REVIEW ARTICLE

A Review of Human Myiasis in Iran With an Emphasis on Reported Cases

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ABSTRACT

Myiasis is the invasion of organs and tissues of humans or other vertebrate animals by fly larvae. The first reported case of myiasis in Iran was ophthalmic myiasis, which was reported in 1975. Since then about 81 cases of human myiasis have been reported in Iran up till 2017. According to this study, all types of myiasis were reported from different parts of Iran. Vectors species of human myiasis in Iran are: *Oestrus ovis, Chrysomya bezziana, Dermatobia hominis, Hypoderma bovis, Rinoestrus purpureus, Lucilia serricata, Eristalis tenax, Sarcophaga haemorrhoidalis, Sarcophaga fertoni, Wohlfahrtia magnifica, Wohlfahrtia nuba, Wohlfahrtia vigil, Cynomyopsis cadaverina*, and *Psychoda albipennis*. There were two age peaks of myiasis infection in Iran: 21- 40 years old, and 65 years old . Specific and primary treatment is removal of larvae from infected tissues . Ironing is an effective way to eliminate eggs, also wearing long sleeve clothes to cover wounds and avoiding outdoor sleep are another way to prevent infection with flying larva. The aim of this review was to determine the prevalence of myiasis in different parts of Iran in order to determine and prioritize the methods of control based on the results.

Keywords: Myiasis, Fly larvae, Diptera, Iran

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INTRODUCTION

The order Diptera consists of common insects in the medical and veterinary fields. This order has three suborders including Nematocera, Brachycera and Cyclorrhapha, of which Cyclorrapha (true flies) made-up of about 160,000 species (1). "*Myiasis*" is a Greek word "*Myia*" meaning fly and "*sis*'' meaning infection (2). This term was first used by F.W.Hoppe in 1840. Nowadays, myiasis is used as to diagnose infection of human and other vertebrate animal's tissues and organs with fly larvae (3).

The first case of myiasis reported in Iran was ophthalmic myiasis in 1975(4). Myiasis classification is done in two methods, thus entomological and clinical method. In entomological method, classification of myiasis is conducted according to the morphology of the parasitic larvae. In this way, myiasis is divided into obligatory, facultative and accidental forms. The obligatory form of myiasis usually occurs in animals, call Bicheira, a Portuguese term or phrase meaning sore or wound. In the clinical method, it is classified according to the part of the body that is infected. In this case, myiasis can be divided into internal ophthalmic myiasis, external ophthalmic myiasis, orbital, urogenital, pharyngeal, auricular, gastrointestinal, oral, cutaneous, and wound myiasis (2).

Although all types of myiasis have been reported from all ages, infections in children can be severe and result in death. Actually, myiasis is more likely to occur in societies living close livestock, such as nomadic and rural communities(5) . By the end of 2017, nearly 81 cases of myiasis have been reported in Iran, and most of which belong to three families of flies thus Oestridae, Calliphoridae, and Sarcophagidae. These three families are of primary important, and the other families are of secondary importance.

Generally, the families of flies resulting in human myiasis include:
1- *Calliphoridae:* These flies are almost as big as house fly or slightly bigger than house flies. They are both green or blue metallic and their antenna aristae are plumose at the end, and usually have two coarse not pleural hairs (6) The larvae of this family are scavenger and feed on rotten animal materials. A group

of calliphoridae is obligatory, facultative and accidental parasites, and some of them may attack invertebrates. In terms of appearance, the larvae are Muscoid type and have the end part of the body truncated, with usually projections in this area (Hazratian, 1997). The main medical species of this family are: *Cochliomyia hominivorax, Chrysomya bezziana, Lucilia sericata, Lucilia illustris, Lucilia cuprina, Calliphora croceipalpis, Phormia terraenovae, Chordilobia anthropophaga, Auchmeromyia luteola* (6) .

2- *Sarcophagidae* or flesh flies: This family of flies has their adult flies being blackish in color with gray stripes on chest and naked aristae or plumose in the mid-basal. These flies usually have four coarse dorso-pleural hairs (6). Most members of this family are seen around carcasses and feces, their sizes are almost equal to or greater than the house flies (7). Larvae of these flies at different ages can be distinguished by their form and number of slits on the posterior respiratory tract and by internal cephalopharyngeal skeleton during molting. Generally, these larvae feed on rotten material. By their morphological characteristics, they poses small hairs on the twelfth segment of the body, numerous openings on the anterior respiratory pores, placement of posterior respiratory pores inside a deep space on the last segment, presence of open peritreme on the posterior porosity plate, and 3 direct and vertical holes (8). This family has about 100 genera and 2600 species worldwide. Important medical species are: *Sarcophaga haemorrhoidalis, Wholfahrtia vigil, W. magnifica and W.nuba* (9).

3- *Oestridae:* This family has species with large heads and wide facades (10) . The members of this family are somewhat bee-like and their mouths are small and the mouth-parts are consumptive or absent, and the scutellum is quite short and postscutellum usually well-developed (6). Antennae are short and the third segment is swollen and their aristae do not have hair. Their larvae are thick without narrow anterior end. The third segment of the larvae has pair of mouth hook. The anterior respiratory protrusions are slightly prominent or basically not seen. The posterior respiratory pore has two prominent plates and two sclerotized plates, which appear to mesh with the holes in it. The important medical species of this family are: *Oestrus ovis, Hypoderma bovis* and *Hypoderma lineatum* (11). Other families causing myiasis include: family *Guterbridae* with famous species of *Dermatobia hominis*, family *Gasterophilidae* with famous species of *Gasterophilus intestinalis* and *G. pecorum*, family *Muscidae* with famous species of *Musca, Fania, Muscina* and *Stomoxys*, family *Syrphidae* with famous species of *Eristalis tenax* and family *Phoridae* with famous species of *Megaselia scalaris* (6).

CASES OF HUMAN MYIASIS REPORTED IN IRAN

The information needed for this study including case reports were derived mainly from the Iranian Journal, Google Scholar, Scopus, Science Direct and PubMed according to the key words.

1- **Ophthalmic myiasis**: This type of myiasis has been reported from different parts in Iran (12). Eye infestation accounts for 5% of all types of myiasis reported in Iran, the infection is common in spring and summer. That is myiasis is a disease of warm seasons (13). Ophthalmic myiasis could be classified into Orbital myiasis, external Ophthalmic myiasis, and internal Ophthalmic myiasis (12,14). The vectors of this myiasis in Iran are the larvae of *Oestrus ovis* (sheep bot fly) , *Chrysomya bezziana* (old world screw worm fly), *Dermatobia hominis*, *Fannia* (Latrin fly), *Musca domestica* (house fly), *Hypodarm bovis* (Cattle bot fly) and *Rhinoestrus purpureus* (Russian bot fly) (14-18).

2- **Nasopharyngeal myiasis**: The most reported cases have been found from this type (12). The vectors are: *Oestrus ovis, Chrysomya bezziana, Lucilia sericata* and *Eristalis tenax* (4, 19, 20).

3- **Cutaneous myiasis**: This type is furunculous or wound form of myiasis(21). The reported vectors in Iran include larvae of *Chrysomya bezziana* and *Lucilia sericata* (22-24).

4- **Auricular myiasis**: This type is also called ear myiasis.A few number of cases has been reported from Iran(12). The reported vectors in Iran are the larvae of *Chrysomya bezziana, Lucilia sericata* and *Sarcophaga haemorrhoidalis* (25). *Lucilia serricata* has also been reported as most frequent vector in some cases. Autogenous species of this family are mostly found in cool and temperate regions and must have protein-rich meal before they can their egg, and if conditions favorable, they can lay about 250 eggs within 3 days and, depending on the ambient temperature, these flies can develop their entire life cycle within 4 to 6 weeks (26). The other important vector of myiasis is the Old-World Screw worm fly (*Chrysomya bezziana*). The reason for naming this fly is that the larva first penetrates its head into the host tissue and with the spine-like rings; the larvae screwed its body around and into the host. In addition to the skin, the fly can also lay eggs into the ears, nose, mouth, urethra, and in ulcers. The presence of these larvae in wounds and pores of the body cause itching, pain, dizziness, erythema, bleeding, eosinophilia, and sometimes bacterial infections(18).

5- **Oral/ gingival myiasis**: This type is also reported from different parts of Iran. Oral myiasis is present in the jaw tissues or the mucosa of the oral cavity. In reported cases, *Oestrus ovis, Wohlfahrtia magnifica* and *Lucilia sericata* larvae have been identified as vectors(12, 27). Actually, oral myiasis was classified as wound myiasis and was first defined by Laurence in

1909. This myiasis is mostly occurs in tropical regions. Oral myiasis is associated with factors such as poor oral hygiene, alcoholism, oral illness, face trauma, paralysis or weakness of the immune system, and incapacity of the brain and respiratory system (Nosocomial Myiasis).

6- **Pharyngeal myiasis**: Several cases of this myiasis have been reported in Iran and *Oestrus ovis* larva has been shown as vector (2).

7- **Nasal myiasis**: Many cases of this type have also been reported in Iran and its vectors are *Chrysomya bezziana, Lucilia sericata* and *Eristalis tenax* (2, 27).

8- **Intestinal or accidental myiasis**: This type is an accidental infection and occurs when the eggs are eaten and larvae excreted by feces, although this may be due to eating the insect larvae (28). Intestinal myiasis may sometimes be seen as false, and occurs when insect lays eggs on the stool outside the digestive tract and before feces examination in the lab. Larvae excretion is usually transient and lack clinical symptoms, but the establishment of larvae in patient can cause severe pain and gastrointestinal symptoms before leaving through stool (29, 30). The cause of this species in Iran, which is very rare, has been described as larvae of *Sarcophaga haemorrhoidalis, Eristalis tenax* and *Cynomyopsis cadaverina* flies. If the agent of the disease is *Eristalis tenax* larvae, it is called pseudo-myiasis (20). More than 50 species of these flies, including 30 species of *Sarcophagidae* have caused gastrointestinal, facultative or accidental myiasis throughout the world.

9- **Urogenital myiasis**: This type is also uncommon in Iran. Limited cases have been reported, and the vectors in Iran are *Chrysomya bezziana* and *Wohlfahrtia magnifica* (2). Recently, one type of urogenital myiasis has been reported for the first time in Iran by the authors of a manuscript titled caused of myiasis by *Psychoda albipennis* from the sub-family of Psychodinae and the family Psychodidae., the report of this manuscript is under publication.

10- **Nosocomial myiasis**: This form of myiasis happens in the hospital environment. This type is considered rare, however, some cases have been reported from different countries and in Iran, and the larvae of *Lucilia sericata* and *Wohlfahrtia nuba* have been identified, and more often considered as nasal type of myiasis (7). About 4% of Iran's cases are of this type and mortality rate of 1.3% has been reported. Most of these cases are facultative and accidental but can sometimes be fatal (31).

Figure 1 shows the distribution and densitiy of the cases in Iran (32). Figure 2 shows the number of reported case in Iran identified according to anatomical sites. Figure 3 shows the percentage of dipteran species not define as myiasis agent in Iran.

Figure 1: Spatial distribution of documented myiasis cases in provinces of Iran

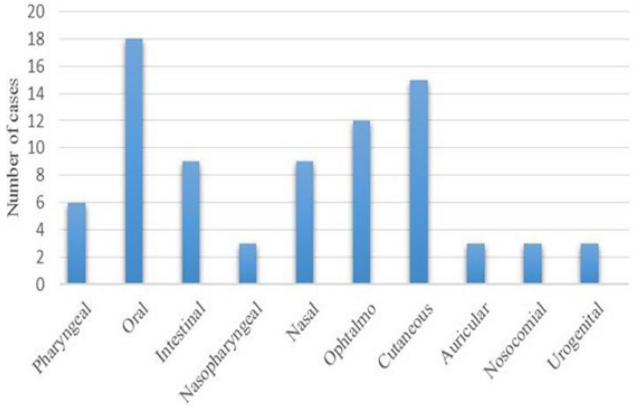

Figure 2: Number of reported case in Iran identified according to anatomical sites

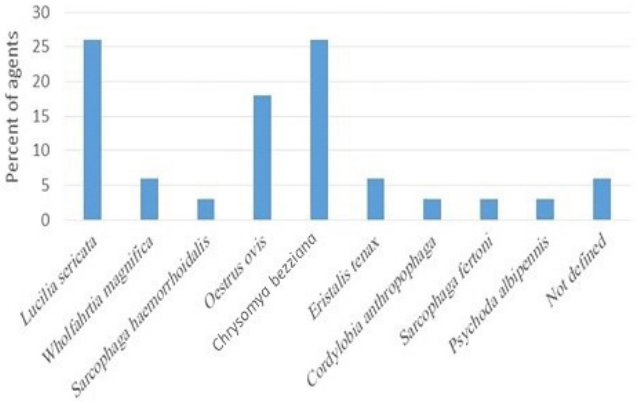

Figure 3: Dipteran species not define as myiasis agent in Iran (%)

CONTROL AND TREATMENT OF MYIASIS

The most important precaution is to prevent human infection because treating the cases, even before complication occur is associated with lot of discomforts. Since myiases in most cases are secondary complication, the presence of any type of ulcer or pustule can cause variety of myiases. Therefore, observance of hygiene and rapid treatment of all forms of wounds seem insignificant but prone to fly larvae, are primarily important.

The indications that can be made about human myiasis are as:
1- treating wounds and protect them from insects, 2- dressed up pricked ears and insert sterile cotton inside the ear during the day until final treatment, 3- in the case of the eye, although healthy people may also be attacked, it is imperative to keep and protect eyes, 4- washing hands after contact with livestock, 5- applying nets in places where flies are numerous, 6- observe hygiene during milking, 7- using repellents, 8- Fight against insects and eliminate them with chemicals, traps or poisonous carcasses (11).

The purpose of the treatment is to clean the tissue from the larvae. Sometimes , pressing with hand is sufficient in the case of cutaneous myiasis before referring to the doctor. Occasionally , blocking the larvae infiltration site to prevent respiration can be beneficial. Larvae can also be taken out with forceps. For migratory form of wound myiasis, manual removal of all visible larvae, followed by delay and debridement is sometime necessary.

Ironing is an effective way to eliminate eggs, also wearing long sleeve clothes to cover wounds and avoiding outdoor sleep are another way to prevent infection with flying larvae (33). Ivermectin is used to treat myiasis in animals and humans. Ivermectin is an antibiotic isolated from *Streptomyces avermitilis* and has been shown to respond well in livestock, especially against digestive and respiratory parasites. Topical administration of 1% of this drug in propylene glycol has been shown effective (32).

DISCUSSION

The larvae of flies (maggots) can attack various tissues to create conditions called myiasis which occurs mainly in rural areas. If infestation with larvae is severe, it may lead to host death, particularly if sensitive organs of the body, such as the nose, eyes and ears, are attacked by larvae.

The aim of this review was to identify the situation and the reported cases of myiasis in different parts of Iran in order to determine and prioritize the methods of control based on the results.The results of this study will help to identify and prioritize the control and prevention methods. Given that husbandry in Iran is still more traditionally and dispersed, the presence of *Oestrus ovis*, as the major agent of oral myiasis is high, therefore, oral myiasis cases are commonly reported more than other cases.

Specific and primary treatment is removal of larvae from infected tissues (34). Classification of clinical myiasis may vary depending on the part of the body infected and the number of larvae. There are different types of myiasis with different generative factors among domestic and wild life animals around the world.

Alcoholism, sensitivity, Mental retardation, hemiplegia, and the presence of respiratory masks during sleep, could cause oral myiasis (35). Intestinal myiasis in humans is likely to be accidental which occurs when contaminated food or water containing fly's larvae is consumed.

Most larvae are destroyed by digestive fluid, but some can survive and cause gastrointestinal disorder. There is possibility of larvae entering through the anus and causing rectal myiasis. Gastrointestinal myiasis is rare in developed countries. Basically, this type occurs in countries where the health status is not satisfactory(20). In Iran about 81 cases of human myiasis have been reported by the end of 2017.

There were two age peaks of myiasis infection in Iran: 21- 40 years old and 65 years old. According to this study, all types of myiasis were reported from different parts of Iran. A questionnaire-based study in Fars Province showed that more than 88% of cases were found in people involved in sheep and goat rearing (15).

In medical centers and colleges, this disease is not much recognized. On the other hand, it is less helpful in term of the vector, diagnosis and reporting for medication by the medical entomologists. Therefore, the exact number of the disease is much higher than those mentioned. In addition, people having the ability to detect flies, do not exist or are very few in most areas.

In order to determine the true cases of myiasis, diagnosis and treatment should be sought from medical entomologists who are skilled in this field. This is highly valued and recommended because the main problem with flies is their precise diagnosis. It is very difficult to accurately detect adult female and larva of Sarcophagidae and the immature stages of the Muscidae family. For this reason, less report has been made on the genus of Sarcophagidae and their larvae. Also the report of urogenital myiasis caused by *Psychoda albipennis* in the subfamily of Moth flies shows that real cases of myiasis in Iran are more than the reported cases, because diagnosis of all types of urogenital myiasis in health centers are not accurately diagnosed or neglected due to lack of consultation with a medical entomologist or a lack of entomologist in the disease area. Reported cases from different parts of Iran often include items that have been sent to faculties of entomology labs.

Therefore, it is advisable to consult with medical entomologist in the diagnosis of all types of myiasis in Iran, particularly with the recent report of urogenital case by *Psychoda albipennis* larvae; it is desirable to recognize the larvae of this insect in the etiology urogenital myiasis. Because of the large population of this insect in places where it grows, it is likely that auricular myiasis, ophthalmic myiasis and nasal myiasis could also be cause by this insect. Various types of

myiasis flies are scattered throughout the world and are also found in Iran. Annually, these flies cause lot of waste and damages meanwhile, the specific geographical and livestock situation in the country could be risk factors.

Myiasis studies in Iran, although not long in history, have provided useful information about zoonosis conditions in Iran. These studies show that different kinds of myiasis are found in humans and in wild animals in most parts of the country, especially in places with poor health status.The occurrence of war and some unpleasant events are among the conditions that increase the number of human cases of these conditions. There are many Diptera species causing myiasis in Iran that are not yet known. Therefore, full investigation is required to identify the myiasis-producing Diptera fauna in Iran (6). The information needed for this study including case reports were derived mainly from the Iranian Journal, Google Scholar, Scopus, Science Direct and PubMed according to the key words.

CONCLUSION

Since 1975 about 81 cases of human myiasis have been reported in Iran up till 2017. Based on reported cases, ophthalmic, nasopharyngeal, cutaneous, auricular, oral, pharyngeal, nasal, intestinal, urogenital and nosocomial myiasis are found in most parts of the country. In medical centers and colleges, this disease is not much recognized. In order to determine the true cases of myiasis, diagnosis and treatment should be sought from medical entomologists who are skilled in this field. This is highly valued and recommended because the main problem with flies is their precise species identification.

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