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Assessment of Knowledge, Attitudes and Practices of Food Safety and the Acceptance of Engineering Controls Among Street Food Handlers in Pagoh Higher Education Hub

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Abstract

Street food is important in the daily life of academic communities within higher education areas, such as the Pagoh Higher Education Hub (PHEH). However, open-air food stalls can create health and hygiene risks. This project examined the food safety Knowledge, Attitudes, and Practices (KAP) of 52 street food vendors at a local night market in the PHEH, and their acceptance of a new handwashing station design. The quantitative research design was used with a structured questionnaire which was designed from the previous KAP studies and customized to the objectives of this project. Results of descriptive analysis showed very high food safety knowledge (mean = 4.57), positive attitudes (mean = 4.50), and good self-reported practices (mean = 4.69). However, observations at the stalls found several hygiene problems, including mixing raw and cooked food, handling money and food without washing hands, and a lack of proper handwashing facilities. To improve hygiene, a prototype of portable handwashing station was designed using SolidWorks and a three dimensional (3D)-printed with Acrylonitrile Butadiene Styrene (ABS) material. The design included two water tanks and a foot-pedal system to reduce hand contact. Vendors showed strong acceptance of the new design (mean = 4.49), demonstrating its potential to support better sanitation and safer food handling practices in street food markets.

1. Introduction

Street food is an important socio-economic component in Malaysia, particularly in rapidly developing regions. It provides affordable, convenient, and culturally diverse meal options for people with busy lifestyles. In academic communities such as the Pagoh Higher Education Hub (PHEH), which includes campuses of Universiti Tun Hussein Onn Malaysia (UTHM), International Islamic University Malaysia (IIUM), Universiti Teknologi Malaysia (UTM), and Politeknik Tun Syed Nasir Syed Ismail (PTSN), students and staff rely heavily on street vendors for their daily meals. Despite this convenience, open-air food operations often face challenges related to sanitation,

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hygiene, and food safety. Recent studies indicate that increasing population density in educational areas drives greater demand for street food, highlighting food safety as an important public health concern [1].

Globally, foodborne disease outbreaks remain a major public health concern, causing significant health impacts and placing a considerable burden on healthcare systems each year. In Malaysia, many food poisoning incidents have been linked to poor hygiene practices and unsanitary food preparation environments [10]. Unlike formal food establishments, small-scale street vendors often operate under challenging conditions, with limited access to essential facilities such as clean running water, proper wastewater disposal systems, and adequate cold storage [1,2]. As a result, compliance with the Food Act 1983 and Food Hygiene Regulations 2009 is often inconsistent, largely due to resource limitations and insufficient training in food hygiene and contamination control [3].

To better understand the factors influencing food safety practices, researchers often use the Knowledge, Attitudes, and Practices (KAP) model. In this framework, knowledge refers to vendors' understanding of foodborne hazards and food safety regulations, attitude reflects their willingness to follow safe food handling practices, and practice represents their actual behavior during food preparation and service [4]. Weaknesses in any of these areas can increase the risk of food contamination. By assessing the KAP profile of vendors in the PHEH, appropriate interventions can be developed to enhance food safety and protect the health of the academic community [5]. In addition, recent studies suggest that combining education and awareness programs with practical engineering solutions is an effective approach for achieving long-term improvements in food safety compliance [6].

Therefore, this project adopts a multi-level approach to identify the demographic profile of street food vendors using structured survey questionnaires [7,8], assess their baseline KAP scores through descriptive statistical analysis [9], and design a low-cost engineering intervention using Computer-Aided Design (CAD) and Fused Deposition Modeling (FDM) of three-dimensional (3D) printing to improve hygiene practices in open-air food markets.

2. Methodology

This section describes the systematic methodology used in this project, providing a comprehensive overview of the research methods, as shown in Figure 1. It presents the research design, which outlines the overall approach and structure of the study, followed by the data collection and analysis methods, including the procedures for gathering and analysing data. The section also describes the engineering design and prototyping processes used to develop the proposed handwashing station.



Fig. 1 *Research methodology flowchart*

2.1 Conceptual Framework Based on the KAP Model and Hierarchy of Controls

The Knowledge, Attitude, and Practice (KAP) model explains that food handlers' knowledge influences their attitudes, which in turn affect their food safety practices [16]. However, previous studies have reported a common knowledge–practice gap, where food handlers possess adequate food safety knowledge but fail to consistently apply safe practices due to factors such as limited access to clean water, inadequate facilities, and weak enforcement [11,12,13].

To address this gap, the Hierarchy of Controls (HOC) framework emphasizes the importance of engineering controls, which reduce safety risks through physical and environmental improvements rather than relying solely on human behavior [14]. Examples include hands-free faucets, separate water storage systems, and easy-to-clean surfaces that support safer food handling practices [14,15]. Therefore, this project considers both behavioural factors and structural conditions as important influences on food safety practices.

2.2 Research Design

This project uses a quantitative research design to assess vendor profiles and KAP scores, combined with a structural engineering workflow to design and prototype physical sanitation equipment. The empirical setting was an active night market located inside the PHEH area. This night market hosts approximately 36 regular street stalls that serve the surrounding student and faculty populations. The street food handlers managing these premises were designated as the target research subjects.

2.3 Quantitative Instrument Development

The survey instrument was adapted from validated previous research designs [5,6,15]. The final questionnaire was divided into five distinct domains: Section A collected respondent background profiles; Section B evaluated knowledge regarding cross-contamination, hygiene definitions, and regulations; Section C examined internal attitudes toward safety and customer welfare; Section D recorded self-reported operational practices; and Section E evaluated the acceptance of the proposed engineering intervention. Sections B through E utilized a standard 5-point Likert scale (1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly Agree).

2.4 Sampling Strategy and Validation Controls

A non-probability convenience sampling method was used due to the informal nature of night market operations, whereby participants were selected based on their willingness to participate during the data collection period. This method was chosen due to its practicality and ease of access to respondents [8]. The final sample comprised 52 active food handlers, surpassing the minimum sample size requirement for exploratory studies [7]. Content validity was established by an expert panel consisting of two academic subject matter experts, who assessed item clarity and relevance. Internal consistency was assessed through a pilot study involving three food handlers and evaluated using Cronbach's alpha. The baseline scale achieved a Cronbach's Alpha coefficient (α) value of 0.928 across the 20 test items, indicating a high level of reliability well above the standard 0.70 threshold [9].

2.5 Engineering Design and Prototyping

To convert user feedback into physical equipment, a prototyping workflow was established using SolidWorks software for three-dimensional (3D) modeling and engineering design. The design criteria prioritized a compact layout for tight market stalls, a dual water system with isolated clean and wastewater tanks, and a mechanical foot pedal to enable hands-free operation. The physical prototype was fabricated on an Ultimaker 3 Extended printer using Fused Deposition Modeling (FDM) and high-grade Acrylonitrile Butadiene Styrene (ABS) filament for improved impact and thermal resistance. Slicing parameters were strictly managed to control warping. Components were assembled using Cyanoacrylate (GAM 3S) adhesive and reinforced with paper matrix spacers to increase joint stability. The completed miniature model was used as a visual aid to gather vendor feedback on the operational feasibility of the design.

3. Results and Discussion

This section presents the findings of the study. Meanwhile, the discussion focuses on key issues identified in the results.

3.1 Preliminary On-Site Observations

Initial on-site observation in the night market in PHEH areas suggested several critical hygiene issues among street food vendors. The main concerns included food handlers frequently handling food with bare hands, lack of handwashing facilities, and the practice of alternating between handling money and food. Although most vendors wear gloves during their work, proper handwashing is often neglected. Without adequate handwashing, dirt from sweat or the surrounding environment can contaminate food [2]. These observations indicate low levels of awareness regarding personal hygiene and food safety among vendors. Poor handling practices, unhygienic environments, inadequate water supply, and limited hygiene awareness pose significant public health risks.

3.2 Quantitative Demographic Analysis of Respondent

The survey in Section A captured a comprehensive cross-section of night market operators (n = 52). The respondents were highly concentrated in solo operations (90.4%), with the majority selling food products (75.0%) and possessing less than one year of experience (76.9%). This rapid turnover matches structural trends noted in regional baseline monitoring data within similar developing educational sectors.

3.3 Descriptive Analysis of KAP and Acceptance of Engineering Control

Descriptive analysis revealed high baseline scores across the knowledge, attitude, and practice (KAP) domains, alongside strong acceptance of the proposed engineering controls as summarized in Table 1. The overall findings indicate a very high level of food safety knowledge, attitudes, and practices, with mean values for Section B (4.57), Section C (4.50), and Section D (4.69), respectively. These values exceed the set threshold [17] and indicate a high level of awareness of food safety [4]. In addition, the engineering control achieved an overall

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acceptance score of 4.49 for Section E. The findings show that vendors strongly support physical design solutions that reduce cross-contamination risks.

Table 1 *Overall mean of KAP and engineering controls*

Section	Variables	Overall Mean	Interpretation
B	Knowledge (K)	4.57	Very High
C	Attitude (A)	4.50	Very High
D	Practice (P)	4.69	Very High
E	Engineering Control	4.49	Very High

3.4 Design and Prototype of a Handwash Station as an Engineering Control Measure

To address these infrastructure gaps, a portable handwash station was designed as a structural intervention as illustrated in Figure 2. The system layout features isolated clean and wastewater tanks to prevent cross-contamination and avoid improper greywater discharge. As shown in Figure 3, the system was scaled down into a physical miniature model using FDM 3D printing with ABS filament to evaluate functional fit and demonstrate the design to local vendors. This model helped illustrate key features such as the mechanical foot pedal. It confirms the design's practical use as an effective structural defense within night market settings.

However, because the prototype is a scaled model (Appendix A), its practicality for routine use by street vendors has not yet been validated under actual operating conditions. Further work is required to fabricate a full-scale prototype and conduct field testing to evaluate its usability, durability, portability, maintenance requirements, and user acceptance before practical implementation in night market settings.

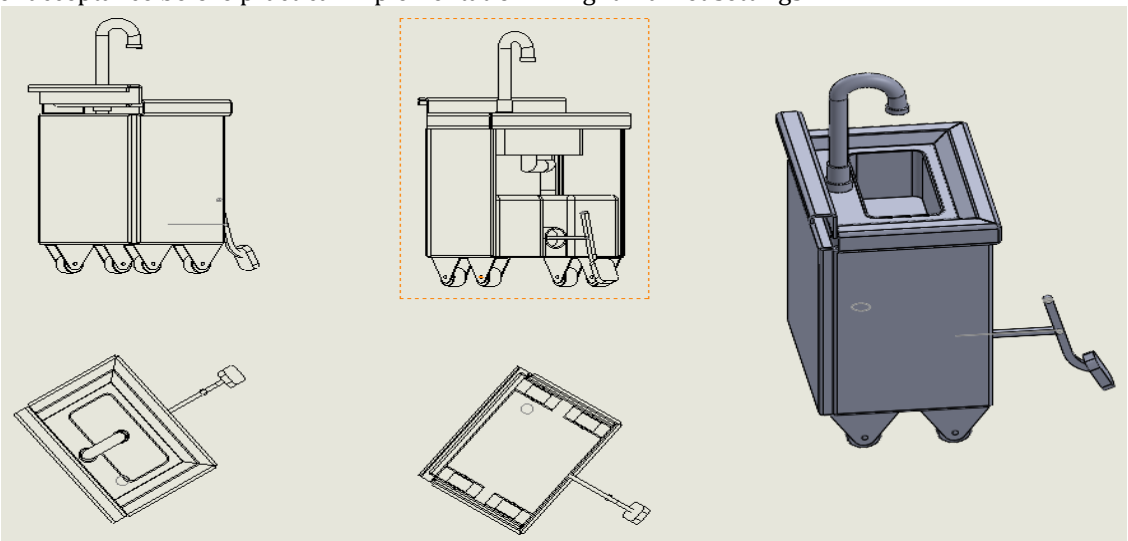


Fig. 2 *Design of a portable handwash station*

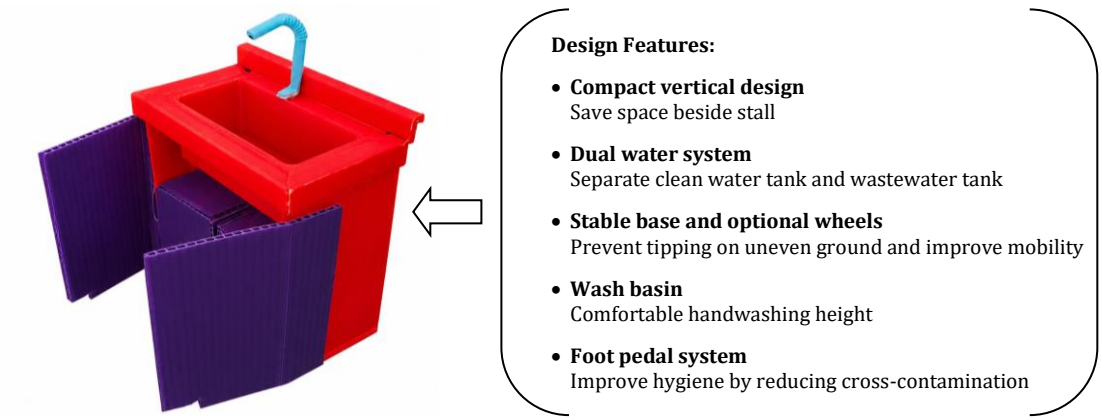


Fig. 3 *Prototype of a portable handwash station*

4. Conclusion

This project successfully achieved its objectives by identifying a predominance of low-experience solo food vendors, assessing their food safety knowledge, attitudes, and practices (KAP), and addressing observed sanitation infrastructure gaps through the development of a portable handwash station with dual-tank and hands-free foot pedal features. Although vendors demonstrated high KAP scores, on-site observations revealed inadequate hygiene facilities, highlighting the need for structural interventions. The high acceptance of the proposed handwash station indicates its potential to improve food sanitation practices in open-market settings. Therefore, local authorities and educational institutions should consider implementing and distributing self-contained handwash units, while municipal management should establish centralized greywater disposal systems to support proper wastewater management. Future studies should focus on full-scale prototype development using durable materials and evaluate long-term performance and microbial control under actual operating conditions.

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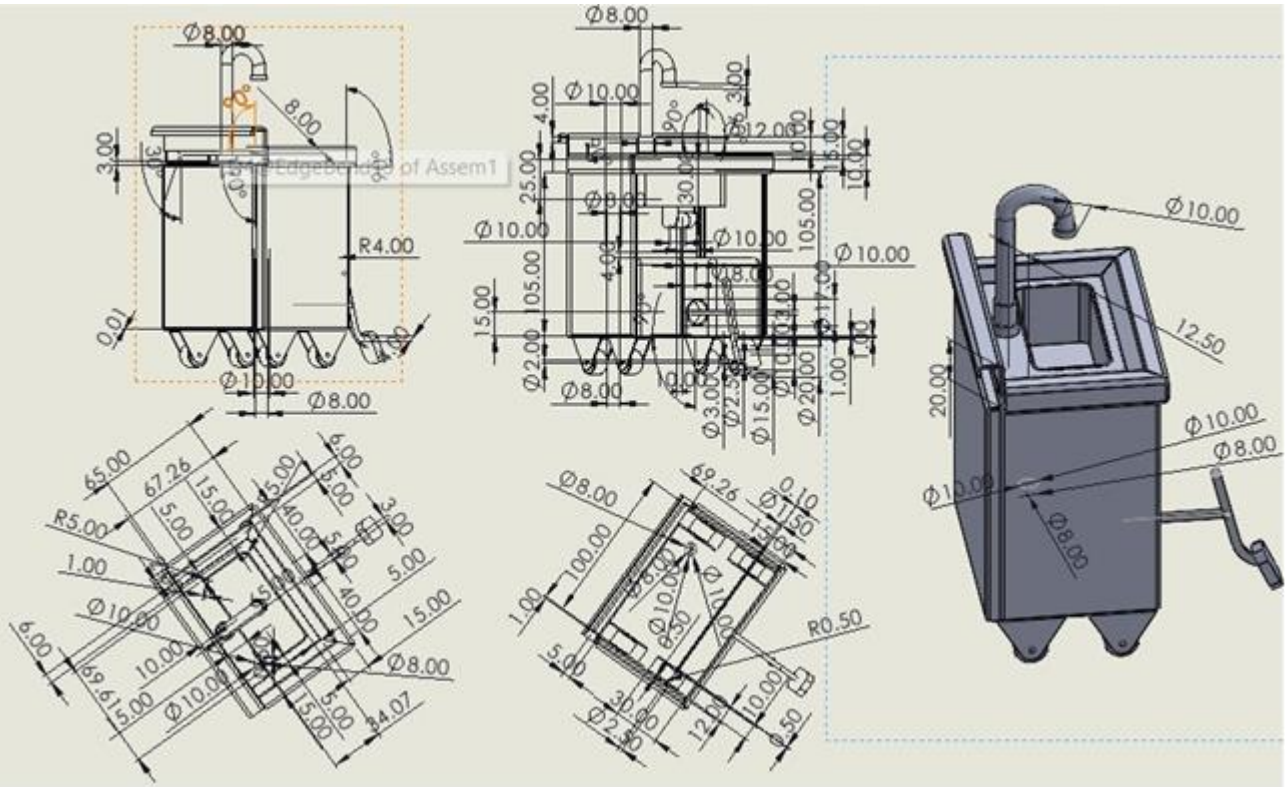
Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: study conception and design: ***Muhammad Muizzuddin Mohd Salimi, Rahim Jamian;*** *data collection:* ***Muhammad Muizzuddin Mohd Salimi;*** *analysis and interpretation of results:* ***Muhammad Muizzuddin Mohd Salimi, Rahim Jamian, Khairu Kamarudin;*** *draft manuscript preparation:* ***Muhammad Muizzuddin Mohd Salimi, Rahim Jamian, Tengku Nur Azila Raja Mamat, Khairu Kamarudin, Izuan Amin Ishak.*** *All authors reviewed the results and approved the final version of the manuscript.*

Appendix A: Scaled-Down Prototype



References

[1] Mustafa, N. A., Rahman, A. H., & Ismail, S. B. (2024). The socio-economic impact and safety challenges of street food vending in Malaysian educational corridors. *Journal of Urban Health and Nutrition*, 12(2), 45-58.

[2] Marwi, F., Adnan, A. S., Mohd Ishar, M. I., & Mohd Nizam, N. F. (2025). Safe bites on the streets: An analysis of food safety and hygiene among Shah Alam's street food vendors. *e-Academia Journal*, 13(2), 212-225.

[3] Halim, N. R. A., Abdul-Hamid, A., & Karim, M. S. A. (2024). Food safety regulations implementation and their impact on food security level in Malaysia: A review. *International Food Research Journal*, 31(1), 20-31. http://www.ifrj.upm.edu.my/31%20(01)%202024/02%20-%20IFRJ22307.R1%20(Review).pdf

[4] Tan, L. H., Ng, K. P., & Ooi, C. Y. (2025). Evaluating the KAP model in food safety: A longitudinal study of Malaysian street vendors. *Food Control and Safety Reviews*, 31(1), 89-104.

[5] Mosas, K., & Jamian, R. (2024). Assessment of knowledge, attitudes and practices of food safety among food handlers at cafeterias in UTHM Pagoh Campus. *Progress in Engineering Application and Technology*, 5(2), 396-404. https://publisher.uthm.edu.my/periodicals/index.php/peat/article/view/17223/5541

[6] Yeargin, T. A., Gibson, K. E., & Fraser, A. M. (2021). New approach to food safety training: A review of a six-step knowledge sharing model. *Journal of Food Protection*, 84(11), 1852-1862.

[7] Bougie, R., & Sekaran, U. (2019). *Research Methods for Business: A Skill-building Approach* (8th ed.). John Wiley & Sons Inc.

[8] Creswell, J. W., & Guetterman, T. C. (2019). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research* (6th ed.). Pearson.

[9] Field, A. (2024). *Discovering statistics using IBM SPSS Statistics* (6th ed.). SAGE Publications.

[10] Latchumaya, R., Mohamad, S. A., & Zakaria, Z. (2024). Assessment of food safety knowledge, attitudes, and practices among street food vendors in Malaysia. *Canrea Journal: Food Technology, Nutritions, and Culinary*, 7(2), 180-198.

[11] Baser, F., Ture, H., Abubakirova, A., Sanlier, N., & Cil, B. (2017). Analytical hierarchy process-based assessment of the factors affecting the food safety knowledge and behaviours of food handlers. *Food Control*, 71, 290-297.

[12] Elsahoryi, N. A., Al-Sayyed, H., Mahmoud, S., & Hammad, F. (2024). Food safety knowledge, attitudes and practices (KAP) of street vendors: A cross-sectional study in Jordan. *British Food Journal*, 126(11), 3870-3887.

[13] da Vitória, A. G., de Souza Couto Oliveira, J., de Almeida Pereira, L. C., de Faria, C. P., & de São José, J. F. B. (2021). Food safety knowledge, attitudes and practices of food handlers: A cross-sectional study in school kitchens in Espírito Santo, Brazil. *BMC Public Health*, 21, 1-10.

[14] NIOSH (National Institute for Occupational Safety and Health). (2023). *Hierarchy of Controls*. U.S. Department of Health and Human Services, CDC. https://www.cdc.gov/niosh/topics/hierarchy/default.html

[15] Ishanuddin, N. M., Sukadarin, E. H., Aziz, H. A., & Zakaria, J. (2019). An investigation of knowledge, attitude and practice of occupational safety and health (OSH) on safety climate at workplace in manufacturing industry. *Journal of Occupational Safety and Health (JOSH)*, 16(2), 21-29.

[16] WHO (World Health Organization). (2008). *Advocacy, communication and social mobilization for TB control: A guide to developing knowledge, attitude and practice surveys*. WHO.

[17] Zaki, A. S. & Ahmad, A. (2019). The level of integration among students at secondary school: A study in Limbang, Sarawak. *The International Journal of Social Sciences and Humanities Invention, 4* (2), 3284-3288.

[18] Kanda, N. F., Chijokwe, A., Mabaya, M. G., & Nyamugure, T. (2020). Food safety knowledge, attitudes, and practices of restaurant food handlers in a lower-middle-income country. *Food Science & Nutrition*, 8(3), 1677-1687.