Journal of Forensic and Legal Medicine 45 (2017) 41–46

Contents lists available at ScienceDirect

Journal of Forensic and Legal Medicine

journal homepage: www.elsevier.com/locate/jflm

Comparative fly species composition on indoor and outdoor forensic cases in Malaysia

Syamsa Rizal Abdullah [a, b, *], Baharudin Omar [b], Ahmad Firdaus Mohd Salleh [a], Hidayatulfathi Othman [b], Shahrom Abd Wahid [c]

[a] Department of Parasitology & Medical Entomology, Universiti Kebangsaan Malaysia Medical Centre, Jalan Yaacob Latif, 56000 Cheras, Kuala Lumpur, Malaysia
[b] Biomedical Science Programme, School of Diagnostic & Applied Health Sciences, Universiti Kebangsaan Malaysia, Jalan Raja Muda Abdul Aziz, 50300 Kuala Lumpur, Malaysia
[c] Forensic Unit, Department of Pathology, UKM Medical Centre, Jalan Yaacob Latiff, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur, Malaysia

ARTICLE INFO

Article history:
Received 16 May 2016
Received in revised form
7 November 2016
Accepted 8 December 2016
Available online 10 December 2016

Keywords:
Forensic entomology
Death
Flies
Chrysomya
Malaysia

ABSTRACT

Forensic entomology refers to the science of collection and analysis of insect evidence in order to determine the minimum time period since death. This study aimed to investigate the occurrence of forensically important flies on 34 human remains referred to Universiti Kebangsaan Malaysia Medical Centre over a period of three years. Entomological specimens were collected at the death scenes and/or during autopsies. Live specimens were reared into adults while preserved specimens were processed for species identification. Five families, seven genera and nine species of flies were identified from human remains. The results of the study showed *Chrysomya megacephala* (Calliphoridae) maggots occurred on corpses with the highest frequency (70.6%), followed by *Ch. rufifacies* (Calliphoridae) (44.1%), sarcophagid fly (Sarcophagidae) (38.2%), *Synthesiomya nudiseta* (Muscidae) (20.6%), *Megaselia scalaris* (Phoridae) (14.7%), *Lucilia cuprina* (Calliphoridae) (5.9%), *Ch. nigripes* (Calliphoridae) (5.9%), *Eristalis* spp. (Syrphidae) (5.9%) and *Hydrotaea spinigera* (Muscidae) (2.9%). The greatest fly diversity occurred on remains recovered indoors (eight species) compared to outdoors (three species). Whilst, single and double infestations were common for both indoor and outdoor cases, multiple infestation of up to six species was observed in one of the indoor cases. Although large numbers of fly species were found on human remains, the predominant species were still those of *Chrysomya*, while *S. nudiseta* was found only on human remains recovered from indoors. The present study provides additional knowledge in the context of Malaysian forensic entomology and the distribution of forensically important flies which is of relevance to forensic science.

1. Introduction

Decomposing remains provide an ecosystem to support the life cycle of certain arthropod communities.[1] The occurrences of those organisms not only change the condition of the remains, but also provide suitable environment for other species to inhabit the remains at a sequential manner, associated with certain stages of decomposition.[2,3] Necrophagous insects, for instance, use decomposing remains as a source of food, while other insects such as some spiders and Lepidoptera utilise the humid condition of skeletonised remains for shelter.[4] This predictable sequence of insect arrival, known as insect succession, is a crucial aspect to estimate the elapsed time since death or post-mortem interval.[5–7] This valuable information, combined with the knowledge of the distribution, biology and behaviour of these insects, may assist forensic investigation by providing information on when, where and how a person died or a crime was committed.[5,8]

In Malaysia, forensic entomology case was first reported by Reid[9] who described the occurrence of *Chrysomya megacephala* (Fabricius) (Calliphoridae) larvae in a dead woman. This was followed by Lee[10–12] and Lee et al.[13] who reviewed and updated the entomological specimens recovered from forensic cases for the

* Corresponding author. Department of Parasitology and Medical Entomology, Universiti Kebangsaan Malaysia Medical Centre, Jalan Yaacob Latif, 56000 Cheras, Kuala Lumpur, Malaysia.
E-mail address: syamsarizal.abdullah@ppukm.ukm.edu.my (R.A. Syamsa).

http://dx.doi.org/10.1016/j.jflm.2016.12.002
1752-928X/

period of three decades. The research in forensic entomology field gained interest with other workers who contributed in reviewing many forensic cases in Malaysia[14–17] as well as describing related case reports which will definitely enhanced the knowledge in this field.[18–20] There is no doubt that a combined review of such cases can enhance an understanding in this subject of research, and ultimately may assist investigators in investigating future cases related to forensic entomology.

However, apart from study by Kumara et al.[17] which reported the occurrence of flies associated with indoor/outdoor human remains in northern part of Malaysia, no comparative study had been conducted on indoor/outdoor fly composition especially in the central part of Peninsular Malaysia. Hence, the present study summarized forensic entomology cases received by Universiti Kebangsaan Malaysia Medical Centre Kuala Lumpur from 2010 to 2013, with special attention to species composition between indoor and outdoor cases.

2. Materials and methods

The present study involved all forensic cases infested with insect specimens received by Forensic Unit, Universiti Kebangsaan Malaysia Medical Centre in Kuala Lumpur, Malaysia (3.10°N, 101.73°E) from January 2010 until December 2013. In general, Malaysia experiences uniform temperature throughout the year with an average of 27 °C and annual relative humidity is approximately 80%. In the study area, maximum rainfall generally occurs in April-May and October-November, while minimum rainfall happens in February as well as from June until July.[21]

Since the death scene was attended by entomologist soon after the body discovery, the physical alteration of the death scene, if any, was minimal and has been noted via conversation with police officers and the deceased relatives or neighbours. The information of the deceased such as name, sex, age, location of where the bodies were found, possible cause of death, if available, were recorded. All insect specimens were collected from decomposed corpses and surrounding areas during visit at the death scene and/or during autopsy, based on the method described by Amendt et al.[22]. The specimens were collected in two sets; 1) preserved in glass vials containing 70% ethanol, and 2) cultured on beef liver provided ad libitum. Fly puparia, if found, were placed inside empty plastic containers. All live and preserved specimens were sent to the Forensic Entomology Laboratory for analysis.

In the laboratory, the preserved larvae samples were prepared according to the method described by Omar et al.,[23] while the live larvae were reared to the adult stage in a room with a temperature of 27.2 ± 0.4 °C, RH 65.6 ± 3.1%, photoperiod (L:D)(h) 12:12. The larvae and emerged adults were later identified using several identification keys[24–28] and reference insect collections at the Forensic Entomology Laboratory, Universiti Kebangsaan Malaysia.

3. Results

A total of 34 corpses (25 males and 9 females) infested with entomological specimens were taken for this study. Twenty nine cases (85.3%) were found indoor, while the remaining five cases (14.7%) were outdoor (Fig. 1). Out of 29 cases found indoors, 27.6% (n = 8) occurred at high rise buildings (fifth-floor and above).

A number of cases infested with various fly taxa according to death locations, whether indoor or outdoor were noted (Fig. 2). There were eight different species of flies which infested the indoor corpses while only three species were found infesting outdoor corpses. Blowfly *Ch. megacephala* maggots occurred on corpses found at both locations with the highest frequency (70.6%, n = 24) followed by *Ch. rufifacies* (Macquart) (Calliphoridae) with 44.1%

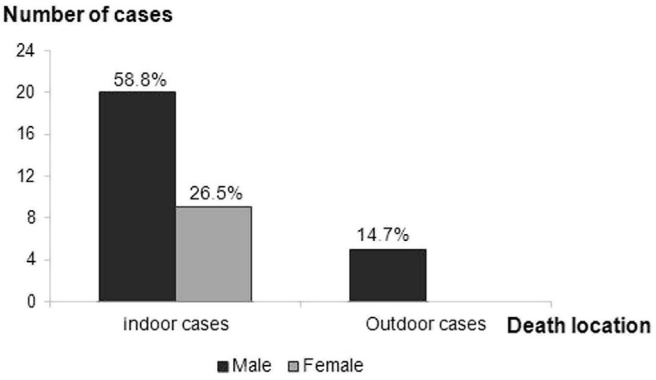

Fig. 1. Distribution of corpses according to gender and death location.

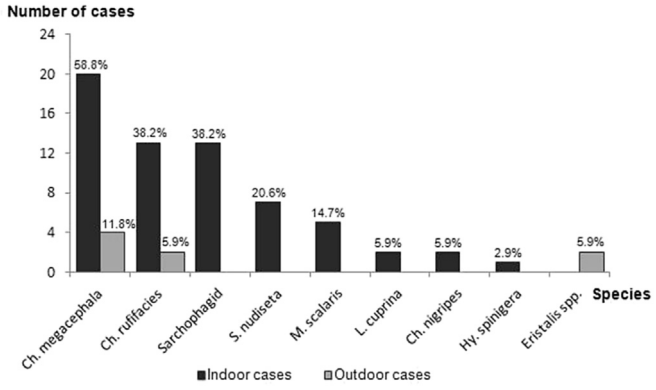

Fig. 2. Number of cases infested with various types of flies according to death location.

(n = 14). Other fly maggots such as sarcophagids only occurred on indoor corpses with 38.2% (n = 13), followed by *Synthesiomyia nudiseta* (Wulp) (Muscidae) (20.6%, n = 7), *Megaselia scalaris* (Loew) (Phoridae) (14.7%, n = 5), *Lucilia cuprina* (Wiedemann) (Calliphoridae) (5.9%, n = 2), *Ch. nigripes* Aubertin (Calliphoridae) (5.9%, n = 2) and *Hydrotaea spinigera* Stein (Muscidae) (2.9%, n = 1). *Eristalis* spp. (Syrphidae) maggots, however, were found infesting two outdoor corpses (5.9%) which are similar to their preference of inhabiting aquatic environment. The details for each case are summarized in Table 1.

The majority of infestations was double species accounting for 38.3% (n = 13) of total cases, followed by single infestation with 35.3% (n = 12). Corpses infested by three species or more were occurred only in indoor cases, with 14.7% (n = 5) of triple infestation, 8.8% (n = 3) of quadruple infestation while a single case showed infestation of up to six species (Fig. 3). The infestation of forensic flies according to indoor or outdoor cases were tabulated (Table 2).

4. Discussion

In terms of location of death, majority (85.3%) of the cases were associated with body found indoors, while only 14.7% involved outdoor locations such as river, monsoon drain, disused mine and bushes. Previous forensic entomology case reviews of the same area also indicated that indoor cases occurred far more frequent than outdoor cases.[14–16] However, this is in contrast with a recent study in north part of Malaysia which showed an almost equal percentage of indoor (54%) and outdoor cases (46%) out of 50 cases in total.[17] This variation could be due to several factors such as the