Asian Journal of Research in Education and Social Sciences
e-ISSN: 2682-8502 | Vol. 7, No. 2, 45-53, 2025
https://asianscholarsnetwork.com/asnet-journals
SPECIAL ISSUE: International Conference on Future and Sustainable Education (ICFSE) 2024

Assessment of Knowledge, Attitude and Practice (KAP) Towards Biosafety Among CFS IIUM Students

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Received: 15 July 2024 | Accepted: 1 December 2024 | Published: 1 March 2025

DOI: https://doi.org/10.55057/ajress.2025.7.2.5

Abstract: *Regular exposure to risks necessitates ongoing monitoring for laboratory personnel and students. Both parties must prioritise biosafety awareness. Insufficient empirical data suggests that students have inadequate knowledge, attitudes, and practices (KAP) when it comes to biosafety procedures. This raise worries regarding their safety practices in laboratories. Therefore, this study aims to address this issue particularly to assess biosafety knowledge, attitudes and practices among CFS IIUM students, across all biological students at the Centre for Foundation Studies (CFS) International Islamic University Malaysia (IIUM). A comprehensive cross-sectional investigation was carried out on the students. Data was gathered by means of an online self-administered questionnaire using Google Forms, targeting students enrolled in CFS IIUM. The results revealed there is a high level of attitude and practice towards biosafety protocols. Still, their knowledge needs slight improvement, particularly in specific areas like the number of containers used to transfer the biological sample. Training on biosafety is imperative to enhance knowledge, attitude and practice among CFS IIUM students. Furthermore, it is necessary to build efficient, operational, and well-executed biosafety policy procedures overseen by the institution. By addressing these deficiencies, safety standards can be improved, reducing the likelihood of accidents or exposure to dangers, and ultimately establishing safer laboratory settings for both students and staff.*

Keywords: Knowledge, Attitude, Practice, Biosafety

1. Introduction

Biosafety refers to containment principles, technologies and practices that are implemented to prevent unintentional exposure to biological agents or their inadvertent release (World Health Organization, 2021). The COVID-19 pandemic has raised additional concerns regarding lab safety, especially when handling biological agents. The concepts, procedures, and guidelines known as biosafety were developed to guarantee the secure handling, containment, and

administration of biological agents and materials (Guerrero & Cañete-Nierras, 2024). It involves taking precautions to shield laboratory users and the environment from potential harm as well as to avoid unintended exposure to biological hazards (Ahmed et al., 2022). By reducing the possible dangers connected to biological research, medical procedures, and other activities using biological materials, biosafety seeks to protect the environment and the public's health. Strengthening laboratory biosafety efforts is listed as one of the major strategic priorities in the Asia Pacific Strategy for Emerging Diseases (APSED), which was first published in 2005 and amended in 2010 (World Health Organization, Regional Office for South-East Asia, 2015).

Schwartz (1976) (Schwartz, 1976) introduced the Knowledge, Attitudes, and Practices (KAP) model, a quantitative approach that incorporates both quantitative and qualitative data. KAP surveys are instrumental in identifying misunderstandings or misinterpretations that could impede planned activities and reveal potential barriers to behavior change. Essentially, KAP surveys highlight the gaps between declared knowledge and actual practices, making this model relevant to our research. Schwartz's (Schwartz, 1976) early KAP paradigm, established in 1976, focuses on the three domains: knowledge, attitudes, and practices. Originating in the 1950s, KAP surveys have gained global traction in social science research due to their targeted and concise nature, which makes them more cost-effective and resource-efficient than other social research methods (Ekman & Walker, 2008). (Sabouhi, Babaee, Naji, & Hassan Zadeh, 2011) found a link between awareness, knowledge, attitude, and practice, emphasizing the critical role of knowledge (Salerno, Nunziante, & Santoro, 2014).

The effective implementation of biosafety needs the community to understand knowledge, attitude, and practice. This is because KAP provides valuable insights and a genuine understanding of the population's situation [9]. KAP surveys can be used to assess the baseline levels of awareness about biosafety practices before designing and implementing educational or interventional programs in the population of interest (Andrade, Menon, Ameen, & Praharaj, 2020). The effective implementation of biosafety requires laboratory users to have the right knowledge, attitude, and practice (KAP). KAP study provides valuable insights and a genuine understanding of the population's situation (Khan et al., 2024). It assesses the awareness of biosafety before designing and implementing educational or interventional programs in the population of interest (Andrade, Menon, Ameen, & Praharaj, 2020).

This study investigates biosafety knowledge, attitudes, and practices among biological students at CFS IIUM, using an online cross-sectional survey. Results show strong adherence to biosafety protocols in attitudes and practices but highlight gaps in specific knowledge areas, such as the proper handling of biological samples. The study underscores the need for enhanced biosafety training and the establishment of robust institutional policies to mitigate risks, improve safety, and foster a secure laboratory environment for students and staff.

2. Methodology

Sample Size and Method

A comprehensive cross-sectional study was conducted on the students. The data was collected through an online self-administered questionnaire using Google Forms, specifically targeting students currently enrolled at CFS IIUM. The sample in this study was selected through a purposive sampling process. From the population size of 256 Biological students at CFS IIUM, the sample size of this study was determined based on the calculation using the Slovin's Formula Sample Size Calculator (Sebhastian, 2024) (Ismail, Pernadi, & Febriyanti, 2022) obtained at a 95% confidence level with ± 5% margin of error. According to (Johnson & Wislar,

2012), there is no definitive evidence indicating the minimum acceptable response rate for research. However, a typically employed threshold is 60%. With a response rate of approximately 64%, this research is deemed adequate for conducting data analyses based on the obtained responses.

Item Development

The model selected for analysis in this study is the Knowledge, Attitudes, and Practices (KAP) model, which consists of three domains: knowledge (K), attitude (A), and practice (P). These domains are integrated into survey questions to collect valuable data. A KAP questionnaire was developed using data from prior studies to provide relevant information (Ahmed et al., 2022). The survey questions utilize a five-level Likert scale, with 1 indicating strongly disagree and 5 indicating strongly agree. The Likert scale is a widely used rationality assessment tool in educational and social research (Joshi & Rahman, 2017). Therefore, the consistency and accuracy of the survey questionnaire will ensure the reliability in the data used for analysis (Taherdoost, 2016). The questionnaire comprised four sections: Section A covered the demographic background of the respondents, while Sections B, C, and D explored their knowledge, attitudes, and practices concerning biosafety. The total number of items was adjusted based on the results of validity and reliability tests.

Item Validity and Reliability

A pilot study was conducted to assess the validity and reliability of the instruments. To establish the instrument's validity, the questionnaire was reviewed by four academics from different disciplines: Public Health, Medical Education, Biology, and English lecturers. These academics provided feedback and suggestions for improvements, which were then incorporated into the questionnaire.

The reliability test demonstrates the internal consistency of the survey instrument utilised in the study. The survey instrument's overall reliability, which includes all 15 items across the three variables, is shown by a Cronbach's Alpha coefficient of 0.829. From the conducted reliability test, all the variables of knowledge, attitude, and practice on biosafety had excellent internal consistency (Hair, Page, Brunsveld, Cleton, & Merkle, 2023), with the Cronbach alpha coefficient reported to be 0.829. This result signifies a significant degree of internal consistency, indicating that the survey instrument as a whole is dependable for assessing the intended concepts. The results indicate that although the overall instrument is robust. Enhancing the dependability of these measurements will guarantee more precise and reliable data collecting in future investigations.

3. Data Analysis

The data was analyzed using the Statistical Package for the Social Sciences (IBM SPSS Version 25) software. The assessment of the Knowledge, Attitudes, and Practices (KAP) of CFS IIUM students regarding biosafety was conducted through descriptive analysis, focusing primarily on average scores to gauge their understanding and behavior in relation to biosafety. This initial investigation provides valuable insights into students' comprehensive perceptions and behaviors towards biosafety.

Table 1 displays an interpretation scale based on (Goh, 2018) research, categorizing response levels based on their average scores. A score between 5.0 and 4.0 is classified as "High," indicating a substantial presence or positive responses. Scores ranging from 4.0 to 3.0 are classified as "Medium-high," denoting a considerable but noticeably less pronounced level of

response. Scores between 3.0 and 2.0 are categorized as "Medium-low," indicating a moderate degree of reactivity. Scores within the range of 2.0 to 1.0 are categorized as "Low," indicating a restricted or unsatisfactory level of response.

This measure is useful for quantitatively assessing and analyzing the extent to which variables, such as knowledge, attitudes, or practices towards biosafety, are perceived or adopted by CFS IIUM students. It offers a clear framework for researchers to categorize and analyze typical outcomes, providing insights into the varying degrees of engagement or understanding across different aspects of biosafety among students.

Table 1: Mean Interpretation Scale (Goh, 2018)

Mean Score	Level
$5.0 \geq y > 4.0$	High
$4.0 \geq y > 3.0$	Medium-high
$3.0 \geq y > 2.0$	Medium-low
$2.0 \geq y > 1.0$	Low

4. Results and Discussions

The findings from Table 2 reveal that the majority of students are female, comprising 80% of the sample. On the other hand, 29.7% of the respondents are enrolled in Medicine, 13.9% in Pharmacy, 18.8% in Dentistry, and 37.6% in other fields, highlighting a diverse demographic background among the students. Regarding socio-demographic characteristics, the current sample shows that the majority of students are female (Table 2). This may be attributed to the increasing number of students enrolling in the Biological program at the Centre for Foundation Studies, IIUM. A similar trend has been observed in the annual Graduate Tracer Study (GTS) conducted by the Ministry of Higher Education (MOHE) (Gong, 2023). In terms of fields of study, 29.2% of the participants are in Allied Health Sciences, 26.7% are in Medicine, 22.5% are in Pharmacy, 10.8% are in Dentistry, 5.8% are in Nursing, and 5% are in Biosciences. This data highlights the diverse demographic composition of the student population.

Table 2: Sociodemographic Background of Study Subjects

Variables		n (%)
Gender	Male	20 (19.8)
	Female	81 (80.2)
Program	Medicine	30 (29.7)
	Dentistry	19 (18.8)
	Pharmacy	14 (13.9)
	Others	38 (37.6)

The findings in Tables 3, 4, and 5 illustrate students' knowledge, attitudes, and practices towards biosafety, measured by mean scores and standard deviations (SD). Overall, the data suggests that students possess good knowledge, positive attitudes, and strong practices towards biosafety, with some areas identified for potential improvement.

As depicted in Table 3, the mean scores for knowledge range from 2.921 to 4.505, with an overall summary mean of 3.900, interpreted as medium high. The medium-high score in knowledge suggests that students possess a good, albeit not exceptional, understanding of biosafety principles and procedures. While they demonstrate a solid foundation in biosafety, there is an opportunity to further enhance their comprehension through additional educational

initiatives. Targeted training programs, workshops, and comprehensive review sessions can help bridge any gaps and elevate their knowledge to a high level. The highest knowledge score is for recognizing the biohazardous symbol (mean = 4.505, SD = 0.795), indicating strong awareness. However, knowledge about the number of containers for sample transportation is notably lower (mean = 2.921, SD = 1.301), suggesting a gap that may need addressing in biosafety education. The discrepancy between the items may reflect the gap in knowledge that is not emphasised in the training or laboratory safety briefing. It could also indicate the familiarity of the subjects with biosafety issues that concern them. While the biohazard symbol is frequently encountered, the CFS IIUM students may not carry out experiments or laboratory work that require them to transport biological samples, hence the low knowledge about it. A previous study conducted by (Ahmed et al., 2022) reported low knowledge of biological sample transportation among laboratory users, with only 24.3% scoring high knowledge.

Table 3: Students' Score on Knowledge Towards Biosafety

No	Knowledge	Mean	SD	Summary Mean	Interpretation
K1	I know the type of shoe worn in the lab.	4.396	0.895		
K2	I know what PPE stand for.	3.752	1.330		
K3	I know the ways of transmission of infectious agents.	3.990	1.025		
K4	I know the importance of ventilation in laboratory safety.	4.495	0.757	3.900	Medium High
K5	I know the number of fire extinguishers that should be available in the lab.	3.228	1.191		
K6	I know the number of containers that should be used for sample transportation.	2.921	1.301		
K7	I know the biohazardous symbol.	4.505	0.795		

On the other hand, the mean scores for attitudes towards biosafety are high (please see Table 4), with a summary mean of 4.200. This high score in attitude reflects a positive and committed mindset towards biosafety among the students, which is encouraging as it suggests that a strong attitude towards biosafety is likely to influence behavior positively. It indicates that students appreciate the importance of biosafety and are motivated to adhere to safety protocols. Maintaining and nurturing this positive attitude through continuous engagement and reinforcement of biosafety values is essential.

Students exhibit a strong understanding of proper glove use (mean = 4.673, SD = 0.634), indicating a generally strong adherence to and understanding of biosafety principles. Similarly, (Ahmed et al., 2022) reported a high score for laboratory users' proper use of gloves, with 94.3% demonstrating high knowledge in this area. In addition, students also exhibit a strong awareness of the consequences of improperly capped centrifuge tubes (mean = 4.188, SD = 1.027), indicating that students recognize the importance of securing centrifuge tubes to prevent accidents and contamination. Likewise, a previous study by (Ahmed et al., 2022) reported that 64% of participants demonstrated a high level of awareness regarding the consequences of using centrifuge tubes without caps.

The lower score on the storage of biological materials (mean = 3.871, SD = 1.163) indicates a slightly weaker area, though still relatively high. This suggests that there may be a need for further education or reinforcement in proper storage techniques for biological materials to ensure maximum safety and compliance with biosafety protocols.

Table 4: Students' Score On Attitude Towards Biosafety.

	Attitude	Mean	SD	Summary Mean	Interpretation
A1	I am aware of the consequence if the centrifuge tube doesn't have a cap	4.188	1.027	4.200	High
A2	I know how to put on and take off gloves.	4.673	0.634		
A3	I know how to deal with spills.	4.050	1.043		
A4	I know how the biological materials are stored according to.	3.871	1.163		

Additionally, as illustrated in Table 5, the mean scores for biosafety practices are consistently high, with a summary mean of 4.390. The highest score among the three domains is in practice, indicating that students are effectively implementing biosafety measures in their laboratory activities. This demonstrates that their knowledge and positive attitudes are being translated into concrete actions, ensuring a safe laboratory environment. Regular practice, along with continuous monitoring and feedback, is crucial to sustain and further improve these high standards of biosafety practice. Hand washing with soap and water has the highest score (mean = 4.683, SD = 0.787), indicating excellent compliance, with students consistently practicing proper hand hygiene. This practice is fundamental in preventing the spread of contaminants and ensuring personal and laboratory safety.

Proper glove use also scores highly (mean = 4.634, SD = 0.745), indicating that students are well aware of and routinely use the correct type of gloves when handling biological materials. This practice is crucial in preventing direct contact with potentially hazardous substances and reducing the risk of contamination.

The disposal of blood samples in clinical waste bins has a relatively high score (mean = 4.178, SD = 1.195). Although slightly lower than the other practices, the mean score is still relatively high, suggesting that most students understand the importance of properly disposing of blood samples to prevent biological hazards. The higher standard deviation indicates more variability in this practice, suggesting that some students may need additional training or reminders about proper disposal procedures.

Segregating household waste (mean = 4.069, SD = 1.061) shows slightly lower compliance compared to other practices, but the mean score still indicates a high level of practice among students. The study by (Ahmed et al., 2022) reported that 78.1% of laboratory users scored high in practicing the segregation of household waste. This reflects a good understanding of waste segregation, which is important for maintaining a safe and organized laboratory environment. The variability here suggests that while most students adhere to this practice, there is room for improvement in ensuring consistent behavior across all students.

Table 5: Students' Score on Practice Towards Biosafety.

	Practice	Mean	SD	Summary Mean	Interpretation
P1	I wash hands with soap and water.	4.683	0.787	4.390	High
P2	I use the appropriate glove when handling biological materials in the lab.	4.634	0.745		
P3	I throw the blood sample in the clinical waste bin.	4.178	1.195		
P4	I segregate household waste and place it into the colored bag.	4.069	1.061		

Overall, students demonstrate strong biosafety performance, particularly in attitudes and practices. Although their knowledge is medium-high, there is room for improvement to achieve consistent excellence. Positive attitudes and high compliance in practice reflect the effectiveness of current biosafety training programs, emphasizing the need for ongoing education. Addressing knowledge gaps while reinforcing diligent practices will enhance students' competence and ensure a safer laboratory environment. Similar trends are observed in other studies. For instance, Mehta et al. (2018) found strong attitudes but identified knowledge deficiencies among healthcare workers. Similarly, Wader et al. (2013) reported that laboratory technicians exhibited good practices but lacked comprehensive biosafety knowledge.

The knowledge, attitudes, and behaviors related to biosafety implementation among university students are interrelated. The findings confirm that biosafety is a concept taught to CFS IIUM biological students and illustrate that knowledge and attitudes significantly influence practices. This relationship underscores the connection between understanding biosafety and its practical application. Similar findings from other studies highlight the interconnectedness of knowledge, attitudes, and practices (KAP) in biosafety. Wader et al. (2013) demonstrated that knowledge and attitudes among laboratory technicians influence compliance with biosafety practices. Mehta et al. (2018) found healthcare workers with greater biosafety awareness and positive attitudes more likely to exhibit safe practices. Taherdoost (2016) emphasized that effective knowledge dissemination enhances attitudes and adherence to protocols. These studies reinforce the critical role of KAP integration in improving biosafety outcomes.

Laboratories are hazardous workplaces, exposing workers to a range of risks including biological hazards, physical incidents, chemicals, and fire (Ahmed et al., 2022). Adequate training and proper personal protective equipment (PPE) are essential for improving workers' skills and safety (Ahmed et al., 2022). Guidelines and safety measures, detailed in manuals, must be accessible to all workers. Regular reviews and assessments of workers' biosafety knowledge and adherence to safety measures are crucial, as improper practices can lead to significant health issues (Ahmed et al., 2022).

To ensure effective biosafety practices, it is crucial to develop Standard Operating Procedures (SOPs) and promote the use of PPE when handling biological samples (Wader, Kumar, & Mutalik, 2013). Regular training on biosafety for laboratory users is also essential (Wader, Kumar, & Mutalik, 2013). Furthermore, appointing a biological safety officer to oversee laboratory activities, manage equipment, personnel, storage, material transfer, and the proper destruction of biological materials is necessary (Wader, Kumar, & Mutalik, 2013). This officer should conduct biorisk analyses and develop written SOPs for the laboratories (Wader, Kumar, & Mutalik, 2013). Additionally, the study by (Mehta, Shah, & Tiwari, 2018) suggested that increased experience in the laboratory field would enhance awareness of biosafety management and improve the practice of these protocols.

5. Conclusion

There is a high level of attitude and practice towards biosafety protocols, but their knowledge needs slight improvement, particularly in specific areas like the number of containers for sample transportation. The outcomes of the study highlight a favourable shift in views and practices about biosafety standards among participants, demonstrating an exemplary commitment to safety precautions in laboratory settings. Nevertheless, the gaps in knowledge that have been detected, specifically regarding certain issues such as determining the optimal

number of containers for transporting samples, emphasise the need for improving the educational content of the university's biosafety training programmes. Enhancing these educational programmes can empower students and staff by equipping them with the essential information and skills to consistently comply with biosafety regulations.

Furthermore, it is essential to establish and enforce effective and organised biosafety protocols under the supervision of the institution. These rules should include explicit recommendations, frequent training sessions, and strong monitoring methods to guarantee adherence and ongoing enhancement in safety measures. To address these areas of limited knowledge and strengthen the policies that ensure safety in biological research, it is possible to lower the risks, minimise the chances of accidents or exposure to dangerous situations, and eventually create laboratory conditions that are safer. By giving priority to these procedures, universities may maintain greater safety standards, ensuring the well-being of both students and personnel engaged in laboratory activities.

Acknowledgments
The authors acknowledge Department of Biology, Centre for Foundation Studies, International Islamic University Malaysia. Special thanks to those who contributed to this project directly or indirectly.

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