MAEH Journal of Environmental Health eISSN 2637-1359
Jurnal Kesihatan Persekitaran MAEH
Published By Malaysian Association of Environmental Health
http://www.maeh4u.org.my/journal

URBAN ENVIRONMENT AND PUBLIC HEALTH:

ASSESSING RISKS AND IMPLEMENTING SOLUTIONS SERIES

Exploring The Role of Environmental Health in the Private Sector

Avianna Nara Ayai[1], Imelda Sonia Biajin[1], Millty Sirinjan[1], Nur Alia Abdul Halim[1], Putri Nurshahira Abdul Rapar[1], Siti Zubaidah Abdul Karib[1], Noor Haziqah Kamaludin[1], Subramaniam Karuppannan[2], Roszita Ibrahim[3], Zaleha Md Isa[3], Salina Hang Jebat[4] & Farah Ayuni Shafie[1,2*]

[1]*Centre for Environmental Health and Safety Studies, Faculty of Health Sciences, Universiti Teknologi MARA, Kampus Puncak Alam, Selangor, Malaysia*

[2]*Malaysian Association of Environmental Health*

[3]*Department of Community Health, Faculty of Medicine, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia*

[4]*Enviroverks (M) Sdn. Bhd., Kuala Lumpur, Malaysia*

**Corresponding author: farahayuni@uitm.edu.my*

Abstract

Aligning economic growth with sustainable development is a significant concern for countries committed to the United Nations Sustainable Development Goals (UN SDGs). Environmental health issues, such as exposure to environmental chemicals and increasing levels of particulate matter, as well as urban health and several other related issues, must be addressed to achieve the UN SDGs. Therefore, it is crucial for countries to prioritize and utilize the expertise of environmental health practitioners and roles in the private sector. The objective of this article is to emphasize the importance of environmental health in the private sector. A Focus Group Discussion was conducted among experts to delve into the roles of environmental health practitioners and discuss various environmental health issues and challenges within the private sector. The discussion revealed three key points: (1) Environmental health roles vary across different fields, (2) Benefits and challenges associated with implementing environmental policies, and (3) The costs associated with environmental health. Overall, this article highlights that the presence of environmental health practitioners, and their roles may expand in the private sector, despite certain limitations in implementing the environmental health policies and associated costs.

Keywords: health risk, industry, health impacts

INTRODUCTION

Environmental health encompasses various aspects of human health, including quality of life, influenced by the physical, chemical, biological, social, and psychosocial factors of the environment (Kasmani et al., 2021). It also includes the planning, implementation, and evaluation of the impact of environmental factors in the workplace on both workers and public health. Malaysia, in line with its commitment to the 1992 Rio Earth Summit Declaration, pledged to protect human health affected by environmental quality. Additionally, at the 2012 UN Conference on Sustainable Development, the Minister of Natural Resources and Environment of Malaysia emphasized Malaysia's sustainability goals, such as maintaining at least 50% of its land as forests, reducing carbon emissions, and promoting green technology (Minister of Natural Resources and the Environment, Malaysia, 2012). In pursuit of these goals, Malaysia, like many other countries, has developed the National Environmental Health Action

Plan (NEHAP), which aims to enhance national environmental health and define the roles and responsibilities of all stakeholders.

NEHAP Malaysia has identified the top 10 priority list of environmental health issues as listed by NEHAP Malaysia as follows: Urban Health, Human Exposure to Environmental Chemicals, Exposure to Ionized and Non-Ionizing Radiation, and Malaysian Particulate Matter and Ozone Levels (NEHAP, 2019). These priority areas serve as a valuable reference for scholars, researchers, and professionals when making decisions regarding future research directions. Environmental health professionals, business owners, and industry managers, as well as academics, and researchers, should pay attention to these priorities when auditing and use them as a guide when conducting audits and assessments of environmental health in the workplace.

The recent COVID-19 pandemic has demonstrated the potential for infections to occur among workers in the workplace, with an increasing number of cases becoming a significant concern. These infections can have detrimental effects on businesses, necessitating careful planning and implementation by management to prevent and reduce the number of cases. It is crucial for individuals with knowledge of environmental health to take the lead in initiating the planning and implementation of strategies to address this matter and other environmental health issues. Therefore, the primary objective of this article is to strongly assert the importance of environmental health is needed in the industries. Additionally, the article aims to achieve several other objectives, which will be supported and demonstrated by the conclusion.

i. To identify the roles of environmental health in the private sector; and;
ii. To discuss potential environmental and health hazards in the industry.

Framework on Environmental Health

Figure 1 depicts the Driving Force -Pressure-State-Exposure-Effect-Action (DPSEEA) framework, also known as the 'health and environment cause and effect framework,' as a hierarchical model relating measurable indicators to diseases caused by the environment. It also presents the six elements of the environment-health chain that can be implemented to mitigate environmental health consequences.

Based on Briggs' (2017) definition, the first "D" in the framework stands for driving forces. These driving forces are variables that act as both fundamental causes and influences in the processes being studied. The "E" represents the Effects, indicating that these exposures have a detrimental impact on an individual's health. Lastly, the "P" stands for Policy, which refers to the various efforts aimed at reducing emissions and addressing the identified issues. Conceptual frameworks can also establish connections between individual monitoring programs and support the development of new indicators, policies, and programs (Edokpolo et al., 2019).

Strategic Plan for Environmental Health

In the context of this strategy, environmental health hazards encompass all environmental, physical, chemical, biological, work-related, and behavioral factors. The focus is on areas of the environment that can undergo significant changes (World Health Organization, 2020). The goal of this strategy is to ensure safe, supportive, and equitable environments for health by 2030, in alignment with the United Nations Sustainable Development Goals (UN SDGs). It provides a vision and a roadmap for how the global health community and the world's response to environmental health risks and challenges. Action needs to be directed towards upstream determinants of health, environment, and climate change determinants in an integrated and mainstreamed approach across all sectors.

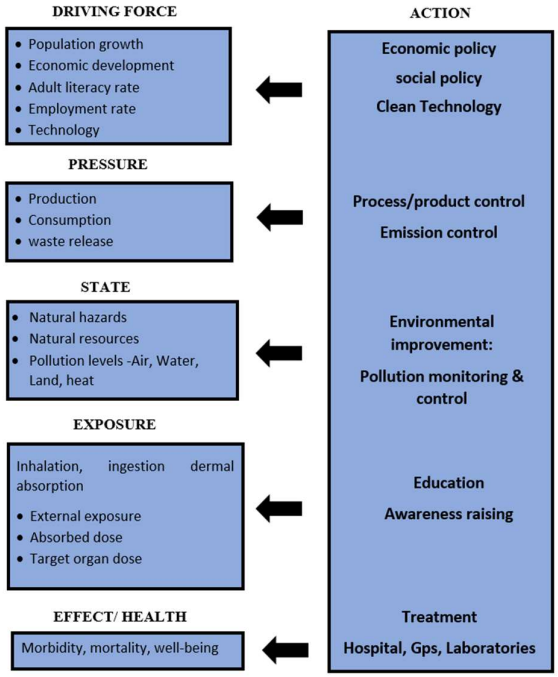

Figure 1. The DPSEEA framework

According to WHO (2020), Strategy 1 emphasizes the need for effective and equitable action on factors contributing to environmental threats to human health. Scaling up effective primary prevention activities involving all major players from all industries is crucial. Strategy 2 focuses on incorporating health perspectives and data systematically into policies across all sectors to maximize the health benefits of environmental protection. Strategy 3 involves the healthcare sector taking the lead and coordinating efforts with other industries impacting the environment and human health to improve overall well-being. Strategy 4 highlights the importance of comprehensive approaches, including interdisciplinary and interdepartmental cooperation, to build governance structures, agreements, and political will that can achieve positive results across impacted sectors. Currently, sectors are often driven primarily motivated by their own objectives and enhancing governance frameworks to enable long-term health protective action, increasing leadership and demand for health, and fostering powerful political movements and enabling agreements are essential. Strategy 5 aims to ensure that evidence-based information is available in all relevant areas to support decision-making on health-protective actions, considering health impacts, economic implications, efficacy, and co-benefits of solutions. Strategy 6 emphasises the monitoring the execution of primary prevention efforts by creating healthier and safer environments as a guide for further actions.

In the Environmental Health (EH) Australia Strategic Plan 2016-2020, the organization has outlined its corporate goals. These goals include the growth of the EH Officer workforce, raising the professional standards of environmental health practitioners, continuous enhancement of governance procedures to better serve its members and advance environmental health, and promoting higher environmental health standards among the Australian population. To achieve these goals, there is a need to improve environmental health standards in the Australian populace. Thus, the improvement of environmental health advocacy should be through the establishment of environmental health policy positions, policy networks and linkages, and advocacy mechanisms (Environmental Health Australia, 2020). By

focusing on these strategies, EH Australia aims to strengthen the environmental health profession and promote the well-being of the Australian population through improved environmental health policies and standards.

Exploring Environmental Health

In exploring the environmental health, perspectives from the professionals in the environmental health (EH) field, focus group discussions (FGD), entitled *"Exploring the Environmental Health Roles in Private Industry,"* revealed three themes: (1) Environmental Health Roles by Field, (2) Implementation of Environmental Policy, and (3) The Cost of Environmental Health implementation. This section quotes panellists' responses. Figure 2 presents the focus group's three topics and subtopics.

Topics	Subtopics
i. Environmental Health Roles in different fields	Constructing and elevating the knowledge and experience of individuals in: a. Environmental health industrial practitioners b. Environmental health academicians
ii. Implementation of Environmental Policy	Environmental policy implementation effectiveness and consistency: a. Implementation of environmental policy in Malaysia's industry b. Environmental policy implementation in Malaysia and other countries.
iii. The Cost of Environmental Health Implementation	Environmental implementation and its costs: a. Essential environmental lecture required by the industry b. Environmental health practitioners' roles in encouraging the company to fund this venture

Figure 2. The emerging topics

i. Environmental Health Roles Vary by Field

Participants viewed EH professionalism in two fields, which are from the EH industrial practitioners and EH academicians. Prof. Dr. Zaleha binti Md Isa from Universiti Kebangsaan Malaysia (UKM), invited as an academician's panellist in the FGD, has an interesting view on EH academicians' role. She said that:

"Academics prepare students to be effective EH professionals. They revise the syllabus every 5 years to meet MQA (Malaysian Qualifications Agency) requirements and the current market needs. This syllabus revision involves both academics and industrial EH practitioners."

In addition, Dr. Roszita binti Ibrahim, a senior lecturer from UKM, stated that, Environmental health professionals who work in the public sector and those who work in the private sector share no significant distinguishing roles. She said that:

"Public and private environmental health professionals are similar. Environmental Quality Act 1974 regulates private and public sector environmental health professions (No. 127 of 1974). This act defined pollution prevention, abatement, control, and environmental enhancement. It also promotes pollution prevention, abatement, control, and environmental enhancement."

During the FGD, Dr. Subra discussed the most concerning environmental issue in Malaysia. Based on a survey conducted in 2019, the top three most concerning environmental issues in Malaysia were climate change, air pollution, water pollution and deforestation. Dr. Subra mentioned that:

"The environmental health in public eyes had become very apparent after the COVID-19 pandemic hit Malaysia especially to the private sector. The lack of the information related to prevention and control of infectious diseases in relation to the Standard Operating Procedures (SOPs) is very apparent in the private sector. They were going through many difficulties when passing the task to the various staff in the industry. Thus increase the demand for Environmental Health Sectors services in the Private sectors. This includes communicable disease control (CDC) & Non-CDC, Environmental sanitation, disinfection, Water safety, water treatment, food safety and food hygiene, environmental health education and social media, etc."

ii. Implementation of Environmental Health Policy

Another topic that became apparent throughout the course of the conversation was the application of environmental health policy. Prof. Dr. Zaleha binti Md Isa added that:

"Malaysia has our own specialty in implementing the environmental health policy. Malaysia collaborates with other countries to handle regional air pollution issues such as haze. At the core of Malaysia's national environmental policy is the Environmental Quality Act (EQA) of 1974, which aimed to prevent and control pollution and set up a system to punish those who harm the environment."

Every country implements their own environmental health policy, and it shows that every country is committed to the laws, regulations and policy mechanisms concerning environmental health issues (Omar et al, 2021).. Puan Salina shared on the general information of the policy that was implemented in her company. According to Puan Salina:

"Our company had implemented Safety, Health and Environmental Policy which had been approved the by the higher up in a few years back. Enviroverks (M) Sdn Bhd, is a local company that perform indoor environmental services, starting from the consultation on indoor environmental quality up to the sanitization, ventilation check etc. For me policy is important because it is part of the management commitment towards the compliance of legal requirements on Safety, Health and Environmental and the management must become a body to commit to the importance of Safety, Health and Environment."

Apart from the implementation of the environment policy, participants also talked about the people or specialised units that were devoted to the management of environmental health in the industry. Puan Salina provided a more in-depth explanation based on her company. Puan Salina said that:

"For a small company like mine and other certain companies, there are certain limitations, for example, a smaller number of workers, so we do not have any specialized units or department that are devoted in managing the environmental health. Therefore, as an environmental worker, I had taken the initiative to propose the program to the higher management."

The discussion continued with participants from the industry. Dr. Subra talked about employee awareness on a company's environmental health policy. Dr. Subra mentioned that:

"The policy is not governing legal compliance. They are volunteering compliance. A company will shut off the policy for management system purposes so that the top management can give instruction to the staff on whatever work needs to be done. In the beginning of the

2019, there were no policies in line with Environmental Health, they mostly investigated occupational safety and health, and suddenly most companies caught off guard during the pandemic. The problem was we cannot create a new policy during the pandemic. The company needs to use the existing policy and try to manage it. So, the alternative is by getting environmental officers that were available. Therefore, the environmental workers responsible for creating the policies and making sure the policies communicated to all the workers."

iii. The Cost of Environmental Health

Environmental health is very essential in every field. Hence, an academician that was invited to give talks in the private sector, Prof. Dr. Zaleha binti Md Isa, also offered her insights on the lecture deliverance by academicians in the private sector. She mentioned that:

"Lecturers are invited to deliver lectures based on their expertise."

Then, Dr. Roszita binti Ibrahim added that:

"Environmental health is particularly important to varying fields. There is no specific type of lectures that private employee chooses to attend."

With the fact that environmental health is essential in every field, the EH industry plays its role in in persuading companies to financially support this venture (Syed Mohd Nizam et al., 2021). Hence, Puan Salina provides more insights on the environmental health worker roles play in persuading companies to offer financial support in implementing environmental policies. Puan Salina mentioned that:

"In order to obtain the trust when proposing to the management, first thing they would like to see is the value for money. Therefore, in any organization, we need to show the management the advantages in managing environmental health."

CONCLUSION

The desire for economic growth often creates a conflict between environmental and worker health concerns, particularly in poor countries experiencing rapid population growth and rising expectations for improved living conditions. The workplace serves as a hub for various activities in daily life, including social and physical interactions. Policymakers, employers, and workers have the ability to influence working conditions, management practices, health services, lifestyle choices, diet, planned activities, safety measures, and risk mitigation for the benefit of both employers and workers. When developing environmental health policies, all these factors need to be taken into consideration. This becomes increasingly important as more individuals are employed in the knowledge-based industries and as society ages, resulting in a decrease in the number of available workers for unskilled labour. Consequently, health goals must extend to all aspects of society, encompassing both the environment and occupational health.

Environmental health officers play a crucial role in monitoring and enforcing health and hygiene regulations. They also investigate incidents such as pollution, noise problems, toxic contamination, pest infestations, and food poisoning outbreaks. Environmental threats stemming from industrial activities can have various detrimental effects on human health, including respiratory, lung, and cardiovascular diseases, and in severe cases, can even result in death. Despite the challenges related to the cost of environmental health and the limitations in implementing policies, environmental health practitioners and their roles have the potential to expand in the private sector in the near future.

ACKNOWLEDGEMENTS

The authors would like to thank the Faculty of Health Sciences, Universiti Teknologi MARA (UiTM) Puncak Alam, Malaysia Association Environmental Health (MAEH) and the panellists of the FGD Exploring the Roles of Environmental Health in Private Sectors (Dr. Subramaniam Karuppannan, Dr. Roszita Ibrahim, Prof. Dr. Zaleha Md Isa, and Puan Salina Hang Jebat) for their full cooperation and assistance.

REFERENCES

Briggs, D. (2017). Making a Difference: Indicators to Improve Children's Environmental Health.

Edokpolo, B., Allaz-Barnett, N., Irwin, C., Issa, J., Curtis, P., Green, B., Hanigan, I., & Dennekamp, M. (2019). "Developing a conceptual framework for environmental health tracking in Victoria, Australia." ("Developing a conceptual framework for environmental health tracking in ...") International Journal of Environmental Research and Public Health, 16(10).

Environmental Health Australia. (2020). Strategic Plan Strategic Plan. Office of the Chancellor, UPRM, 1, 16. http://www.afpe.org.uk/physical-education/wp-content/uploads/afPE-Strategic-Plan-2016-2020.pdf

Kasmani, N., Abd Azhar, F. S., Syed Badrul, S. M., Abd Manaf, A. A., Abd Jalil, M. A., Shafie, F. A., Karuppannan, S., Zawawi, S., Subramaniam, M., Ismail, S. A., Abdul Majid, A., Mokhtar, K. A., Nizam Kamis, N., & Abu Talib, S. N. (2021). The Current Status and The Way Forward for Environmental Health in Malaysia: The Delivery of Environmental Health Services in Malaysia Series. *MAEH Journal of Environmental Health*, *3*(1), 1–8.

Minister Of Natural Resources and Environment, Malaysia. (2012). The United Nations Conference on Sustainable Development 22 June 2012, Rio De Janeiro The Republic Of Brazil Statement By The Honourable Dato' Sri Douglas Uggah Embassy Minister Of Natural Resources And Environment, Malaysia.

Omar, A. F., Hazani, N. H., Yusup, A. Y., Rahim, M. H., Roslan, R., Shafie, F. A., Zaki, M. A., Hassan, H., Ujang, M. F., Tan, P. A., Hashim, J., Ahmad, R. M., Onasis, A., & Awang, M. F. (2021). Environmental Health Delivery for Developed and Developing Countries: The Delivery of Environmental Health Services in Malaysia Series. *MAEH Journal of Environmental Health*, *3*(1), 22–28.

Secretariat NEHAP Malaysia. (2013). Guidance document: national environment health action plan (NEHAP) Malaysia.

Syed Mohd Nizam, S. N., Mohd Yunus, S., Adam, A., Azizul, M. H. S., Brohan, M. A., Shafie, F. A., Syed Ismail, S. N., Rasdi, I., Lakui, K., Salleh, S. N. R., Asri, M. A., & Mohamad Salleh, M. R. (2021). Environmental Health Staff Competencies and Workloads: The Delivery of Environmental Health Services in Malaysia Series. *MAEH Journal of Environmental Health*, *3*(1), 29–34.

Victor, C., Mansor, M. L. N., Yaacob, M. F., Nordin, M. A., & Shafie, F. A. (2022). An Approach to Pandemic Era – Proper Handling of The Used Face Mask: Life in Pandemic Era Series. MAEH Journal of Environmental Health, 4(1), 16–18.

World Health Organization (WHO). (2020). WHO Global Strategy on Health, Environment and Climate Change and wellbeing sustainably through healthy. https://apps.who.int/iris/bitstream/handle/10665/331959/9789240000377eng.pdf%0Ahttps://apps.who.int/iris/bitstream/handle/10665/331959/9789240000377-eng.pdf?ua=

MAEH Journal of Environmental Health eISSN 2637-1359
Jurnal Kesihatan Persekitaran MAEH
Published By Malaysian Association of Environmental Health
http://www.maeh4u.org.my/journal

URBAN ENVIRONMENT AND PUBLIC HEALTH:

ASSESSING RISKS AND IMPLEMENTING SOLUTIONS SERIES

Preparedness and Mitigation of Flash Floods in Urban Area

Hidayah Abdullah[1], Maizatul Raihanah Mokhtarul Kudus[1], Mohd Khairul Asraf Mustapha[1], Muhammad Rafhan Johary[1], Nur Anis Syamine Muhammad Shukri[1], Nur Najihah Mohamad Zulkifeli[1], Faridah Othman[2], Noor Mazhuari Zakaria[3], Noor Haziqah Kamaludin[1] & Farah Ayuni Shafie[1,4]*

[1]*Centre for Environmental Health and Safety Studies, Faculty of Health Sciences, Universiti Teknologi MARA, Kampus Puncak Alam, Selangor, Malaysia*

[2]*Department of Civil Engineering, Faculty of Engineering, University of Malaya, Jalan Universiti, 50603 Kuala Lumpur, Malaysia*

[3]*ALPS Inspirations Consultant, Kuala Lumpur*

[4]*Malaysian Association of Environmental Health*

**Corresponding author: farahayuni@uitm.edu.my*

Abstract

Flash flood incidents have recently increased, especially in the heart of Malaysia, Kuala Lumpur and its nearby areas. This Focus Group Discussion (FGD) was conducted to identify the reasons and causes behind these incidents. The main objective of this article is to gain a comprehensive understanding of Climate Change and Adaptation Strategies for Human Health by refining the assessment of its health impacts. Additionally, it aims to raise awareness and enhance the understanding of flash floods, as well as assess the level of preparedness of citizens in dealing with such events. The FGD took place at the Teesside Room, Fakulti Sains Kesihatan 6 (FSK 6), UiTM Puncak Alam. Three panellists were invited to participate, namely Prof. Ir. Dr. Faridah Othman from Universiti Malaya (UM), Encik Noor Mazhuari Zakaria representing ALPS Inspirations Consultant and General Takaful Insurance, and Encik Mohd Khairul Asraf bin Mustapha representing the Inspectorate & Enforcement Unit, District Health Office of Tanah Merah. Their opinions were recorded and are presented in this manuscript.

***Keywords*:** urbanization, emergency preparedness, health, safety

1. Introduction

According to Bari et al. (2021), flash floods in Malaysia are the most catastrophic event. Examples of excessive water flow include rainstorms, delayed run-off, and burst dams. Flash floods occur within minutes or hours following severe rain and are particularly dangerous due to their combination of a flood's normal destructive potential, unpredictability, and a short duration. They can cause dry creeks and river banks to fill with water and overflow during a flash flood before people have time to react. The US Department of Commerce (2014) notes that flash floods can be caused by more than just heavy rain, as dam failures, likewise, can also result in walls of water rushing downstream without warning. Various factors contribute to the vulnerability of certain locations vulnerable to flash flooding. Buildings, motorways, and vast parking lots, for instance, can make metropolitan environments unsafe because they restrict the amount of soil available to absorb heavy rains, making metropolitan environments unsafe during such events (Bari et al.,

2021). Flash floods are typically triggered by a sudden rise in water level, high wind speeds, and the presence of debris in rapidly developed areas (Buslima et al., 2018). Climate change, due to its effect of warmer air holding more water, climate change has the potential to generate more intense rainstorm events. However, flash flood occurrences vary greatly from location to location based on the local microclimatic variations, which are challenging to forecast accurately (Bari et al., 2021).

As mentioned in a report by Mahidin (2022), the flood that affected Malaysia in late 2021 and early 2022 had significant impacts on various sectors, including living areas, automobiles, commercial locations, the manufacturing and agricultural industries, as well as public assets and infrastructure. The total loss resulting from the flooding amounted to RM6.1 billion, equivalent to 0.40 percent of the nominal Gross Domestic Product. Losses from dwellings totaled RM1.6 billion, losses from commercial properties reached RM0.5 billion, losses from cars amounted to RM1.0 billion, losses from agriculture were RM90.6 million, losses from manufacturing totaled RM0.9 billion, and losses from public assets and infrastructure amounted to RM2.0 billion.

When flooding occurs in flood-prone areas, Malaysia has effective measures in place to provide information and assistance before, during, and after a disaster. However, due to the changing climate with new patterns, Malaysia needs to enhance its pre-disaster delivery system to mitigate future adverse effects and minimize flood damage. It is also crucial to raise public awareness in order to improve flood preparedness (Harith et al., 2016; Busmah et al., 2021). The objective of this article is to gain a comprehensive understanding of Climate Change and Adaptation Strategies for Human Health by refining the assessment of the health impacts. Additionally, it aims to improve awareness and understanding of flash floods and enhance the level of preparedness among citizens for such events.

3. Preparedness Pertaining to Flash Flood Events

Disaster preparedness is an initiative aimed at increasing readiness and knowledge among the various stakeholders about the risks, relevant agencies, preventive measures, and other disaster-related information (Harith et al., 2016; Zakaria et al., 2022). One mitigation measure for flash floods is the implementation of smart tunnels, which are designed not only for drainage but also for water storage during flood events. To illustrate this concept, consider a bottle with a capacity of 300ml. If we pour 500ml of water into it, the excess water will cause flooding. This analogy emphasizes the need for adequate storage capacity. The government has implemented various storage solutions, such as water retention areas in housing and playgrounds. When water levels exceed their capacity, the water will flow towards these retention areas. From there, it will gradually drain into the drainage system, preventing excessive pressure and water overflow. Different types of retention systems, including surface retention and underground retention, are utilized. In the Klang Valley, three major rivers—Sungai Klang, Sungai Langat, and Sungai Selangor—are present. However, the smart tunnel specifically covers the Sungai Klang area, starting from Kampung Berambang to Klang Gate.

The Ministry of Health (MOH) is one of the agencies involved in disaster preparedness, particularly in terms of medical and public health aspects. In 2015, the Ministry of Health published the Flood Action Plan to address floods and related emergencies. This plan aims to coordinate all efforts of the Ministry of Health in preparing for and providing public health assistance during such incidents. Asraf, a representative from the Ministry of Health, mentioned during the FGD that he has been working at the Health District Office for over ten years and has been directly involved in flood preparedness and mitigation programs. Additionally, compliance with Directive No. 20 from the National Security Council ensures readiness through the formation of committee members at three levels: headquarters, state, and district. This action plan guides the Ministry of Health's preparedness in three phases: before, during, and after the disaster.

3.1. Preparedness Before Disaster

(a) Ensure adequate space and equipment for the Flood Operations Room preparation. This includes setting up a designated area with sufficient space to accommodate the necessary equipment, such as computers, communication devices, and monitoring systems.

(b) Conduct site visits and assessments of locations intended for the settlement of flood victims. This involves evaluating the suitability of the sites in terms of accessibility, infrastructure, sanitation facilities, and capacity to accommodate and provide essential services for displaced individuals.

(c) Conduct studies and preparations in high-risk areas based on past experiences and historical data. Take preventive measures to minimize the occurrence of disease contagious diseases. This may include implementing vaccination campaigns targeting specific groups in certain circumstances only.

(d) Develop a schedule of duties for the relevant health personnel involved in flood preparedness. Clearly define their roles and responsibilities, outlining the activities they are expected to perform during flood situations.

(e) Ensure that all hospitals, health offices, health clinics, and rural clinics are always prepared in terms of logistical needs for health services. This includes maintaining an adequate supply of human resources, medical equipment, and specialized emergency equipment to address the potential influx of patients during flood emergencies.

(f) Provide feedback to the Ministry of Health (MOH) Headquarters and the State and Central Operations Room regarding the preparedness status and any specific needs, if applicable. This information may include the names and contact details of the chief officers on duty, address, operating room locations, telephone numbers, fax numbers, and email addresses for effective communication and coordination.

3.2. Preparedness During Disaster

a) Communicate with and receive instructions from the Disaster Operations Command at the state and regional levels.

b) Establish an effective, complete, and operational Operations Room within the specified timeframe.

c) Ensure that all steps and preparations at each stage are ready and ongoing, as necessary.

d) Conduct a daily Rapid Health Risk Assessment (RHA) daily to track the progression of floods in different areas and relay the information to the Flood Operations Room (Health) at the state and national levels.

e) Monitor the temporary settlement situation of flood victims based on the Temporary Placement guidelines.

f) Monitor the incidence of infectious diseases, particularly waterborne and foodborne diseases, as well as other related illnesses (epidemiological monitoring).

3.3 Preparedness After Disaster

a) Assess the impact or effects of floods on the settlements or villages of flood victims, following the format provided.

b) Receive reports and monitor the situation in flood-affected areas regarding the increased incidence of infectious diseases, particularly waterborne and foodborne diseases like cholera, typhoid, food poisoning, diarrhea, and dysentery.

c) Implement measures to prevent infectious diseases, including the provision of safe drinking water, sanitary toilets, hygienic food preparation practices, health advice, and other relevant measures.

d) Prepare a comprehensive final report on the flood situation, covering the public health actions taken, weaknesses which have been identified, and recommendations for action made for the future actions.

However, Asraf emphasized the importance of readiness at the individual and family levels, stressing the need for awareness regarding flood expectations and necessary preparations. An all-hazards preparedness handbook, based on the Centers for Disease Control and Prevention, is available for individuals and families to utilize (Harith et al., 2016).

4. Food Safety Issues during Flash Flood Events

Food safety is a crucial element during disaster events. An article authored by Mikulsen and Diduck (2016) proposes a comprehensive, integrated model for food safety that combines the cycle of disaster management with the governance framework for food safety. The model aims to unify various factors involved in food safety and food catastrophe decision-making, while also allowing for communication and public engagement initiatives that encompass a wider range of concerns and activities compared to standalone models. The integrated model's main objective is to reimagine decision-making processes by emphasizing the importance of dialogical risk communication and deliberate public participation in all aspects of health and catastrophe governance.

Water and foodborne diseases often occur during and after floods. These diseases, such as typhoid fever, cholera, hepatitis A, dysentery, and food poisoning, are frequently diagnosed in flood victims. Common symptoms include diarrhea, vomiting, fever, abdominal pain, and headache. Infections are typically caused by consuming contaminated water or food. These diseases are highly contagious and pose significant risks. Monitoring and control of disease incidence are carried out by government-appointed medical and health officers, as well as environmental health officers appointed by the government.

Asraf explained that at the district level, the Ministry of Health (MOH) receives a list of caterers responsible for preparing food and water for flood victims at temporary placement centers. Prior to any flood event (in the case of seasonal flooding or adverse weather signals from the Malaysian Meteorological Department), inspections are conducted as part of their preparation. Additionally, all food handlers involved in food preparation are advised to have valid anti-Typhoid injections and food handler training certificates. These measures aim to ensure compliance, promote good behaviour, and establish proper practices among food handlers to prevent food and waterborne diseases.

During the flood event, the team from the Health District Office team visits the temporary placement centres daily. The purpose is to ensure that the food that the victim received is well and in good condition. If necessary, health education on food safety is repeatedly provided to the victims, particularly children under twelve, emphasizing the use of clean and safe water and the importance of consuming their food within four hours from receiving it to prevent spoilage.

5. Relationship between Climate Change and Flash Floods

The hydrological cycle is expected to intensify with global warming, leading to an increased risk of flooding and more intense extreme precipitation events. The changes observed often differ from the expected increase in the water-holding capacity of the atmosphere under warmer conditions, particularly when water availability is limited (Tabari, 2020).

According to the Focus Group Discussion conducted, Prof. Ir. Dr. Faridah mentioned that the Climate Change index is measured based on Greenhouse Gas (GHG) emissions. Human activities such as combustion, open burning, and fertilizer usage contribute to human activities. The increase in GHG concentrations leads to a rise in temperature. Previous research indicates that human activities are the main driver of the increase in GHG concentration. The primary effects of Climate Change include droughts and increased precipitation, particularly heavy rainfalls. Climate Change leads to an increase in atmospheric moisture, resulting in more intense rainfall within shorter periods. Floods are often associated with Climate Change due to the high intensity of rainfall. Insufficient drainage capacity and inadequate maintenance of the drainage systems are major factors contributing to flash floods. Sedimentation from construction activities and the accumulation of rubbish block the drains, impeding the smooth flow of water from flowing smoothly.

6. Insurance for Natural Disasters

Firstly, it is important to note that "natural disaster insurance" is not a specific type of insurance policy that can be purchased by people. However, homeowners insurance typically provides coverage for various perils, including wind and rainstorms, accumulation of snow, and fire. Homeowners' insurance can also be extended to provide protection against more extreme natural disasters such as tornadoes, wildfires, volcanic eruptions, falling meteorites, and blizzards.

Additionally, car insurance coverage also can be expanded to include protection against floods. While this additional coverage may come at a higher cost, it is worth considering, particularly if the community area is prone to flooding.

7. Conclusion

Lately, there has been a rise in the frequency of flash floods, impacting a significant number of people both physically and mentally. Flash floods can result in substantial losses to the economy, resources, individuals, and properties. Climate change is among the various factors contributing to flash floods. Implementing measures like Smart Tunnels can help mitigate the impact of flash floods in urban areas, although they can be costly to implement. It is crucial for the government to increase awareness among the public so that people can be more vigilant and prepared before, during, and after such disasters. Individually, Malaysians should be prompt in responding to be more quick to respond if incidents like flash floods happen and always be prepared. Given the unpredictable nature of climate and disasters, people should be predicted, so people should be more ready to mitigate and prepare for such events. In the future, we can expect an increase

in the number of people opting for insurance coverage as awareness about insurance grows through media channels.

References

Bari, M. A., Alam, L., Alam, M. M., Rahman, L. F., & Pereira, J. J. (2021). Estimation of losses and damages caused by flash floods in the commercial area of Kajang, Selangor, Malaysia. *Arabian Journal of Geosciences*, *14*, 1-9.

Buslima, F. S., Omar, R. C., Jamaluddin, T. A., & Taha, H. (2018). Flood and flash flood geo-hazards in Malaysia. *Int. J. Eng. Technol*, *7*(4), 760-764.

Busmah, M. R., Nik Ab. Rahim, N. N. A. Z., Abdul Kadir, N. N., Saleh Tawfeeq, T. A., Baderu Khisam, M. R., Shafie, F. A., Dom, N. C., Riyadzi, M. R., Loo, P. L., Abu Samah, N., Zulfakar, S. S., & Mohamed, N. H. (2021). Environmental Health Law Enforcement: The Delivery of Environmental Health Services in Malaysia Series. *MAEH Journal of Environmental Health*, *3*(1), 14–21.

Harith, N., Tohit, N. F. M., Rusli, M. F., & Juni, M. H. (2016). Assessing Malaysian disaster preparedness for flood. *International Journal of Public Health and Clinical Sciences*, *3*(2), 1–15.

Mahidin, M. U., Special Report on Impact of Floods in Malaysia 2021 (2022). Department of Statistics.

Mikulsen, M., & Diduck, A. P. (2016). Towards an integrated approach to disaster management and food safety governance. *International Journal of Disaster Risk Reduction*, *15*, 116-124.

Tabari, H. (2020). Climate change impact on flood and extreme precipitation increases with water availability. *Scientific reports*, *10*(1), 1-10.

US Department of Commerce, (2014, September 24). *Floods*. National Weather Service. Retrieved May 25, 2022, from https://www.weather.gov/pbz/floods.

Zakaria, N., Mior Ismail, W. N., Zainal Abidin, N. N., Hashim, N., Saari, R., & Shafie, F. A. (2022). Building Climate-Resilient and Sustainable Cities During Pandemic: Life in Pandemic Era Series. *MAEH Journal of Environmental Health*, *4*(1), 1–5.

MAEH Journal of Environmental Health eISSN 2637-1359
Jurnal Kesihatan Persekitaran MAEH
Published By Malaysian Association of Environmental Health
http://www.maeh4u.org.my/journal

URBAN ENVIRONMENT AND PUBLIC HEALTH:

ASSESSING RISKS AND IMPLEMENTING SOLUTIONS SERIES

Urbanization and Changing Dietary Habits

Rosnita Mohd Amin[1], Nur Ain Shohaime[1], Noruzana Rozaiman[1], Muhaini Mohmad[1], Md Tarmizi Tami Sha[1], Mohd Shuib Mohd Hassan[1], Noor Haziqah Kamaludin[1], Farah Ayuni Shafie*[1,2]

[1]*Centre for Environmental Health and Safety Studies, Faculty of Health Sciences, Universiti Teknologi MARA, Kampus Puncak Alam, Selangor, Malaysia*

[2]*Malaysian Association of Environmental Health*

**Corresponding author: farahayuni@uitm.edu.my*

Abstract
With the rising rate of urbanization, Malaysians' opportunities to dine out have substantially expanded. Over the past several years, there has been a steady growth in the demand for multinational fast-food companies due to the global spread of fast-food marketing. Today, the fast-food sector has adapted to Malaysian dietary needs and has become a major phenomenon in the country. Changes in dietary patterns, such as food choices, are known to be linked to changes in health status and may increase the number of chronic illnesses. Thus, a rapid increase in urbanization brings about a change in economic status, resulting in significant changes in lifestyle, including food habits and diseases.

Keywords: Fast food, food additives, preservation, food hygiene, non-communicable diseases

INTRODUCTION

Food plays a vital role in representing our cultural background, way of life, values, and level of wealth. In today's globalized and urbanized world, our dietary habits are evolving. Fast food has gained popularity as a convenient meal option among Malaysians due to factors such as increasing prosperity, urbanization, changing lifestyles, and more women joining the workforce (Baskaran et al., 2017; Ismail et al., 2022). The fast-paced nature of modern life has led people to favor eating at local fast-food restaurants instead of preparing meals at home (Krishnan et al., 2022). Access to a wide range of foods, including calorie-dense and processed options, has contributed to a shift from traditional to Western-style diets (Casari et al., 2022).

Maintaining a nutritious diet is crucial for overall health and the prevention of chronic diseases, as it helps reduce the risk of being overweight or obese (Lassale et al., 2019). Various factors, including individual characteristics and influences from the physical, social, and economic environments, contribute to poor dietary choices, with easy access to affordable fast food being a significant factor (Velde et al., 2022; Sulaiman et al., 2020). The accessibility of fast food promotes impulsive and binge eating, which are influenced by strict time constraints for meal preparation at home, at work, and in the community. In many urban low and middle-income communities, the burden of infectious diseases remains high, alongside increasing rates of obesity and dietary-related non-communicable diseases related to diet (Vargas et al., 2022; Abidin et al., 2020).

Food safety has become a major concern in developing countries. The importance of quality, freshness, ease of preparation, and cleanliness in urban food safety has gained significant attention. Customers of fast food restaurants have expressed concerns about various food-related issues, including pesticides, vegetable residues, excessive use of artificial flavor enhancers and colorants, bacterial contamination, migration of harmful substances from plastic packaging, and the generally unsanitary conditions in which food preparation and handling practices (Dey & Nagababu, 2022; Omari & Frempong, 2016). As consumers, we all bear the responsibility of ensuring the safety of the food we consume. Given the complexities of food safety, consumers need quick, accurate, and reliable information about the health and nutritional risks associated with their food choices due to the complexity of food safety (Wang et al., 2022).

This study aims to describe the impact of unhealthy food consumption, particularly fast food, resulting from lifestyle changes in urban environments. It also explores how cities can develop sustainable environmental practices to ensure that people will have access to healthy, nutritious, and safe food. Initiating and implementing policies, awareness campaigns, and programs by the government, local authorities, and Non-Governmental Organizations (NGOs) are advantageous in addressing issues related to unhealthy food and food safety for the urban community, as they are essential factors for enhancing the quality of urban life.

Urban Food: Chemical Risks

Food safety is a global concern that affects everyone around the globe. It involves protecting the food supply chain from the introduction, growth, or survival of harmful microbial or chemical

agents (Gizaw, 2019). In the urban food landscape, chemicals are extensively used to inhibit microbial growth of microbes like yeasts and prevent fat oxidation of fats that leads to rancidity, as highlighted by Dr. Nooratiny Ishak of the Department of Chemistry in Malaysia. Consequently, a significant portion of our food consists of chemical additives. Commonly used preservatives include sugar, salt, nitrites, Butylated hydroxytoluene (BHT), tert-butylhydroquinone (TBHQ), vinegar, citric acid, and calcium propionate. Adulterants, substances that compromise the safety or efficacy of food ingredients, have been added to food since ancient times to increase quantity while reducing quality (Bavadharini et al., 2022).

The presence of hazardous substances in food poses a threat to many nations, causing various illnesses among consumers, often without their awareness (Essuman et al., 2022). When consumers have doubts or suspect fraud in a particular food product, there is currently no standardized analysis available to differentiate between a genuine product and an adulterated one. However, the temptation for adulteration, especially during periods of food scarcity and the pursuit of economic profit, has increased alongside population growth, urbanization, and the demand for more convenient and readily available, and ready-to-serve food products (Meghwal et al., 2022).

While developed countries have advanced technology to detect counterfeit and contaminated food products, developing countries often lack the necessary equipment to detect counterfeit and tainted food goods (Bavadharini et al., 2022). The Malaysian Department of Chemistry has made strides in enhancing its services through scientific research and quality assurance to ensure compliance with regulations regarding hazardous compounds in food. Molecular methods are preferred for detecting biological adulterants, while physical and biochemical techniques are employed to identify other adulterated substances. Breakthroughs in food. To combat chemical risks in urban foods, animal testing, chemical analysis, endocrine-active substances, toxicological thresholds, margin exposure, and DNA technology have contributed to addressing chemical risks in urban food (Meghwal et al., 2022).

Urban Eating Lifestyle Vs. Chronic Diseases

The current prevalence of chronic diseases in Malaysia and the contributing factors that contribute to them, are closely intertwined with lifestyle and urban eating habits. Consequently, the government has called for behavior modification among the population. Chronic diseases such as diabetes, heart disease, and cancer are prevalent examples of chronic diseases. Mrs. Mushidah Zakaria, Senior Dietitian from Prince Court Medical Centre, highlighted that a significant percentage of adults, 25.1%, are physically inactive, with females exhibiting higher levels of inactivity at 28.2% (Yadav & Krishnan, 2008). The dietary habits of urban dwellers, including frequent dining out, are influenced by viral food trends on social media platforms, and e-hailing services have made food delivery more accessible.

Many meals consumed outside the home consist of large portions and are higher in salt and sugar, and low in fiber content. A presenter noted that only 1 in 5 respondents were aware of the Malaysian Healthy Plate Concept, which advocates for a quarter of the plate to be filled with protein, a quarter with carbohydrates, and half with vegetables.

Processed food refers to food that has undergone cooking, canning, freezing, packaging, or alteration in nutritional composition through fortification, preservation, or unconventional preparation methods. A lack of awareness exists regarding the additives present in processed foods. Additives in processed foods can include artificial colors, flavors, sweeteners, emulsifiers, and preservatives. Processing food occurs during cooking, baking, or food preparation. Unprocessed foods, such as fruits, vegetables, grains, nuts, and legumes, herbs, spices, garlic, eggs, and milk, as well as seafood, and meats, are reliable sources of protein.

Processed foods are created when substances such as oil, sugar, or salt are added to foods before packaging. According to (Moubarac et al. (2013), the quality of the diet declines as the proportion of ultra-processed products increases. However, not all processed foods are detrimental to health; some, such as bread, cheese, tofu, and canned tuna or beans, can be part of a healthy meal. Ultra-processed foods are the ones that should be minimized, as they account for nearly half of the calories consumed. These foods undergo multiple processes, such as extrusion, molding, and milling.

Examples of ultra-processed foods include soft beverages, chips, chocolates, candies, ice cream, sweetened breakfast cereals, packaged soups, chicken nuggets, hotdogs, fries, and other foods that include many extra components and are heavily modified food items. Making small modifications to our habits can have a positive impact. For instance, reducing the consumption of sugary beverages and increasing fiber intake is recommended. Aim for at least two servings of fruits and three servings of vegetables daily, as fiber enhances satiety. Portion control is important, and it is beneficial to have at least one home-cooked meal each day, choosing low-fat foods. Additionally, engaging in physical activity for a minimum of 2 hours and 30 minutes per week is advised.

Food Premise Hygiene: Crisis Vs. Safety

Despite Malaysians' strong passion for food, there is a lack of significant concern about food safety. The urban phenomenon of diverse food options from a wide range of foods from various locations presents challenges in ensuring food safety nationwide poses obstacles; the main concern is how food safety as food supply chains become more complex. This is not due to say that incidents are scarce. Foodborne diseases rank among the top five communicable diseases in Malaysia (Abdullah & Ismail, 2021). According to the World Health Organization (WHO, 2016), among the established foodborne illness burden in Southeast Asia faces a burden of foodborne illnesses that include non-typhoidal Salmonella, pathogenic Escherichia coli, and norovirus.

The food industry has transitioned from a scenario where distribution channels were well-known and unlimited and widely known to a booming global trade with a broader range of items supplied items, posing new challenges for food safety. Factors such as the emergence of these foodborne pathogens, rapid outbreak spread, and the magnitude of food crises contribute to these challenges. Notably, high-demand foods carry a greater risk of food contamination (Ismail et al., 2022).

Cross-contamination and unhygienic food handling practices are the key factors contributing to the occurrence of foodborne diseases. Mr. Baharudin bin Osman, an Environmental Health Officer from Pejabat Kesihatan Daerah Seberang Perai Tengah, emphasized six fundamental aspects of food safety: food handling, facilities and equipment, food preparation, storage practices, washing and sanitation, and vector control.

To mitigate hazards in the food industry, the government has enhanced preventive efforts. Malaysia's Food Hygiene Regulations, implemented in February 2009, aim to ensure the provision of providing customers with high-quality and safe food to consumers. This legislation mandates the registration of food premises and addresses the conduct, maintenance, handling, and specific requirements for preparing, packing, serving, storing, and selling food. Ongoing surveillance programs, effective inspections, and risk communication are crucial for maintaining food safety.

Other relevant laws include the Food Act 1983, Food Regulation 1985, and Vector Borne Control Act 1988. Strategies for guaranteeing food safety involve reviewing and updating legislation, strengthening implementation, improving collaboration among government agencies, consumer groups, academia, the food industry, and international organizations, as well as developing and training food handlers. Additionally, raising customer knowledge and awareness of food safety issues is paramount.

CONCLUSION

In summary, the impact of urbanization on food and eating habits is significant due to factors such as a rising global population, technological advancements, and stressful, busy lifestyles. This shift has resulted in individuals having limited time to prepare meals at home and opting for dining out or takeaway options. However, it is crucial for consumers to be aware of the potential health risks associated with the chemicals present in processed foods, which can contribute to chronic diseases.

To mitigate these effects, it is important to incorporate regular physical exercise, maintain a balanced and healthy diet, and include a variety of homemade meals. Additionally, consumers can make informed choices by selecting establishments that adhere to food safety standards such as Good Manufacturing Practice (GMP), Hazard Analysis and Critical Control Point (HACCP), Clean, Safe and Healthy or "Bersih, Selamat dan Sihat" (BESS), and the Industry Responsibility Safe Food Scheme (MESTI) implemented by the Food Safety and Quality Division, Ministry of Health.

Education about healthy eating practices, fostering social responsibility among food entrepreneurs, and effective governance by local authorities are vital factors in enhancing the important factors for urban quality of urban life. By promoting these measures, we can ensure the health and safety of consumers while supporting sustainable urban development.

CONTRIBUTION STATEMENT

A webinar entitled "When food can kill you" was held on 8th June, 2022. The webinar was conducted by UiTM students with three panelists from a great background discussing the relevant topics. The first topic was "Urban Food: Chemical Risk" by Dr. Nooratiny Ishak, a Science Officer from the Department of Chemistry, Malaysia. This topic discusses the composition of chemicals in fast foods, such as food additives, preservation, and adulteration. This topic was explained in detail in terms of the advantages and disadvantages of these chemical compounds in fast foods. The second topic was "Urban Eating Lifestyle vs. Chronic Disease" by Mrs. Mushidah Zakiah, a senior dietitian from Prince Court Medical Centre. The objectives of this topic are to gain knowledge about the prevalence of chronic illnesses in Malaysia today, the factors that contribute to them, and how urban eating practices relate to them. Mr. Baharudin bin Osman, an Environmental Health Officer from Pejabat Kesihatan Daerah Seberang Perai Tengah, Ministry of Health, presented "Food Premises Hygiene: Crisis vs. Safety." This topic benefits the audience to gain awareness about food safety and food hygiene on food premises. The webinar attracted a total of 323 participants from various backgrounds.

REFERENCES

Abdullah, N. B. A., & Ismail, A. F. (2021). Food poisoning outbreaks among schoolchildren in Terengganu and their associated factors. *Sains Malaysiana, 50*(4), 1027–1036.

Abidin, N. F. Z., Anuar, S. F. H., Bakar, A. A., Isa, I., Mahiddin, N. A. K., Shafie, F. A., Abidin, E. Z., Azidin, M. L., Aziz, K. I., Chandrakant, P., & Veeramohan, S. (2020). On Social Norm: Extension of Non-Smoking Areas: The Langkawi Charter on Urban Health. *MAEH Journal of Environmental Health*, *2*(1), 12–14.

Baskaran, S., Ayob, S. A., Howe, N. C., & Mahadi, N. (2017). Understanding purchase intention of ready-to-eat food among Malaysian urbanites: A proposed framework. *Int. J. Acad. Res. Bus. Soc. Sci, 7*, 566-579.

Bhavadharini, B., Kavimughil, M., Malini, B., Vallath, A., Prajapati, H. K., & Sunil, C. K. (2022). Recent Advances in Biosensors for Detection of Chemical Contaminants in Food—a Review. *Food Analytical Methods*, 1-20.

Casari, S., Di Paola, M., Banci, E., Diallo, S., Scarallo, L., Renzo, S., ... & Lionetti, P. (2022). Changing Dietary Habits: The Impact of Urbanization and Rising Socio-Economic Status in Families from Burkina Faso in Sub-Saharan Africa. *Nutrients, 14*(9), 1782.

Dey, S., & Nagababu, B. H. (2022). Applications of Food Colour and Bio-Preservatives in the Food and Its Effect on the Human Health. *Food Chemistry Advances*, 100019.

Essuman, E. K., Teye, E., Dadzie, R. G., & Sam-Amoah, L. K. (2022). Consumers' Knowledge of Food Adulteration and Commonly Used Methods of Detection. *Journal of Food Quality.*

Gizaw, Z. (2019). Public health risks related to food safety issues in the food market: a systematic literature review. *Environmental health and preventive medicine, 24*(1), 1-21.

Ismail, N. A. F., Nasir, N. M., Ghazali, S. N. F. M., Zamli, S. S., & Shafie, F. A. (2022). Delivering Safety and Hygiene: Online Food Delivery during Crisis: Life in Pandemic Era Series. *MAEH Journal of Environmental Health, 4*(1), 12-15.

Joshi, S. (2008). The sick building syndrome. *Indian Journal of Occupational and Environmental Medicine, 12*(2), 61.

Krishnan, A. R., Hamid, R., Lin, R. Y. S., Tanakinjal, G. H., & Rathakrishnan, B. (2022). Making Informed Decisions to Improve Restaurant Image Using a Hybrid MADM Approach: A Case of Fast-Food Restaurants in an Island of East Malaysia. *Information, 13*(5), 219.

Lassale C, Batty GD, Baghdadli A (2019) Healthy dietary indices and risk of depressive outcomes: a systematic review and meta-analysis of observational studies. *Mol Psychiatry 24*, 965–986.

Meghwal, M., Mahalakshmi, M., Mahalakshmi, R., Rani, S., de Souza, C. K., Jain, S., ... & Hoffmann, T. G. (2022). Food Adulteration: A Challenge for Safer Food. In *Food Safety Practices in the Restaurant Industry* (pp. 221-254). IGI Global.

Moubarac, J. C., Martins, A. P. B., Claro, R. M., Levy, R. B., Cannon, G., & Monteiro, C. A. (2013). Consumption of ultra-processed foods and likely impact on human health. Evidence from Canada. *Public Health Nutrition, 16*(12), 2240–2248.

Petruzzello, M., 2022. Encyclopaedia Britannica | History, Editions, & Facts. Encyclopedia Britannica. Available at: https://www.britannica.com/topic/Encyclopaedia-Britannica-English-language- reference-work [Accessed 19 May 2022]

Omari, R., & Frempong, G. (2016). Food safety concerns of fast food consumers in urban Ghana. *Appetite, 98*, 49–54.

Redlich, C. A., Sparer, J., & Cullen, M. R. (1997). Sick-building syndrome. *The Lancet, 349*(9057), 1013–1016.

Saijo, Y. (2020). Sick building/house syndrome. *Indoor Environmental Quality and Health Risk toward Healthier Environment for All*, 21-38.

Sulaiman, M. S., Halim, N. M. H. N. A., Kamari, I. Z., Pungging, P., Wahab, N. A., Rahman, S. A. A., Shafie, F. A., Megat Mokhtar, M. A., Tee, E. O., Baharudin, M. R., Maon, M. P., Bakar, R. A., Nadziah, N., Yahaya, M. F. R., & Setapa, A. (2020). Raising Food Safety to Street Food Vendors in Urban Area: The Langkawi Charter on Urban Health. *MAEH Journal of Environmental Health*, *2*(1), 8–11.

Velde, L., Zitman, F., Mackenbach, J., Numans, M., & Kiefte-de Jong, J. (2022). The interplay between fast-food outlet exposure, household food insecurity and diet quality in disadvantaged districts. *Public Health Nutrition, 25*(1), 105-113.

Wang, F. J., Wang, L. Q., Zhang, X. C., Ma, S. F., & Zhao, Z. C. (2022). Study on the barrier properties and antibacterial properties of cellulose-based multilayer coated paperboard used for fast food packaging. *Food Bioscience, 46*, 101398.

World Health Organization. (2016). Burden of foodborne diseases in the South-East Asia Region. In WHO Library Cataloguing-in-Publication data.

Yadav, K., & Krishnan, A. (2008). Changing patterns of diet, physical activity and obesity among urban, rural and slum populations in north India. *Obesity Reviews, 9*(5), 400–408.

MAEH Journal of Environmental Health eISSN 2637-1359
Jurnal Kesihatan Persekitaran MAEH
Published By Malaysian Association of Environmental Health
http://www.maeh4u.org.my/journal

URBAN ENVIRONMENT AND PUBLIC HEALTH:

ASSESSING RISKS AND IMPLEMENTING SOLUTIONS SERIES

Risk Assessment and Disaster Management at Petrol Stations

Haizul Afta Masri, Mohd Zairie Mohd Yusuff, Mohd Zulkifli Jusoh, Nur Izzah Bahaman, Nur Husna Othman, Noor Haziqah Kamaludin, Farah Ayuni Shafie*

Centre for Environmental Health and Safety Studies, Faculty of Health Sciences, Universiti Teknologi MARA, Kampus Puncak Alam, Selangor, Malaysia

**Corresponding author: farahayuni@uitm.edu.my*

Abstract

Petrol stations are classified as hazardous workplaces due to the presence of flammable substances, such as petrol and diesel, which are stored underground in tanks. These substances pose risks to employees, employers, the public, property, and the environment. Handling flammable and hazardous materials at petrol stations can lead to fire and explosion hazards. Risk assessment is a crucial process that involves estimating the level of risk and determining whether it is acceptable or tolerable. The government advises petrol station operators to comply with the Petroleum Safety Measure Act 1984 in order to mitigate the risk of dangerous incidents on their premises. This article emphasizes the importance of petrol stations being prepared for disasters or crises and highlights the need for all stakeholders to have a clear understanding of risk and emergency response plans to promote best practices, particularly in Malaysian petrol stations.

Keywords: gas station, petrol filling station, fire safety, explosion

INTRODUCTION

Crude oil, petroleum products, and natural gas are the primary energy sources in Malaysia (Saari et al., 2018). Industrial, residential, and commercial sectors account for 51.7% of Malaysia's total oil demand. The demand for petroleum products in terms of energy consumption is growing at a rate of 4.5% per year. The transportation sector is the largest consumer of energy in Malaysia. Petrol stations play a crucial role in supplying these essential energy sources to consumers, not only in Malaysia but also worldwide. Apart from fuel and lubricants, petrol stations often offer additional services such as automobile accessories and parts sales, food and beverage sales, car servicing and washing, as well as vehicle accessory and part installation or repair (Saari et al., 2016). Common dangerous chemicals found at petrol stations, which can be potential air contaminants, include unleaded petrol, premium unleaded petrol, diesel, and compressed natural gas (Anuar et al., 2022).

In Malaysia, petrol stations attract public attention, regardless of whether they are located in urban or rural areas. The increasing availability of convenience facilities at petrol stations, such as ATMs, cafes, fast food outlets, car washes, Suraus (prayer rooms), and sundry shops, has attracted more visitors. As a result, petrol stations have become not only a place for refuelling vehicles but also a hub for various activities. With the growing number of visitors, the risk of fire incidents at petrol stations has also increased.

Handling flammable and hazardous materials at petrol stations can lead to fire and explosion hazards. These materials possess properties such as volatility, high flammability, explosiveness, and the ability to release vapors even at low temperatures (Luo et al., 2022). Therefore, when addressing risks associated with petrol station operations, it is crucial to have comprehensive knowledge that can help mitigate and eventually eliminate the effects of these primary hazards. Operating a petrol station entails risks to individuals, the environment, property, and reputation.

In recent years, various incidents involving petrol stations, including those in Malaysia, have been reported by the media. These incidents have resulted in property damage, injuries, and even fatalities. One notable recent event was the explosion and fire incident in Rantau Panjang, Kelantan, which was caused by static electricity resulting in the formation of sparks due to unbalanced electric charges on or within a conducting substance.

Risk assessment is a valuable approach for identifying and estimating the risk of fires and explosions from the entire layout of a petrol station in Kota Bharu, Kelantan, including the toilets, underground storage tanks, petrol pumps and retail area. Thus, an effective risk management framework was developed to highlight the hazards and risks so the operations at the petrol station would be inherently safer (Salleh et al., 2021).

Environmental, Safety & Health (EHS) Implementation among Petrol Station

The Petroleum Act (Safety Measures) 1984 (PSMA 1984) was established to ensure safety in the transportation, storage, and utilization of petroleum. The act covers various provisions concerning the transportation of petroleum via road, railway, water, air, and pipelines. It also addresses the storage, handling, and utilization of petroleum, including equipment, buildings, and materials.

Petrol and diesel are the most commonly found chemicals in gas stations. These fuels are typically stored in large quantities underground at petrol stations. As flammable materials, petrol and diesel can pose a risk of explosions if proper safety measures are not followed by operators, employees, and consumers at petrol stations.

In the state of Kelantan, there are a total of 175 petrol stations, with the highest number located in Kota Bharu, accounting for 62 stations. Records of accidents related to petrol stations in Kelantan indicate that three incidents have occurred from 2014 to 2022. These incidents have resulted in injuries, vehicle damage, and damage to the petrol station itself. Compliance with the rules outlined in the PSMA can help reduce the risk of such dangerous events.

Petrol station operators are required to adhere to seven inspection elements, which can be categorized into administrative and physical inspections. Administrative elements, such as safety management and the provision of personal protective equipment, can be managed through administrative measures. Physical inspection elements include unloading from road tankers, physical safety measures, underground storage tanks, dispensing areas, and emergency response plans. These inspections are essential to ensure the safety and proper functioning of petrol stations.

Disaster Management

A disaster is an incident that occurs suddenly, is complex in nature, and results in the loss of lives, damage to property or the environment, and disruption of daily activities in local communities. Disasters can happen at any time and in any place, and they are unavoidable. However, the impact and losses caused by disasters can be reduced through the effective management of disaster information (Torani et al., 2019; Salleh et al., 2021).

Disaster management is the process of effectively preparing for and responding to disasters. It involves the strategic organization of resources to minimize the harm caused by disasters. It also encompasses a systematic approach to managing the responsibilities of disaster prevention, preparedness, response, and recovery (Qonono, 2019). By implementing proper disaster management practices, communities can enhance their ability to mitigate the effects of disasters and improve their overall resilience.

Fire Hazard at Petrol Station: Fire Risk Assessment

In evaluating a fire risk assessment, it is crucial to identify the fire hazards and risks present in a petrol station. This ensures that owners and petrol station workers are aware of the potential hazards and risks that could arise in the event of any incident. After collecting data on the hazards specific to the petrol station, decisions must be made to mitigate and control these hazards. It is important to have competent individuals with extensive knowledge and experience in fire safety to provide guidance and advice to the premises owner during the fire risk assessment process (Spinardi & Law, 2019).

The fire risk assessment process typically involves five stages. Firstly, the fire hazards within the petrol station need to be identified. Secondly, the people who may be at risk in the event of a fire, including workers and customers, must be identified. Thirdly, the level of risk associated with each identified hazard needs to be evaluated, considering factors such as likelihood, potential consequences, and the vulnerability of individuals at risk. Fourthly, data collection is conducted, gathering relevant information to support the risk assessment process. Finally, the data collected is reviewed, analyzed, and revised as necessary to ensure continuous improvement and effectiveness (Akashah et al., 2017).

Stages of Fire Risk Assessment: Identify Fire Hazard

In the event of a fire incident at a petrol station, the presence of ignition, fuel, and oxygen is necessary for a fire to occur. This three-component model is commonly referred to as the fire triangle, and the removal of any one of these components would reduce the risk of a fire incident (Shimada et al., 2022). It is important to note that the capacity of a powder fire extinguisher may not be sufficient for extinguishing a fire involving hydrocarbon products due to their chemical properties. Instead, a high-pressure foam fire extinguisher is often needed to effectively put out the fire (Liu et al., 2022).

The second stage in fire risk assessment involves determining the origin of the fire. In a petrol station, there are various potential sources of fire, including solid, liquid, and gas materials. Solids such as textiles, wood, papers, and waste materials can serve as fuel sources. Liquids such as solvents, petrol, diesel, and adhesives are also present. Additionally, gases like liquid petroleum gas (LPG) and acetylene can be found in a petrol station (Sharma et al., 2022).

Abundant oxygen is another factor contributing to the fire hazards in a petrol station. While oxygen is present in all premises, petrol stations pose a higher risk of fire ignition due to the presence of hydrocarbon liquids, which are highly susceptible to fire. When combined with potential sources of ignition, such as hot surfaces, naked flames, sparks from activities like grinding or welding, friction, sparks, or deliberate arsonist actions, the chances of a fire incident occurring increase (Health and Safety Executive, 2022).

Stages of Fire Risk Assessment: People at Risk

In the event of a fire, the ingestion of fire and smoke by victims often leads to fatalities, even before the fire directly reaches and burns them. Therefore, ensuring the availability of adequate escape passages should be the main priority to prevent casualties. All premises should have well-designed escape routes that enable occupants to evacuate the scene before the fire spreads, utilizing all available exits (Health and Safety Executive, 2022).

When assessing fire risks, it is important to consider factors such as the speed of fire growth, the heat generated by the fire, and the smoke it produces, as each type of fire behaves differently. In the fire risk assessment, it is essential to take into account not only the safety of employees but also that of contractors, visitors, and the general public, who are categorized as "relevant persons" under the fire safety order. Adequate arrangements should be made to provide clear instructions in the event of a fire, disseminate danger rapidly, and utilize alarm systems and fire detection methods as necessary. Informing all "relevant persons" about the fire and ensuring they possess the necessary capabilities to escape quickly, easily, and safely is of utmost importance.

Stages of Fire Risk Assessment: Evaluating The Risk

To reduce the risk of fire hazards, it is important to implement actions that bring the risk to an acceptable level. Various measures can be taken to prevent ignition, such as turning off the engine while transferring hydrocarbons into vehicles, avoiding the use of mobile phones that can potentially produce sparks, and refraining from smoking cigarettes while using the pump. These measures, along with other preventive actions, should be considered to minimize the possibility of ignition (Akashah et al., 2017).

Minimizing the presence of fire-prone items in the premises is also crucial in reducing the risk of burns. Discarding unnecessary items,

particularly waste materials, helps decrease the fuel source, thereby reducing the potential for the fire to spread. Additionally, establishing an emergency response team can aid in controlling fires during the initial stages and ensure the safe evacuation of premises occupants to designated assembly sites (Akashah et al., 2017). By conducting risk assessments at an early stage and implementing preventive and remedial measures, the likelihood of fire incidents occurring can be significantly reduced. Early intervention and proactive measures play a critical role in preventing and mitigating fire risks.

Stages of Fire Risk Assessment: Record

It is important to maintain records of all significant findings from the previous stages of fire risk assessment. Premises should obtain the necessary licenses and comply with the requirements stated in the enactment and fire safety order. For large premises, providing easily understood floor plans along with proper risk assessments is mandatory. These floor plans serve as guidance for the floor commander during a fire incident, enabling them to evacuate occupants and rescue individuals trapped in a timely manner (Kuncoro et al., 2023).

In certain premises, there may be hazardous items that can increase the risk to both occupants and firefighting teams. It is essential to register and store these items in accordance with the appropriate requirements. For example, substances like Boron tribromide and Calcium carbide are highly explosive when they come into contact with water. Firefighters need specific information about these hazardous items to effectively respond to incidents involving them (Rielage, 2020).

Stages of Fire Risk Assessment: Review and Revising All Stages

Fire risk assessment is an ongoing process that requires regular monitoring and auditing to ensure its effectiveness (Shield Safety, 2016). It is crucial to keep the fire-risk assessment up to date and valid. If there are any indications that the assessment is no longer valid, such as after a near-miss incident or a significant change in the level of hazards on the premises, it should be re-evaluated.

Amendments to the fire-risk assessment may be necessary if there are changes in the premises, such as alterations to the layout that impact the availability of exits. If the occupancy increases and the existing exits cannot accommodate the larger numbers, additional exits may need to be constructed. Changes in the use of structures that pose an increased risk of fire, particularly those related to electrical causes, should also be taken into consideration. Any structural modifications must adhere to specified guidelines to prevent an increase in risk for all parties involved (Occupational Safety and Health Administration (OSHA), 2015).

Emergency Response Team (ERT) Set-up

The establishment of an Emergency Response Team (ERT) is mandated by the Occupational Safety and Health (OSH) Act of 1994, as stated in Part IV, Section 15 of the OSH Act 1994 and the Occupational Safety and Health (Control of Industrial Major Accident Hazards) Regulation 1996 (DOSH, 2002). The ERT is a specialized group formed by an organization to respond to emergency situations that may occur on its premises.

The primary role of an ERT is to respond effectively to emergencies, ensuring the safe evacuation of personnel, shutting down building services and utilities, collaborating with civil authorities in the response efforts, protecting and recovering property, and evaluating the safety of affected areas before re-entry. In the event of a major accident such as a chemical leak, release of hazardous gas, or workplace fire, the ERT works closely with relevant government authorities, such as the Fire and Rescue Department. Despite the limitations that may exist in utilizing ERTs, their impact in emergency situations is significant (Aziz et al., 2019; Pilemalm, 2020).

Psychological First Aid

Psychological First Aid (PFA) is a modular strategy based on scientific evidence that aims to provide support to children, teenagers, adults, and families in the immediate aftermath of disasters and terrorist attacks. The primary goals of PFA are to reduce early suffering and promote adaptive functioning in the short and long term (Brymer et al., 2006). It is important to note that PFA does not assume that all survivors will experience significant mental health issues or have long-term difficulties in recovering. Instead, it recognizes that individuals impacted by disasters will likely have a range of early emotions and experiences across physical, psychological, behavioral, and spiritual domains. Some of these emotions may hinder adaptive coping, and the support provided by caring disaster responders can aid in the recovery process.

One objective of PFA is to promote the well-being of employees, businesses, and profits. It can be applied in various settings, including petrol stations, where injuries, accidents, and crises may occur in different ways such as workplace hazards, natural disasters, or incidents involving violence, bomb threats, or suicide. Competent individuals, such as first responder teams, incident command systems, primary and emergency healthcare providers, or Community Emergency Response Teams (CERT), can deliver PFA according to its basic and simple principles (Brymer et al., 2006). These principles can be categorized into three main categories: Look, Listen, and Link. Table 1 provides an overview of the principles of PFA.

Table 1. Overview of The Principle of PFA

Look	- Observe safety. - Observe people with obvious urgent basic needs. - Observe people with serious distress reactions.
Listen	- Make contact with people who may need support. - Ask about people's needs and concerns. - Listen to people and help them feel calm.
Link	- Help people address basic needs and access services. - Help people cope with problems. - Give information. - Connect people with loved ones and social support.

Training plays a crucial role in ensuring that individuals are equipped to provide Psychological First Aid (PFA) effectively. It is important for trained individuals to have a comprehensive understanding of distress responses in crisis situations, the ability to identify symptoms and signals that require further intervention, and the knowledge of how to apply the principles of PFA (Amat & Ibrahim, 2018). It is recommended to provide PFA training to as many individuals as possible to enhance community resilience and reduce the emotional impact of disasters on individuals. Integrating PFA training into school health curriculums can help develop a larger pool of individuals capable of providing adequate support to those with emotional wounds during crises (Gillespie, 1963).

CONCLUSION

All hazards and risks should be managed as best as possible. All procedures and control measures should be followed and adhered to at all times. Training and competency development programs should be implemented on an ongoing basis. In managing issues relevant to disasters, several levels of action need to be implemented, namely, to prevent disasters from occurring, manage disasters when they occur, and decide what actions need to be implemented after the disaster.

ACKNOWLEDGEMENT

The authors would like to thank the speakers who were willing to participate in the webinar that we conducted related to the issue of Risk Assessment and Disaster Management at Petrol Stations. Our first paper's topic was Disaster Management and was presented by Dr. Khairilmizal bin Samsudin, Head Program of Environmental and Occupational Safety & Health, Universiti Sains Malaysia (USM). Our second paper's topic was Fire Hazard at Petrol Station and presented by PgKBII Mohd Wildan bin Azhari, Assistant Director (Operation) of BOMBA Kelantan. The last paper's topic was Psychological First Aid was presented by Dr. Shawaludin bin Husin, President of the Malaysian Society For Occupational Safety & Health (MSOSH). We value their input on the risk assessment and disaster management at the petrol station.

REFERENCES

Aziz, N. F. A., Akashah, F. W., & Aziz, A. A. (2019). Conceptual framework for risk communication between emergency response team and management team at healthcare facilities: A Malaysian perspective. *International Journal of Disaster Risk Reduction*, *41*, 101282.

Akashah, F. W., Baaki, T. K., & Lee, S. P. (2017). Fire risk assessment of low cost high rise residential buildings in Kuala Lumpur: A case study. *Journal of Design and Built Environment*, *17*, 124–138.

Amat, D. B., & Ibrahim, D. B. (2018). Psychological First Aid. Ministry of Health, Malaysia.

Anuar, A., Hamidun, S., Azman, S. I., Mazalan, F., & Shafie, F. A. (2022). Movement Control Order Impact on Air Pollution in Malaysia: Life in Pandemic Era Series. *MAEH Journal of Environmental Health*, *4*(1), 6-11.

Brymer, M., Jacobs, A., Layne, C., Pynoos, R., Ruzek, J., Steinberg, A., Watson, P. (2006). Psychological First Aid: Field Operations Guide. National Child Traumatic Stress Network and National Center for PTSD.

DOSH. (2002). Laws of Malaysia Act 514 Occupational Safety and Health Act 1994.

Gillespie, D. K. (1963). Psychological First Aid. Journal of School Health, 33(9), 391-395.

Health and Safety Executive. (2022). HSE Offshore: Fire and Explosion Strategy - Pool Fires. Fire and Explosion Strategy.

Kuncoro, L., Zainal, V. R., & Hakim, A. (2023). Fire Emergency Action Plan In The Indonesia Stock Exchange Building. *International Journal of Advanced Multidisciplinary*, *1*(4), 376-387.

Liu, Y. C., Jiang, J. C., & Huang, A. C. (2022). Experimental study on extinguishing oil fire by water mist with polymer composite additives. *Journal of Thermal Analysis and Calorimetry*, 1-12.

Luo, Z., Wang, X., Zhang, S., Wang, T., Liang, H., Liu, J., ... & Deng, J. (2022). Experimental study on the flammability limit parameters of premixed methanol-gasoline vapor-air mixtures. *Journal of Loss Prevention in the Process Industries*, *80*, 104856.

Pilemalm, S. (2020). Volunteer Co-production in Emergency Management in Excluded Areas. *JeDEM - EJournal of EDemocracy and Open Government, 12*(1), 61–86.

Occupational Safety and Health Administration (OSHA). (2015). Fire Service Features of Buildings and Fire Protection Systems.

Qonono, K. (2019). *Analysis of the fire hazard posed by petrol stations in Stellenbosch and the extent to which planning acknowledges risk* (Doctoral dissertation, Stellenbosch: Stellenbosch University).

Rielage, R. (2020). *Beirut and Beyond: Planning for Explosives in your community*. FireRescue1. https://www.firerescue1.com/fire-products/hazmat-equipment/articles/beirut-and-beyond-planning-for-explosives-in-your-community-MIgjv8o6ZE1hl5M8/

Saari, M. Y., Dietzenbacher, E., Los, B. (2016). The impacts of petroleum price fluctuations on income distribution across ethnic groups in Malaysia, *Ecological Economics, 130*, 25-36

Saari, M. Y., Habibullah, M. S., Utit, C., & Maji, I. K. (2018). Economic Impacts of petroleum industry in states of Pahang and Terengganu. *Jurnal Ekonomi Malaysia*, *52*(2), 149-161.

Salleh, S., Misri, N., Saufian, I. N., Abdul Razak, N., Ishak, M. F., Shafie, F. A., Megat Mokhtar, M. A., Jalaludin, J., Abu Bakar, F., Mustaffa, M., Soon, P. G. K., & Kunju, S. (2021). Challenges in Crisis Management on Environmental Health: The Delivery of Environmental Health Services in Malaysia Series. *MAEH Journal of Environmental Health*, *3*(1), 9–13.

Shield Safety. (2016). The importance of Risk Assessments. https://shieldsafety.co.uk/resources/fire-safety/the-importance-of-fire-risk-assessments/

Shimada, Y., Sato, Y., & Takahashi, A. (2022). A simple hazard scenario identification method for risk assessment on chemical hazards to prevent fire and explosion for open space work. *Chemical Engineering Transactions*, *90*, 283-288.

Spinardi, G., & Law, A. (2019). Beyond the stable door: Hackitt and the future of fire safety regulation in the UK. *Fire safety journal*, *109*, 102856.

Torani, S., Majd, P. M., Maroufi, S. S., Dowlati, M., & Sheikhi, R. A. (2019). The importance of education on disasters and emergencies: A review article. *Journal of education and health promotion*, *8*.

MAEH Journal of Environmental Health eISSN 2637-1359
Jurnal Kesihatan Persekitaran MAEH
Published By Malaysian Association of Environmental Health
http://www.maeh4u.org.my/journal

URBAN ENVIRONMENT AND PUBLIC HEALTH:

ASSESSING RISKS AND IMPLEMENTING SOLUTIONS SERIES

Distribution Mapping Of House Type, House Age And Sick Building Syndrome Among Work-From-Home Workers By Using A GIS-based Approach

Nur Afrina Miza Aziz Nasatioun[1], Mohammad Adam Adman[1, 2, *], Norsaffarina Aziz[1], Syarifuddin Misbari[1]

[1] *Faculty of Civil Engineering Technology, Universiti Malaysia Pahang, Kuantan, Pahang, Malaysia*
[2] *Environmental Management and Research Association of Malaysia, Petaling Jaya, Selangor, Malaysia*

*Corresponding author: adamadman@ump.edu.my

Abstract

Sick Building Syndrome (SBS) is a condition that commonly affects building occupants, and it is characterized by various symptoms related to the indoor climate, including indoor air quality, inadequate lighting, maintenance efficiency, and ventilation. This study aims to create distribution maps of housing infrastructure in Kuantan based on house type and house age and determine the prevalence of SBS among work-from-home (WFH) workers in the Kuantan study areas. A geospatial-based approach was employed to visualize the distribution of the general SBS symptoms among 112 WFH workers using a questionnaire that combined the Swedish MM040 and ICOP2010 questionnaires. The results obtained from the geospatial distribution maps revealed that a significant number of WFH workers in Kuantan experienced SBS symptoms, and most of them resided in terrace houses that were more than ten years old.

Keywords: *sick building syndrome, house, geospatial, work-from-home workers*

INTRODUCTION

Most modern buildings are designed with a focus on human comfort, incorporating features that provide control over the indoor environment, such as regulating the air temperature, lighting, sound levels, humidity, odors, and airflow. These characteristics aim to mitigate symptoms associated with sick building syndrome (SBS) and protect occupants. Research suggests that approximately one out of every five building occupants experiences SBS-related symptoms in their workplace, influenced by factors including the location, temperature, building systems, construction materials, building dampness, pollutant sources, and occupant activities (Saijo et al., 2019).

Epidemiological studies indicate that the estimated prevalence of home SBS in homes varies depending on the circumstances experienced by building occupants experience it (Aziz et al., 2023) Acute health and comfort impacts appear to be linked to the duration of time spent in a particular dwelling (Saijo et al., 2019). Therefore, this study will employ a geographic information system GIS-based approach to map and analyze the distribution of sick building syndrome symptoms, using specific parameters as records for distribution mapping purposes.

Given the distinct effects of factors influencing indoor environmental quality on occupants in different settings, the prevalence of SBS may increase (Dhungana & Chalise, 2020).

METHODOLOGY

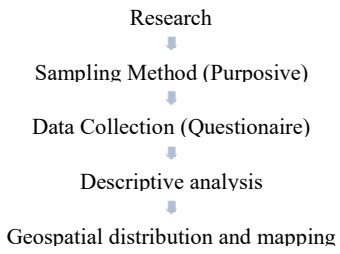

Figure 1. Flowchart of mapping distribution

This study involves creating a distribution map of SBS in Kuantan using a questionnaire to collect data. The collected data will be processed using GIS application software, specifically QGIS, to perform the delineation processes for this study (see Figure 1).

Study Area and Sampling Population

The study area for this research is the Kuantan district. A convenience sampling technique, a non-probability sampling method, was used to select the participants for this study. A total of 112 samples were collected from respondents who were available and willing to participate in the study.

Questionnaire

In this study, data on the frequency of the SBS symptoms among Work-From-Home (WFH) individuals were collected using a conventional self-administered questionnaire. The questionnaire consisted of six sections: Part 1: General Information (the respondent's background information of the respondent); Part 2: Occupation Type; Part 3: Work Environment; Part 4: Past/Present Symptoms; Part 5: Present Symptoms; and Part 6: Complementary Questions. The symptoms of SBS were categorized into general, mucosal, and skin symptoms. Respondents had the option to complete the questionnaire either face-to-face or using an online, with the majority of respondents opting for the online method due to its convenience.

Descriptive Analysis

The SBS symptoms were identified using descriptive statistics. Tables 1 and 2 indicated the house types and ages of 112 participating respondents in frequency and percentage. Table 3 indicates the prevalence of general symptoms of SBS experienced by participating respondents. The data analysis instrument was SPSS statistical software (IBM SPSS Statistic, Version 22).

Geospatial Distribution Map

The data on the location, house type, house age, and SBS symptoms of the Work-From-Home (WFH) workers will be used to create distribution maps of residences in Kuantan, Pahang. To facilitate this, the software tools QGIS and Google Earth Pro will be utilized. The WFH workers' location data will be imported into Google Earth Pro using a data spreadsheet, allowing the points to be plotted as a layer on the map. A vector shapefile (.shp) will be created to store the layer, and it will be added to QGIS. By utilizing the QGIS application, the geospatial distribution map of SBS in the Kuantan, Pahang area can be visualized, aiding relevant stakeholders in identifying SBS-affected buildings.

RESULT AND DISCUSSION

This study focuses on examining the home environment of respondents while working from home, as well as the type of homes they reside in. The data collected from the 112 participants reveals the most common housing types in Kuantan. Table 1 presents the distribution of respondents across different housing types. It can be concluded that out of the 112 respondents, 78 individuals (69.6%) reside in terraced houses, indicating that terraced houses are the predominant type of residence among the selected respondents in Kuantan. Additionally, 22 respondents (19.6%) live in two-story houses, 10 respondents (8.9%) reside in bungalow houses, and two respondents (1.8%) live in apartments.

Table 1. House type of the WFH workers in Kuantan.

House Type	Frequency	Percent (%)
Terrace House	78	69.6
Bungalow	10	8.9
Apartment	2	1.8
Two-Storey House	22	19.6
Total	112	100.0

The map distribution of house type and design is illustrated in Figure 2. It shows that most houses in Kuantan are terrace-type.

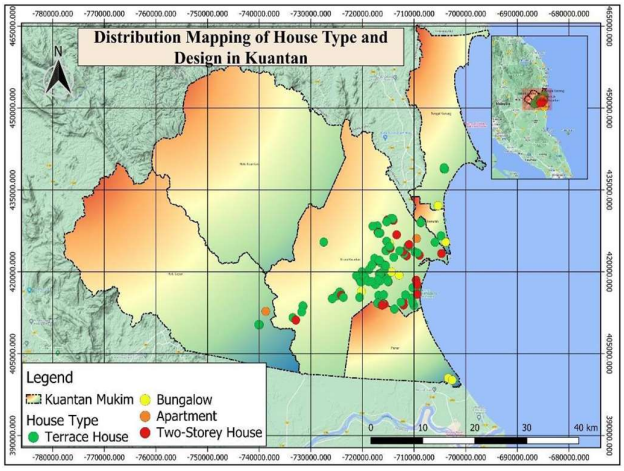

Figure 2. Distribution map of house type and design in Kuantan

The age of the buildings is an important factor in assessing their condition and potential impact on the occupants. Table 2 provides an overview of the building ages in the study location. It can be observed that the majority of the houses (n=46, 41.1%) fall within the age range of 10 to 19 years. This is followed by houses with an age range of 5 to 9 years (n=31, 27.7%), less than 5 years (n=21, 18.8%), and more than 20 years (n=14, 12.5%). The study area, being a developed region with a diverse range of buildings, is characterized by a significant number of houses that are between 10 to 19 years old.

Table 2. House age of the WFH workers in Kuantan.

House Age (years)	Frequency	Percent (%)
<5	21	18.8
5-9	31	27.7
10-19	46	41.1
>20	14	12.5
Total	112	100.0

The map distribution of house age is shown in Figure 3. It shows that most houses in Kuantan are between 10 to 19 years of age.

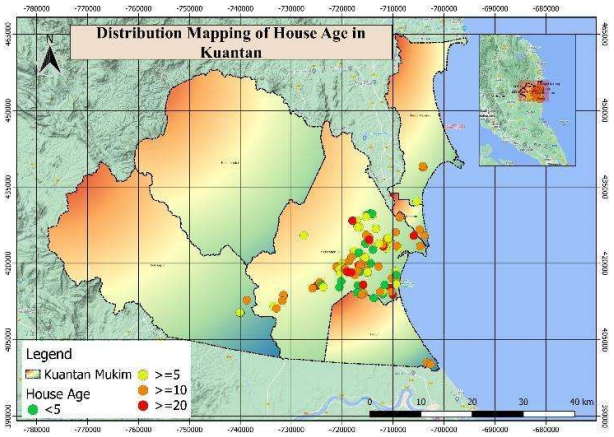

Figure 3. Distribution map of house age in Kuantan

Table 3 presents the prevalence of general SBS symptoms among Work-From-Home (WFH) workers. Based on the mapping Figure 3, out of the 112 respondents, a majority of 102 respondents (91.1%) reported experiencing general SBS symptoms while working from home. Only 10 respondents (8.9%) did not experience any symptoms of SBS. These findings indicate that a significant proportion of WFH workers in Kuantan have encountered general SBS symptoms during their work activities.

Table 3. General symptoms of SBS among WFH workers in Kuantan.

General Symptoms	Frequency	Percent (%)
Yes	102	91.1
No	10	8.9
Total	112	100.0

The map distribution of general SBS symptoms is depicted in Figure 4. It shows that most WFH workers in Kuantan experienced general SBS symptoms.

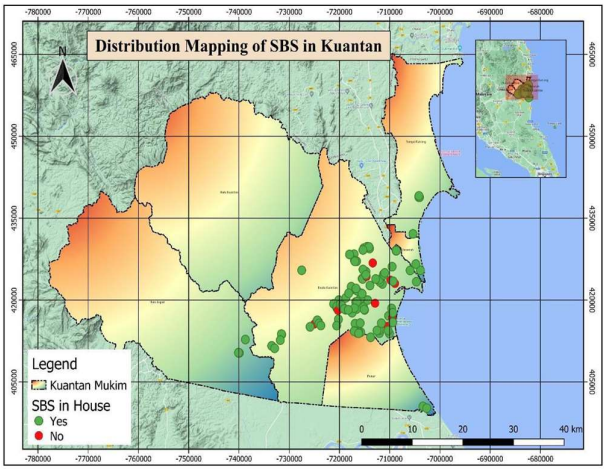

Figure 4. Mapping of sick building syndrome in Kuantan

CONCLUSION

This study concludes that a significant proportion of WFH workers in Kuantan, specifically 91.1%, have experienced general SBS symptoms. The majority of these workers reside in terrace houses, and their houses are predominantly between 10 to 19 years old. The geospatial distribution maps generated in this study provide valuable insights for relevant stakeholders, including the State Government, housing developers, and employers, to develop improved policies and procedures for WFH arrangements that prioritize the well-being of workers. However, further analysis is required to examine the relationship between house age, house type, and the prevalence of SBS symptoms among WFH workers.

ACKNOWLEDGEMENT

This article is part of the preliminary research activity for the UMP research grant. The authors would like to thank Universiti Malaysia Pahang (UMP) for supporting this study through financial grant RDU210356 and an appreciation to the Malaysia Geospatial Data Infrastructure (MyGDI) for the GIS database. All respondents who participated in this study are truly appreciated.

REFERENCES

Aziz, N., Adman, M. A., Suhaimi, N. S., & Misbari, S. (2023). Indoor Air Quality (IAQ) and Related Risk Factors for Sick Building Syndrome (SBS) at the Office and Home : A Systematic Review.

Dhungana, P., & Chalise, M. (2020). Prevalence of sick building syndrome symptoms and its associated factors among bank employees in Pokhara Metropolitan, Nepal. Indoor Air, 30(2), 244–250.

Esri. (2021, July 15). GIS Mapping Software, Location Intelligence & Spatial Analytics Esri. https://www.esri.com/en-us/home

Joshi, S. (2008). The sick building syndrome. *Indian Journal of Occupational and Environmental Medicine, 12*(2), 61.

Petruzzello, M., 2022. Encyclopaedia Britannica | History, Editions, & Facts. Encyclopedia Britannica. Available at: https://www.britannica.com/topic/Encyclopaedia-Britannica-English-language- reference-work [Accessed 19 May 2022]

Redlich, C. A., Sparer, J., & Cullen, M. R. (1997). Sick-building syndrome. *The Lancet, 349*(9057), 1013–1016.

Saijo, Y. (2020). Sick building/house syndrome. *Indoor Environmental Quality and Health Risk toward Healthier Environment for All*, 21-38.