermore, this study placed emphasis on obtaining feedback from food service vendors, which is a group often overlooked in planning and implementing sustainable and healthy food environment guidelines. Hence, this added valuable practical insights into the challenges and opportunities faced at the operational level.

Several limitations should be noted. Firstly, conducting the study at a single site may limit the generalisability of findings to university cafeterias more broadly. Secondly, while vendors' perspectives were informative, the absence of direct input from students, who are the primary consumers, restricted the ability to corroborate vendor observations regarding student preferences. Thirdly, this study reported the nutritional content of food descriptively, classifying items into high or low nutrient categories, without incorporating portion size information. While this approach provides useful insights into the overall nutritional landscape of foods served within the university, it limits the understanding of actual consumption patterns.

Future research should address these limitations by adopting a multi-site design and incorporating a broader range of stakeholders, particularly students, alongside faculty members and university administrators. Including students' perspectives will

help triangulate findings and ensure that vendors' views are corroborated by those of the consumers themselves. In addition, collecting portion size data would enable more accurate nutrient estimation and enhance the utility of findings for both policy and education. Together, these steps will strengthen the evidence for the TUNE Project and support the development of more targeted and sustainable interventions within university food environments.

CONCLUSION

Both quantitative and qualitative data provided a broad view of the university cafeteria food environment. Quantitative analysis showed a high prevalence of energy-dense, high-fat, high-sodium, and low-fibre foods, with sugary beverages dominating drink options. Qualitative findings from food service vendors reinforced these patterns, highlighting students' preferences, cost constraints, and profitability as key drivers of menu choices. Vendors often relied on processed and frozen ingredients and showed limited awareness of national dietary guidelines. Awareness of university sustainability policies was also low, despite some interest in adopting sustainable practices. Overall, these findings revealed that unhealthy food options are influenced not only by consumer demand but also by systemic barriers, including limited nutrition literacy, economic pressures, and insufficient institutional awareness. Therefore, addressing these challenges is essential for fostering healthier and more sustainable food environments in universities.

In conclusion, the findings emphasise the need for coordinated action across multiple stakeholders. Universities should reform internal policies, such as subsidising healthier meals to make them more affordable, providing targeted nutrition training and standard guideline for food service vendors, and implementing nutrition education campaigns for students. In addition, universities should establish guidelines promoting the intake of whole grains, lean proteins, and plant-based alternatives. Food service vendors should work closely with university management and students to co-create menus that enhance food quality, focusing on health and sustainability. Students, as end-users, should be engaged through awareness programmes to cultivate healthier and more sustainable food choices. Future research should explore interventions aimed at shifting food preferences within university communities, particularly students' healthy and sustainable eating behaviours.

Acknowledgement

Authors sincerely thank the Occupational Safety & Health and Environment Centre (OSHEC) Universiti Malaya team for their support and the food service vendors operating at the Universiti Malaya residential campus cafeterias for their valuable insights. We thank SEAMEO RECFON for supporting the publication of this paper. The content of this article was partly presented at the 2nd SEAMEO International Conference of Food and Nutrition (ICFN) held on 17–18 October 2024 in Jakarta.

Authors' contributions

Ng AK, principal investigator, conceptualised and designed the study, prepared the draft of the manuscript and reviewed the manuscript; Algaba JC, led the data collection and reviewed the manuscript; Rao R, conducted the study, data analysis and interpretation, assisted in drafting of the manuscript; Yong HY, co-investigator, conceptualised and designed the study, assisted in drafting of the manuscript and reviewed the manuscript; Yang WY, co-investigator, conceptualised and designed the study, assisted in drafting of the manuscript and reviewed the manuscript; Nithiah T, co-investigator, conceptualised and designed the study, assisted in data analysis and reviewed the manuscript; Sundram BM, co-investigator, reviewed the manuscript. Noran NH, co-investigator, conceptualised and designed the study, reviewed the manuscript.

Conflict of interest

The authors declare no conflict of interest.

References

Aguirre Sánchez L, Roa-Díaz ZM, Gamba M, Grisotto G, Moreno Londoño AM, Mantilla-Uribe BP, Rincón Méndez AY, Ballesteros M, Kopp-Heim D, Minder B & Suggs LS (2021). What influences the sustainable food consumption behaviours of university students? A systematic review. *Int J Public Health* 66:1604149.

Anderson E, Wei R, Liu B, Plummer R, Kelahan H, Tamez M, Marrero A, Bhupathiraju S & Mattei J (2021). Improving healthy food choices in low-income settings in the United States using behavioral economic-based adaptations to choice architecture. *Front Nutr* 8:734991.

Azhar SBM, Vanoh D & Ganggaya KS (2023). Food choice motives, physical activity level and body mass index status among undergraduates students: A cross-sectional study. *Malays J Med Health Sci* 19(6):151-156.

Aziz NS, Yoep N, Hasani WSR & Paiwai F (2019). Predictive factors of fruits and vegetables intake among Malaysian adults: Findings from Malaysian Adults Nutrition Survey 2014. *Southeast Asian J Trop Med Public Health* 50(2):392–400.

Balasubramanian GV, Chuah KA, Khor BH, Sualeheen A, Yeak ZW, Chinna K, Sundram K & Karupaiah T (2020). Associations of eating mode defined by dietary patterns with cardiometabolic risk factors in the Malaysia lipid study population. *Nutrients* 12(7):2080.

Bekele WB & Ago FY (2022). Sample size for interview in qualitative research in social sciences: A guide to novice researchers. *Res Educ Policy Manag* 4(1):42–50.

Bidin N, Khushmee WNAWH, Mohamed M, Jalis MH, Bakar AMFA & Kassim ARA (2024). Factors affecting food choice among university students in Malaysia. *Asian J Res Educ Soc Sci* 6(S1):103–117.

Burrows L (2017). Children as change agents for family health. *Health Educ* 117(5):498–510.

Colombo PE, Patterson E, Lindroos AK, Parlesak A & Elinder LS (2020). Sustainable and acceptable school meals through optimization analysis: an intervention study. *Nutr J* 19(1):61.

Dahl AA, Fandetti SM, Ademu LO, Harris R & Racine EF (2024). Assessing the healthfulness of university food environments: a systematic review of methods and tools. *Nutrients* 16(10):1426.

Evans J, Jones R, Karvonen A, Millard L & Wendler J (2015). Living labs and co-production: university campuses as platforms for sustainability science. *Curr Opin Environ Sustain* 16:1–6.

Gesteiro E, García-Carro A, Aparicio-Ugarriza R & González-Gross M (2022). Eating out of home: influence on nutrition, health, and policies: a scoping review. *Nutrients* 14(6):1265.

Health Promotion Board Singapore (2003). *In: Food Composition Guide Singapore.* Health Promotion Board, Singapore. From https://focos.hpb.gov.sg/eservices/ENCF/[Retrieved May 11 2025].

Hazreen MA, Ng AK, Dahlui M, Mohammadi S, Mohamed MNAB, Su TT & Jalaludin MY (2022). Outcome evaluation on impact of the nutrition intervention among adolescents: A feasibility, randomised control study from Myheart Beat. *Nutrients* 14(13):2733.

Hilger J, Loerbroks A & Diehl K (2017). Eating behaviour of university students in Germany: Dietary intake, barriers to healthy eating and changes in eating behaviour since the time of matriculation. *Appetite* 109:100–107.

IPH (2020). *In: Technical Report National Health and Morbidity Survey (NHMS) 2020.* Institute for Public Health, Malaysia. From https://iku.gov.my/images/IKU/Document/REPORT/2020/report/2_Report_NHMS2020_Vol-2.pdf [Retrieved May 11 2025].

Lee KM, Dias GM, Boluk K, Scott S, Chang YS, Williams TE & Kirkpatrick SI (2021). Toward a healthy and environmentally sustainable campus food environment: a scoping review of postsecondary food interventions. *Adv Nutr* 12(5):1996–2022.

McIsaac JLD, Spencer R, Chiasson K, Kontak J & Kirk SF (2019). Factors influencing the implementation of nutrition policies in schools: a scoping review. *Health Educ Behav* 46(2):224–250.

Ministry of Health Malaysia (2023). *In: Garis Panduan Pelabelan 2023.* Ministry of Health Malaysia, Putrajaya. From https://hq.moh.gov.my/fsq/garis-panduan-pelabelan-makanan. [Retrieved March 19 2025].

Mozaffarian D (2016). Dietary and policy priorities for cardiovascular disease, diabetes, and obesity: a comprehensive review. *Circulation* 133(2):187–225.

Naim MN & Rahman HA (2020). Knowledge, attitude and practice on food waste management among food vendors in Universiti Putra Malaysia, Serdang, Selangor. *Malays J Med Health Sci* 16(11):118–127.

Ng AK, Hairi NN, Dahlui M, Su TT, Jalaludin MY & Majid HA (2020). The longitudinal relationship between dietary intake, physical activity and muscle strength among adolescents. *Br J Nutr* 124(11):1207–1218.

Okunogbe A, Nugent R, Spencer G, Powis J, Ralston J & Wilding J (2022, in press). Economic impacts of overweight and obesity: current and future estimates for 161 countries. *BMJ Glob Health* 7(9):e009773.

Powell PK, Durham J & Lawler S (2019). Food choices of young adults in the United States: a scoping review. *Adv Nutr* 10(3):479–488.

Ramlee IS, Zalbahar N, Wahab RA & Jaafar SNA (2019). Food insecurity among university students at two selected public universities in Malaysia. *Malays Appl Biol* 48(1):101–110.

Salhadi NA, Ab Hamid MR, Osman NS & Md Nor N (2018). Practice and challenges towards Healthy Cafeteria in Selangor, Malaysia. *Asian J Qual Life* 3(12):127–136.

Sulaiman N, Jusoh Z & Razak M (2013). Food insecurity among public university students receiving financial assistance in Peninsular Malaysia. *Malays J Consum Fam Econ* 16(12):78–90.

Tee ES, Noor MI, Azudin MN & Idris K (1997). *The Nutrient Composition of Malaysian Food (4th ed.).* Institute of Medical Research, Kuala Lumpur, Malaysia.

Tunde OA, Kuek TY, Mohan N, Rastogi G, Bhatt G, Singh H & Wardina A (2023). Fast-food consumption patterns among university students: A case study of McDonald's in Malaysia. *Asia Pac J Manag Educ* 6(2):104–115.

Wetherill MS, White KC, Rivera C & Seligman HK (2019). Challenges and opportunities to increasing fruit and vegetable distribution through the US charitable feeding network. *J Hunger Environ Nutr* 14(5):593–612.

WHO (2020). *In: Healthy Diet.* World Health Organization, Geneva. From https://www.who.int/news-room/fact-sheets/detail/healthy-diet [Retrieved March 19 2025].