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Brief communication (Original)

Forensic entomology in Malaysia: knowledge and practices

Kavitha Rajagopal[a,c], Tan Tian Chye[b], John Jeffery[b], Mohd Sofian-Azirun[d]
[a]Integrative Pharmacogenomics Institute (iPROMISE), Faculty of Pharmacy, Universiti Teknologi Mara (UiTM), Selangor, [b]Department of Parasitology, Faculty of Medicine, University of Malaya, 50603 Kuala Lumpur, [c]Faculty of Applied Sciences, Universiti Teknologi Mara (UiTM), Shah Alam, Selangor, [d]Institute of Biological Sciences, Faculty of Science, University of Malaya, 50603 Kuala Lumpur, Malaysia

Background: This cross-sectional survey is to our knowledge the first attempt in Malaysia to study forensic entomology knowledge and practices among relevant Malaysian practitioners. Analysis of our questionnaire identified three major themes: understanding of forensic entomology, the acceptance and application of forensic entomology in crime scene investigation, and future directions for forensic entomology in Malaysia. We found that only a few experienced crime scene police officers had a meaningful knowledge of forensic entomology and were involved in maggot collecting during crime scene investigation.
Objectives: To assess knowledge, attitude, and practice of forensic entomology among relevant practitioners in Malaysia.
Methods: A total of 402 relevant practitioners were asked to complete a questionnaire regarding knowledge, attitude and practice of forensic entomology.
Results: Half of the respondents had some understanding that forensic entomology is a study of insects found on a dead human body. The study also found that forensic entomology research in Malaysia is mainly to determine the postmortem interval (PMI), to identify the types of flies, and to study insect maturation and succession; particularly of local species. The Malaysian government should be encouraged to play a role through the Department of Education to attract more students to this field and to support academic institutions to formulate research in forensic entomology.
Conclusions: Forensic entomology in Malaysia needs improvement of technical knowledge and awareness among relevant practitioners through curriculum development, policy, and training programs.

Keywords: Forensic entomology, occupational health practice, pathology, sociology, statistics

Forensic entomology concerns use of certain arthropods, especially local fly species, in legal investigation to determine the postmortem interval (PMI) [1]. In Malaysia, interest forensic entomology is now increasing. Younger police officers and other judicial personnel are becoming more aware of this field and research institutions of higher learning are engaged in its study, thus creating increased awareness among undergraduates and postgraduates. Nevertheless, the low use of forensic entomology in crime scene investigation remains a challenge. Currently, maggots or larvae found on dead human bodies are frequently collected by pathologists, but not by police officers. Few police officers collect entomological evidence from dead human bodies during the initial crime scene investigation as a tool for determining the PMI. Some valuable evidence is thus neglected and perhaps even discarded. We consider provision of training for police officers and other practitioners is the best way to expand the use of forensic entomology. We designed a questionnaire and distributed it to the police officers, pathologists, scientific officers, and students (undergraduates and postgraduates) to evaluate understanding and knowledge of using insects found at a crime scene in the determination of PMIs.

Correspondence to: Kavitha Rajagopal, Integrative Pharmacogenomics Institute (iPROMISE), Faculty of Pharmacy, Universiti Teknologi Mara (UiTM), Bandar Puncak Alam, Selangor, Malaysia. E-mail: kavy1129@yahoo.com

Materials and methods

Analysis of our questionnaire identified three major themes, the understanding of forensic entomology, the acceptance and application of forensic entomology in crime scene investigations, and the future directions for forensic entomology in Malaysia. A total of 402 questionnaires was distributed to the crime scene police officers from all 14 districts in Malaysia, pathologists from 3 government hospitals, scientific officers, and undergraduates and postgraduates from 3 public universities.

Our questionnaire consisted of two parts. The first part contained general ideas regarding forensic entomology, while the second part demanded more specific knowledge in this field. Crime scene police officers and pathologists were required to answer only the first part. Scientific officers and students were required to answer all 20 questions. To ensure that the questions could be understood by individuals from the four different groups, the questionnaire was prepared in both English and Malay. The questionnaire was based on opinions from renowned forensic entomologists in Malaysia.

For crime scene police officers, undergraduates, postgraduates and scientific officers, an appointment was made to conduct the questionnaire survey in person. A brief description regarding the purpose of the survey was given to respondents before they answered the questionnaire. The questionnaire was collected directly after they completed it. Pathologists were contacted by telephone and the purpose of the survey was explained. Subsequently the questionnaire was sent via e-mail. All completed questionnaires were received by e-mail.

During the content selection, the questions were limited to knowledge about forensic entomology and its importance in the crime scene investigation. The contents of the questionnaire were validated by the research team. Factor analysis was carried out using Bartlett's test of sphericity and the Kaiser–Meyer–Olkin measure. A reliability scale evaluation was applied to estimate the internal consistency of the items was based on Cronbach's alpha (α).

Results

Bartlett's test of sphericity was considered significant at 0.0001, while the Kaiser–Meyer–Olkin measure was 0.710. Cronbach's $\alpha = 0.67$.

A sustained interest in pursuing forensic entomology studies in Malaysia is shown by the sociodemographic distribution of respondents (**Table 1**). Out of 402 respondents, 80.3% of respondents were aged below 40 and 19.7% of the respondents were 40 and above. The minimum age of a respondent was 20 years old and maximum 57 years old, with a median value of 28.5. The majority of the respondents were crime scene police officers (54.5%). The second largest groups of respondents were undergraduates and postgraduates (31.3%) recruited from local universities. This showed an increased interest in pursuing forensic entomology studies in Malaysia (**Table 1**).

Table 1. Sociodemographic distribution of the respondents

Criteria	Number (n)	Percentage (%)
Age		
Below 40	323	80.3
40 and above	79	19.7
Education level		
Diploma and below	264	65.7
Degree and above	138	34.3
Police officer		
Uniformed	219	54.5
Not uniformed	183	45.5
Working experience		
≥15 years	329	81.8
>15 years	73	18.2
Frequency in investigating murder cases		
<5 cases	322	80.1
≥5 cases	80	19.9

Scientific officers working in hospitals, in forensic departments with various job descriptions, and in research institutions formed a third group. About 3.7% of the respondents were pathologists from local government hospitals. Only 33% of the respondents had a Malaysian Certificate (SPM) qualification, and nearly 11% had a Malaysian Higher School Certificate (STPM) qualification. About 22% of the respondents had a diploma qualification and almost 34% had tertiary education (**Table 1**).

About 81.8% of the respondents had 15 years or less and the remaining 18.2% had more than 15 years of working experience. As for the frequency in investigating murder cases, about 80.1% of the respondents investigated less than 5 cases and about 19.9% investigated 5 cases and above since they started their job service.

Consistent with the age distribution of the respondents, most investigations of murder cases were conducted by younger investigators (**Table 1**).

Qualitative analysis of the questionnaire identified three major themes: the understanding of forensic entomology, the acceptance and application of forensic entomology in crime scene investigations, and the future directions of forensic entomology in Malaysia.

Theme 1. Understanding of forensic entomology

The main aim of theme 1was to explore the level of familiarity of the respondents with forensic entomology. Question 1 (Forensic entomology is a study about insects found on dead human bodies. What is your degree of understanding about forensic entomology?). Question 2 (Do you know that the study of insects in forensic entomology includes study of the eggs, the larvae, the pupae, the adult, the empty puparium, and other insects like beetles?), and question 3 (Do you know that maggots found on a dead human body originated from flies and can be used to determine the time of death (PMI)?). For question 1, the overall level of understanding of forensic entomology among the respondents was good. Only 56 respondents had only heard about forensic entomology for the first time in their life. Most respondents stated that they were aware of the fly life cycle and the maggots found on a dead human body originated from flies, and that they can be used to determine the postmortem interval.

Theme 2. Acceptance and application of forensic entomology in crime scene investigation

In theme 2 the acceptance and application of forensic entomology in crime scene investigations was evaluated.

The response to question 4 of theme 2, (Have you ever collected maggots or any other insects found on a dead human body to assist in investigations?) showed that 70% of the respondents (crime scene police officer, pathologists and scientific officers) had never collected maggots found on dead human bodies. Despite apparent awareness indicated in theme 1 and questions 5 and 6 discussed below, respondents seldom applied forensic entomology in crime scene investigations.

To question 5, whether they knew that the maggots found on a dead human body or its surroundings could be used to determine the cause of death of the victim, almost 72% of the respondents answered in the affirmative. To question 6, whether they knew that flies can find and join a dead human body within 24 hours, depending on the area surrounding the dead body, around 75% of the respondents were aware. To question 7, whether they had encountered a dead human body infested with maggots; and to question 8, whether they had ever found an empty puparium at the crime scene during an investigation or during a postmortem examination, only a few respondents answered in the affirmative.

To question 9, 80% of the respondents answered that they knew that maggots or larvae found on a dead human body can assist in crime scene investigation in other countries that applied forensic entomology to assist in murder cases. In response to question 10, which asks whether the questionnaire introduced forensic entomology, the majority of respondents agreed.

Theme 3. Future direction of forensic entomology in Malaysia

The main aim of this theme was to explore the future prospects for forensic entomology in Malaysia. To achieve this aim undergraduates, postgraduates, and scientific officers were questioned about their understanding of forensic entomology, by answering the second part of the questionnaire.

Question 1 sought to explore the respondent's knowledge concerning the different species of flies that are attracted to a decaying corpse, and question 2 was designed to explore whether they could identify the flies. Most of the respondents knew more than one species of flies was attracted to a decaying corpse

and most of the respondents could identify the flies. For question 3, 58% of the respondents used morphological identification to identify the fly species because they found this method to be easy, cheaper, and faster than identification using molecular techniques.

For question 4, the majority of respondents said that their main motive for conducting research or studies in this field were to be able to apply their knowledge to determine the postmortem interval (PMI). For question 5, the two main problems they encountered in their studies and research relating to forensic entomology were the identification of the fly species and lack of information on forensic entomology.

The response to question 6 indicated that motivation for choosing forensic entomology as a research field or as a subject for their studies was to know more about forensic entomology or because it was a compulsory subject for some students. Generally respondents were driven by enthusiasm for knowledge in this field. Most of the respondents to question 7 strongly believed that the Department of Education in Malaysia had to play a role to encourage more students to do research in forensic entomology. Some respondents believed Department of Education in Malaysia should be urged to continue to develop forensic entomology such that is becomes a distinct discipline.

The respondents to question 8 indicated that to improve forensic entomology in Malaysia they would do more research related to forensic entomology and would promote the discipline to the student fraternity. The majority of the respondents to question 9 indicated that forensic entomology could contributed to Malaysian society in the future by helping to solve murder cases through determine the postmortem interval (PMI), and by creating a wider career opportunities for young people. Respondents to question 10 opined that mostly the police department, but also and institutions of higher learning and research centers needed the services of the forensic entomologists.

Discussion and conclusion

To our knowledge this is the first study of the awareness and knowledge of Malaysian professionals in the field of forensic entomology. Survey respondents reported that they acquired more understanding of the field by answering the questionnaire. Most of the respondents understood forensic entomology because of their profession.

According to Scheridan and Lyndall, the contents of a tool are considered adequate if the value of the Kaiser–Meyer–Olkin measure is more than 0.6 [2]. Our findings of 0.710 suggested that the questionnaire was adequate and that the items were internally consistent at a Cronbach's $\alpha = 0.67$.

An important focus of the survey was to create increased awareness of the application of forensic entomology in crime scene investigations. We found that only a few experienced crime scene police officers had meaningful knowledge of this field and collected maggots during crime scene investigation. However, much useful information was often inadvertently overlooked by crime scene police officers. According to Amendt, the first and most important stage of the procedure in forensic entomology involves careful and accurate collection of insect evidence at the scene [3]. Some evidence provided by insects may be lost during removal of the corpse. Only a crime scene police officer will be able to provide data on the general habitat, ambient weather conditions, location and microhabitat of the corpse. This shortcoming was highlighted by the respondents to our questionnaire.

A bright future for the application of forensic entomology, particularly in crime scene investigation in Malaysia is gaining pace. However, deeper professional training should be provided, particularly for the crime scene police officers so that more entomological insect evidence can be collected from crime scenes in future. Forensic entomology should be included in the curriculum of those training to become crime scene police officers including professional training on collection of maggots. The practical value of the entomological evidence is dependent on accurate collection by crime scene investigators [2].

The survey suggested that entomological evidence is currently largely ignored during crime scene investigation because maggots are generally not collected at the crime scene. Insect specimens, such as blowfly larvae or adults, should be considered as important as other physical evidence such as blood stains, fingerprints, hairs, fibers, or any other biological materials [3]. Therefore, insects should be processed as evidence at the crime scene examination as well as in the autopsy room [4].

The application of forensic entomology in Malaysia has been hindered by a general lack of available information regarding the biology of the forensically important flies found in Malaysian fauna. Moreover, forensic entomology has not been established as a profession. Rarely forensic entomologists are invited for appearance in court. Active and continued research is essential to provide up-to-date data on the biology of the forensically important blow flies and to generate more experts in forensic entomology. The survey respondents generally agreed that forensic entomology will develop fully into a distinct discipline.

To improve the status of forensic entomology in Malaysia, more research related to forensic entomology and its application in the crime scene investigation has to be conducted. Publicly to introduce forensic entomology to other students and participation in seminars held both in Malaysia and overseas needs to be encouraged. Forensic entomology can create more career opportunities. Actions that need to be considered for the furtherance of forensic entomology in Malaysia should be pursued. Students need to be taught so that they will have basic knowledge and awareness of why they should know about forensic entomology. This will create a new generation of scientists with knowledge of forensic entomology. The police department should emphasize forensic entomology in their crime investigations and expose the crime scene police officers to forensic entomology and its importance alongside training them how to collect entomological evidence during crime scene investigations.

In conclusion, knowledge and interest in forensic entomology is expanding. To improve the status of forensic entomology in Malaysia, education should be used to spread knowledge and awareness of forensic entomology effectively and comprehensively. Forensic entomology can be promoted and improved through curriculum development, relevant policies, and training programs.

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