International Journal of Medical Toxicology & Forensic Medicine

January 2026, Volume 16, E50778

Research Paper

Identification of Larvae in the Examination of Eight Decomposed Bodies at Sardjito Hospital and Bhayangkara Polda DIY Hospital, Period July – December 2024

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Citation Yulianti Siregar L, Nurhantari Y, Arfianti Wiraagni I, Bagus Gede Surya Putra Pidada I, Aji Kadarmo Dh, Anggun Dhiasworo P. Identification of Larvae in the Examination of Eight Decomposed Bodies at Sardjito Hospital and Bhayangkara Polda DIY Hospital Period July – December 2024. International Journal of Medical Toxicology and Forensic Medicine. 2026; 16:E50778.

https://doi.org/10.22037/ijmtfm.v16.50778

Article info:

Received: 03 Nov 2025

First Revision: 08 Nov 2025

Accepted: 02 Dec 2025

Published: 01 Jan 2026

Keywords:

Entomology forensic, Flies larva, Decomposition, Justice

ABSTRACT

Background: The increasing incidence of decomposed body discoveries in Indonesia poses significant challenges in forensic investigations. Forensic entomology, particularly the identification of fly larvae, plays a critical role in estimating the post-mortem interval (PMI) and identifying potential body relocation. This research directly aligns with SDG 3 (Good Health and Well-Being), SDG 11 (Sustainable Cities and Communities), SDG 16 (Peace, Justice and Strong Institutions) through its contribution to mortality assessment and evidence-based forensic investigations.

Methods: This descriptive, observational, cross-sectional study was conducted on eight decomposed bodies examined at Sardjito Hospital and Bhayangkara POLDA DIY Hospital from July to December 2024. Larva samples were collected from specific anatomical sites and morphologically identified through posterior spiracle analysis.

Results: Out of a total of 334 larvae examined, four types of larvae were found: *Chrysomya* (63%), *Sarcophaga* (20%), *Calliphora* (13%), and *Musca* (4%). *Chrysomya* species were predominantly found on indoor corpses within optimal larval development temperatures (24.2°C–35.6°C). Morphological classification also identified distinct patterns in hairy and non-hairy larvae across the discovery environment.

Conclusion: Larval diversity aids post-mortem interval estimation and may indicate body relocation based on species and habitat. In eight examined cases, four larval types of Chrysomya predominated, with prior temperatures ranging from 25.2°C to 35.4°C.

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Introduction

The global rise in decomposed body discoveries reflects growing social and health challenges. In England, Wales, and South Australia, cases have increased sharply, mainly among older people with physical or mental impairments that complicate cause-of-death determination [1].

Since 2023, POLRI has cracked down on 1,680 cases of body discovery and 451 suicides throughout Indonesia. This number tends to increase from January to April 2023 [2]. Police records show that housing and residential areas are the locations with the highest number of bodies found and suicides [3]. Cases of bodies found in decomposing conditions in Yogyakarta Province, examined at Sardjito Hospital and Bhayangkara POLDA DIY Hospital in the period from 2019 to 2023, are quite diverse. At Sardjito Hospital, 3 cases were examined in 2019, 1 in 2020, 1 in 2021, 3 in 2022, and 2 in 2023. At Bhayangkara POLDA DIY Hospital, 29 cases were examined in 2019, 17 in 2020, 10 in 2021, 8 in 2022, and 42 in 2023. Cases have increased in the past year, with males in the 40-60 age range accounting for the largest number.

Forensic science often involves multidisciplinary approaches, including forensic entomology (the study of insects associated with decomposing bodies) and justice. Insects are usually the first to arrive at a death scene, and their activity provides valuable clues about the time and circumstances of death [4, 5]. The presence of unusual species may also indicate body relocation, which can be verified by comparing local faunal data and ecological references [6].

Decomposition is a complex biological process that begins with autolysis and enzymatic tissue breakdown, then proceeds through microbial activity, and is accelerated by insects and scavengers. Flies and other arthropods rapidly colonize exposed remains and depart once resources are depleted. The rate and pattern of decay are influenced by environmental factors such as temperature, humidity, and habitat, as well as body-related factors including age, clothing, trauma, and manner of death [7-10].

Diptera insects significantly impact the decomposition of humans and animals. Necrophilic species within this order are crucial in forensic studies, as their taxonomy and life cycles enable estimation of the post-mortem interval (PMI). Diptera comprises two suborders, Nematocera and Brachycera, with key forensic families including Calliphoridae, Sarcophagidae, Muscidae, Lucilia, Piophilidae, Phoridae, Sepsidae, Trichoceridae, and Stratiomyidae [11].

This research supports the United Nations Sustainable Development Goals (SDGs), particularly SDGs 3 (Good Health and Well-Being), 11 (Sustainable Cities and Communities), and 16 (Peace, Justice and Strong Institutions), by strengthening forensic investigation processes that enable reliable death analysis and promote access to justice.

Materials and Methods

This study employed a descriptive, observational, cross-sectional design. Each decomposed body was examined to record the discovery chronology, scene details, and physical condition. When fly larvae were found, samples were collected following standard forensic entomology procedures. The research was conducted at the Department of Forensic and Medicolegal Medicine, FKKMK UGM, and at Sardjito Hospital and Bhayangkara POLDA DIY Hospitals between July and December 2024.

The tools in this study are, a tool box, a protocol sheet to write down what specimens were collected, when and where, pencils or pens with waterproof and alcohol-resistant ink, label paper, anatomical tweezers, spoons to collect larvae, a cleanly sealed container for storage measuring 30 cc, ziplock plastic bags, glass objects and glass covers, razors, cameras for image documentation, microscope with camera. The materials used are Ethanol (70–95%) to store larval specimens, *Merck Entellan* as an adhesive for glass objects and covers, and fly larvae.

The examination begins with the alloanamnesis, chronology of death, and identification of the body, and proceeds to a physical examination of the body. Samples from the body are collected from the area of the holes, wounds, under the body, in the folds of clothes and pockets, shoes, socks, etc. Samples may also be collected from carpets, bags, or other materials located near the body, including inside the body bag or body wrap. Afterward, a sample from the area with the largest larval population is collected using a spoon. Label the bottle or closed container. If the larvae are still alive, they are immediately turned off by adding hot water at about 80– 90 °C for 30 seconds. Then the water is discarded, and the sample is rinsed once with 70 – 90% alcohol; 70 – 90% alcohol is then added again until the sample is submerged. A sample examination is carried out as soon as possible, preferably within 24 hours of sampling. The larvae

Table 1. Estimated age of the body.

Body	Estimated Age (Years)	Case Type
A	30 – 40	Suspected illness
B	35 – 55	Suspected illness
C	55 – 65	Suspected illness
D	30 – 40	Suspected illness
E	0	Suspected infanticide
F	0	Suspected infanticide
G	60 – 70	Suspected illness
H	25 – 35	Suspected suicide

collected are then taken to the FKKMK UGM Laboratory for larval measurement, posterior spiracle examination, and identification of the type of fly larvae.

Results

The examination carried out on 8 bodies found the most estimated age range in adulthood, with the most causes of death suspected to be due to illness. The distribution is shown in Table 1.

In alloanamnesis, the location of the most decomposing bodies was found in the house with 3 bodies, which can be seen in Table 2.

Temperature plays an important role in both the decay process and the development of larvae. For the collection of temperature data, the average temperature over the 5 days prior to discovery was used. The data were obtained from the website of the Badan Meteorologi, Klimatologi dan Geofisika (BMKG). I The ideal temperature for fly breeding is 25–35°C. The average temperature at the discovery site ranged from 24.2°C to 35.6°C, as shown in Fig. 1.

Based on the morphology of fly larvae divided into Hairy (hairy) and non-hairy (hairy) larvae, the results of macroscopic examination of larvae taken from 8 corpses, Hairy and non-hairy larvae were obtained. Hairy larvae have tubercles or prickly protrusions on the body, giving them a "hairy" appearance, while non-hairy have a smooth body without protrusions or tubercles. Hairy flies tend to be found in natural environments such as gardens and forests, while hairless flies are more common in human settlement environments [12]. The results of the distribution of Hairy and Non-Hairy larvae are shown in Fig. 2.

After sampling, a posterior spiracle examination of the larvae was carried out, yielding 4 types: Sarcophaga, Calliphora, Chrysomya, and Musca. In the

Table 2. Location of the discovery of the body.

Body	Discovery Location
A	Inside the house
B	Inside the house
C	Inside the warehouse
D	At the backyard
E	At the riverside
F	Inside the house
G	At the backyard
H	At the forest

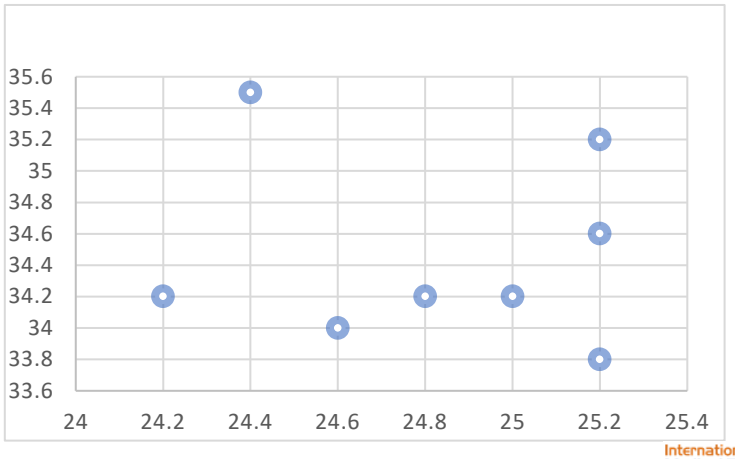

Figure 1. Average temperature 5 days before the discovery of the body.

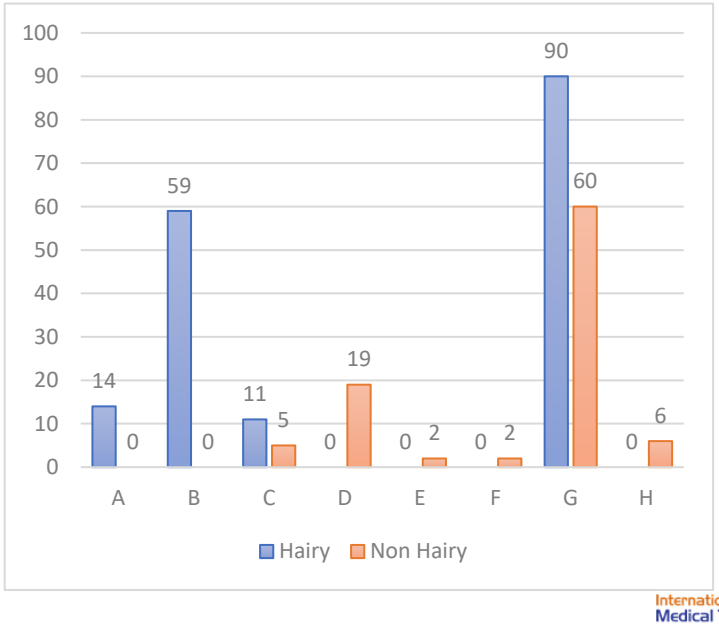

Figure 2. Distribution of Hairy and Non-Hairy larval data on each body.

examination, the researcher obtained slides that could not be identified, and some larvae were not included in the larvae of flies. The results of the larval type analysis for each body are shown in Fig. 3.

Of the total samples identified (n = 334), the most common type was Chrysomya (63%), followed by Sarcophaga (20%), Calliphora (13%), and the least Musca (4%), as presented in Fig. 4.

Documentation of posterior spiracles for identifying the larval types of Sarcophaga, Calliphora, Chrysomya, and Musca can be seen in Figs. 5, 6,7 and 8.

Discussion

Body age influences decomposition rate: infants decompose faster, while the elderly decompose more slowly, depending on tissue condition and disease. In forensic analysis, age must be considered alongside environmental and biological factors when estimating time of death [16].

A study in Chiang Mai, Thailand (2009–2010), identified 63,158 flies, dominated by *Chrysomya* spp. (45.6%), followed by *Calliphora* (21.1%), *Musca* (21%), and *Sarcophaga* (3.8%) [17]. In Malaysia (2010–2013), *Chrysomya megacephala* was most frequent (70.6%), followed by *C. rufifacies* (44.1%), *Sarcophaga* (38.2%), *Musca* (20.6%), and

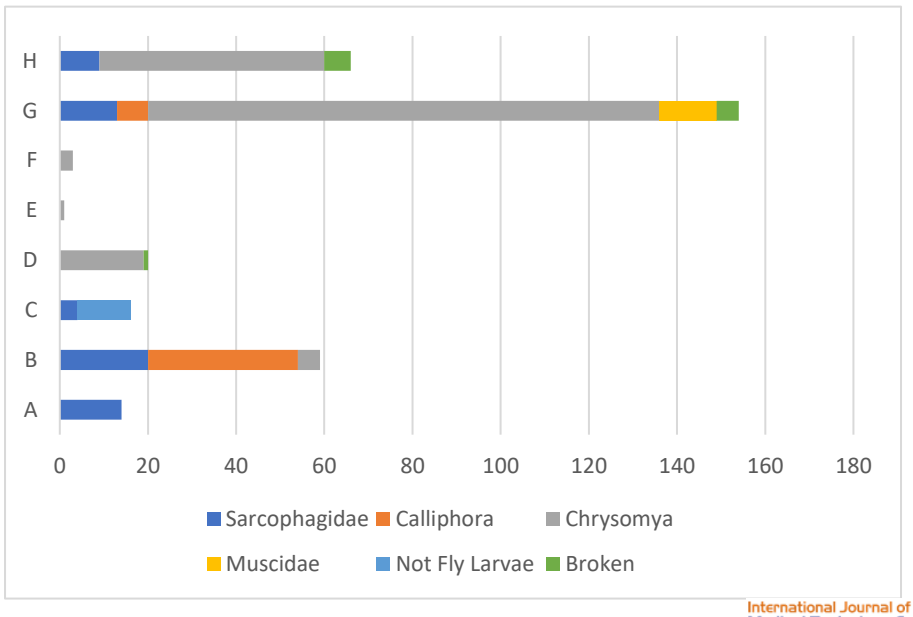

Figure 3. Types of larvae found on corpses.

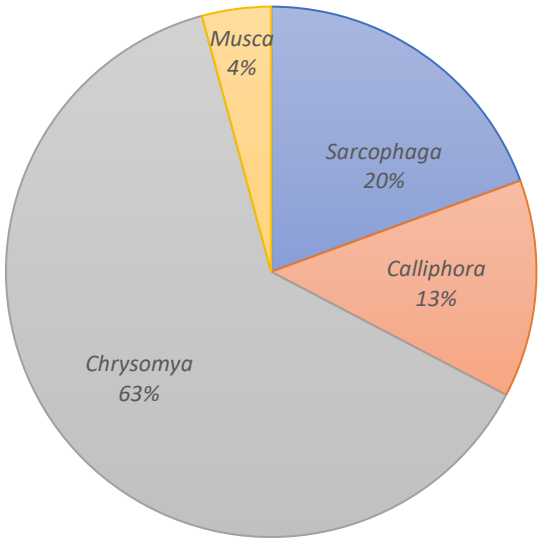

Figure 4. Number of larval types examined from the entire larval sample.

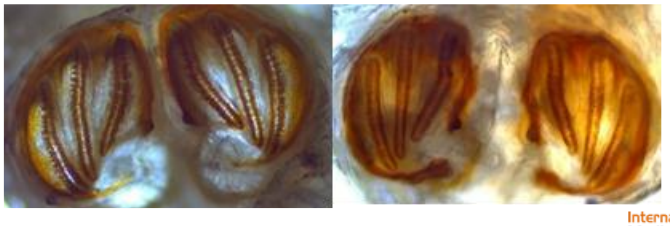

Figure 5. Posterior spiracle of the *Sarcophaga type.* The middle spiracle gap is more straightforward, the outer spiracle gap is facing inward, the inner spiracle gap is facing the middle, the button is not clearly visible [13].

Phoridae (14.7%); indoor cases showed greater species diversity [18].

In this study, *Chrysomya* (63%) was also the dominant species, followed by *Sarcophaga* (20%),

Figure 6. Posterior spiracle of the *Chrysomya type.* All spiracle slits point downwards and inwards, the periterms do not close, and the buttons are not clearly visible [12].

Figure 7. Posterior spiracle of the *Calliphora type.* Characteristic of the spiracle slit leads downwards and inwards, the periterms close perfectly [14]

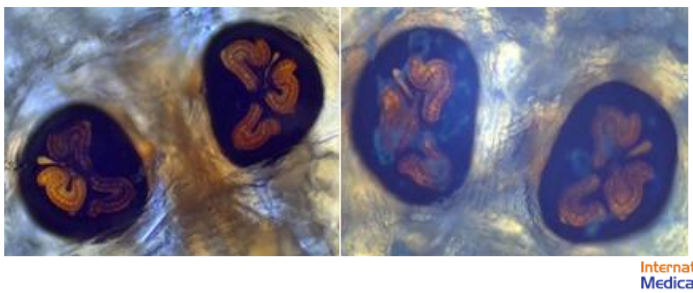

Figure 8. Posterior spiracle of the *Musca type.* It is characterized by a spiracle slit like the letter "S", peritrem closes perfectly, a kidney-shaped button [15]

Calliphora (13%), and *Musca* (4%).

The optimal temperature for the growth of fly larvae in depth is about 33.3 ± 1.52°C. *Sarcophag's* larvae develop at optimal temperatures of 30 – 35oC; Chrysomya type, 30 – 34oC; Calliphora, 20 – 23oC; and Musca type,0 – 35ºC [19-21].

Temperature influences larval growth rate and development quality. Larvae actively move toward warmer areas to accelerate growth, with optimal development at 24–33°C in tropical regions like Indonesia. Extreme temperatures may inhibit or halt development [22, 23].

Conclusion

The diversity of larval types in corpses has significant value in forensic examination, as it can provide crucial information such as Post-Mortem Interval (PMI). Each larval type has a different life cycle, allowing forensic experts to estimate the time since death. Identifying these types of larvae can also be a clue to the location of death. The presence of certain larvae, which are generally only found in specific environments, can indicate that the body may have been moved after death. Therefore, the examination and identification of larvae on corpses is an important part of forensic entomology, helping to more accurately determine the time, place, and conditions of death. On examination of these 8 decomposing remains, the average temperature over the last 5 days before discovery ranged from 25.2 to 35.4 °C. Examination of the larval spiracles revealed 4 larval types: Chrysomya, Sarcophaga, Calliphora, and Musca, with the greatest distribution in Chrysomya, followed by Calliphora, Sarcophaga, and the rarest, Musca.

Acknowledgment

The authors would like to express their sincere gratitude to Bhayangkara Hospital POLDA DIY and Dr. Sardjito General Hospital for their permission, support, and valuable cooperation, which made this research possible.

Ethical Approval

This study was approved by the Health Research Ethics Committee of the Faculty of Medicine, Universitas Gadjah Mada, Yogyakarta, Indonesia (Approval No. KE/FK/1369/EC/2025).

Funding

No specific funding was provided for this article.

Conflicts of Interest

The authors report there are no competing interests to declare.

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