Vol. 20, No. 1, Spring, 2024, 121-132 *Original Article*
DOI: 10.22055/IVJ.2024.421368.2643
Journal Homepage: http://www.ivj.ir/

# A survey on frequency of insect bite hypersensitivity (IBH) in horses of Khuzestan province, Iran

Bahare Soleimani[1], Ali Reza Ghadrdan Mashhadi[2*], Mohammad Rahim Haji Hajikolaei[2], Masoud Ghorbanpoor[3], Mohammad Razi Jalali[2] and Rahim Chinipardaz[4]

[1] DVSc Graduated of Large Animal Internal Medicine, Faculty of Veterinary Medicine, Shahid Chamran University of Ahvaz, Ahvaz, Iran
[2] Professor, Department of Clinical Sciences, Faculty of Veterinary Medicine, Shahid Chamran University of Ahvaz, Ahvaz, Iran
[3] Professor, Department of Pathobiology, Faculty of Veterinary Medicine, Shahid Chamran University of Ahvaz, Ahvaz, Iran, and Department Pathbiology, Faculty of Veterinary Medicine, Sharekord University, Sharekord, Iran
[4] Professor, Department of Statistics, Faculty of Mathematical Science and Computer, Shahid Chamran University of Ahvaz, Ahvaz, Iran

Received: 03.11.2023 Accepted: 12.03.2024

## Abstract

Insect bite hypersensitivity is a recurrent and chronic dermatitis in horses, that is mainly caused by an allergic reaction to the bites of Culicoids species, and therefore in areas where these insects can grow, the risk of getting the disease also increases. The conditions in Khuzestan province (located in southwestern of Iran) are mostly hot and humid, causing many veterinarians to encounter horses with IBH symptoms. The present study aimed to evaluate the frequency of insect bite hypersensitivity among horses in this province. The study was performed on 255 Arabian horses kept in 21 horse breeding centers located in 6 cities of this province. The horses were examined for the presence or absence and location of skin lesions, along with the individual animal information, which was recorded in relevant forms. The prepared serum samples (32 healthy horses and 61 affected horses) were evaluated for total IgE using the ELISA test according to the instructions of the kit manufacturer. The results showed that 144 (56.5%) out of totally 255 horses had clinical signs of IBH. Statistical evaluations also revealed that among the hosting factors (including age, gender, bloodline, coat color, body condition score, and type of use), and management and environmental factors (including stud size, methods of control of insect, distance from the horse breeding centers to the water source, times of fecal collection in the horse breeding centers and the geographical location of the horse breeding centers), only stud size had a significant effect on the prevalence of IBH, In other cases, there was no significant relationship between the prevalence of the disease and the evaluated factor. The results also showed that the amount of IgE in affected horses was higher than in healthy horses. The results of this study showed that insect bite hypersensitivity exists with a significant frequency among horses kept in the horse breeding centers in Khuzestan province.

**Key words**: Insect bite hypersensitivity, Elisa, Horses, Khuzestan province

## Introduction

Insect bite hypersensitivity (IBH) that also known as summer eczema, Sweet itch, and Queensland itch (Anderson et al, 1988; Wagner et al, 2008), is a recurrent and chronic dermatitis in horses, that is (mainly) caused by an allergic reaction to the bites of Culicoids species (Kleider and Lees, 1984; Mellor et al, 2000; Van Grevenhof, 2007).

* **Corresponding Author**: Ali Reza Ghadrdan Mashhadi, Professor, Department of Clinical Sciences, Faculty of Veterinary Medicine, Shahid Chamran University of Ahvaz, Ahvaz, Iran
E-mail: a.ghadrdan@scu.ac.ir

The geographical distribution of this disease is consistent with the geographical distribution of the insect habitat; therefore, in areas where these insects can grow, the risk of getting the disease also increases. Conditions that exist in the mostly hot and humid Khuzestan province (located in the southwest of Iran) and cause many veterinarians to encounter horses with IBH symptoms every year and during most months of the year. It is noteworthy that based on the available sources, no research has been conducted on the frequency of the disease in this province and there is very little published research on the disease in the country. Given the above, this study aimed to evaluate the frequency of insect bite hypersensitivity among horses in Khuzestan province.

However, based on the contents of the sources and articles, different laboratory methods can be used to diagnose the disease but it is still believed that the gold standard method for identifying patient domains is to evaluate history and clinical signs (Morris and Lindborg, 2003; Langer et al., 2008), two criteria that have been considered in the present study as diagnostic criteria for affected animals. It should be noted that in the history of the disease, attention to its seasonal occurrence (Marti et al, 1999) and temporary and incomplete response to treatment (Marsella, 2013), in the case of symptoms, the presence of itching along with the type and distribution of lesions (Marti et al, 1999) is one of the diagnostic keys to IBH.

## Materials and Methods

The present study was performed on 255 Arabian horses (with three different bloodlines including Purebred Arabian, imported, and Partbred) kept in 21 horse breeding centers located in 6 cities of Khouzestan province (including Shushtar, Bavi, Ahvaz, Susangard, Abadan, and Ramhormoz). In each case, after attendance at the horse breeding centers, almost all the horses at the site were examined for the presence or absence of skin lesions. The lesions included Alopecia, papule, scab, scale, wound, lichenification, macule, nodule and scar that were seen in different parts of body (for example mane, withers, neck, face, ears, tail, shoulder, hip, back, limb….). The presence of skin lesions, along with personal characteristics and history of the diseases of horses were recorded in the relevant forms. Horse breeding centers information were also recorded on these forms. Following physical examination, a total of 32 healthy and 61 affected horses were sampled. The obtained blood samples into plain tubes were transferred on ice as soon as possible to the clinical pathology laboratory of the Faculty of Veterinary Medicine, Shahid Chamran University of Ahvaz. In the laboratory, total serum IgE levels were determined using the ELISA method according to the instructions of the manufacturer of the kit (Horse Immunoglobulin Elisa kit manufactured by Bioassay Technology Laboratory, China).

The collected data were analyzed by SPSS version 28. Statistical analysis includes descriptive evaluation, analysis of variance, goodness-of-fit test, and comparison of ratios. The significance level is considered $P<0.05$.

## Results

In the present study, 144 out of 255 examined horses had clinical signs of IBH.

Role of hosting factors: Table 1 shows the frequency distributions of IBH cases based on age, sex, bloodline, coat color, body condition score, and type of use, respectively. However, according this table, there are differences (which are occasionally significant) between different groups (defined based on the host factor) in terms of the prevalence of the disease; however, the tests performed indicate that in none of these cases, the relationship between the host factor was evaluated and the prevalence of IBH was not statistically significant ($P>0.05$).

**Table 1: The frequency of IBH studies horses on the base of hosting factors**

| | Non-affected | Affected | Total |
|---|---|---|---|
| Age (month) | | | |
| 6≤Age ≤24 | 28 (50) | 28 (50) | 56 (100) |
| 24< Age ≤120 | 58 (38.4) | 93 (61.6) | 151 (100) |
| 120< age | 25 (52.1) | 23 (47.9) | 48 (100) |
| Total | 111 (43.5) | 144 (56.5) | 255(100) |
| Gender | | | |
| Female | 70 (40.2) | 104 (59.8) | 174 (100) |
| Male | 41 (50.6) | 40 (49.4) | 81 (100) |
| Total | 111 (43.5) | 144 (56.5) | 255 (100) |
| Bloodline | | | |
| Purebred Iranian Arabian | 99 (44.2) | 125 (55.8) | 224 (100) |
| Imported Arabian | 6 (27.3) | 16 (72.7) | 22 (100) |
| Partbred*[1] | 6 (66.7) | 3 (33.3) | 9 (100) |
| Total | 111 (43.5) | 144 (56.5) | 255 (100) |
| Coat color | | | |
| Bay | 38 (37.6) | 63 (62.4) | 101 (100) |
| Chestnut | 28 (40.6) | 41(59.4) | 69 (100) |
| Black | 13 (52) | 12 (48) | 25 (100) |
| Nile or White | 32(53.3) | 28(46.7) | 60(100) |
| Total | 111 (43.5) | 144 (56.5) | 255 (100) |
| BCS | | | |
| 5 | 69 (40.4) | 102 (59.6) | 171 (100) |
| BCS < 5 | 26 (47.3) | 29 (52.7) | 55 (100) |
| BCS > 5 | 16 (55.2) | 13 (44.8) | 29 (100) |
| Total | 111 (43.5) | 144 (56.5) | 255 (100) |
| Type of use | | | |
| Breeding | 61 (45.5) | 73 (54.5) | 134 (100) |
| Riding*[2] | 16 (40) | 24 (60) | 40 (100) |
| Beauty | 2 (50) | 2 (50) | 4 (100) |
| Breeding and riding | 4 (21.1) | 15 (78.9) | 19 (100) |
| Breeding and beauty | 1 (16.7) | 5 (83.3) | 6 (100) |
| Non | 27 (51.9) | 25 (48.1) | 52 (100) |
| Total | 111 (43.5) | 144 (56.5) | 255 (100) |

*[1]Partbred bloodline is the result of a combination of pure Iranian Arabian and imported Arabian.
*[2] Riding means course competitions or endurance.
*P>0/05

Role of managerial and environmental factors: Table 2 shows the frequency distributions of cases of insect bites hypersensitivity in horses of this study, respectively, based on stud size, methods of control of insects, distance between horse breeding centers and water sources, times of fecal collection in the horse breeding centers and the geographical location of the horse breeding centers (city). Statistical tests showed that except for the stud size (P<0.05), in other cases, there was no significant relationship between the prevalence of the disease and the evaluated factor (P>0.05).

**Table 2: The frequency of IBH studies horses on the base of managerial and environmental factors**

| | Non-affected | affected | Total |
|---|---|---|---|
| Stud size*[7] | | | |
| Number of horses ≤ 10 | 38 (54.3) | 32 (45.7) | 70 (100) |
| Number of horses > 10 | 73 (39.5) | 112 (60.5) | 185 (100) |
| Total | 111 (43.5) | 144 (56.5) | 255 (100) |
| methods of control of insects | | | |
| Method 1*[1] | 2 (50) | 2(50) | 4 (100) |
| Method 2*[2] | 28 (50) | 28(50) | 56 (100) |
| Method 3 *[3] | 4 (33.3) | 8 (66.7) | 12 (100) |
| Method 4*[4] | 0 (0) | 0 (0) | 0 (0) |
| Method 1 and 2 | 37 (46.8) | 42 (53.2) | 79(100) |
| Method 1 and 4 | 4 (44.4) | 5 (55.6) | 9 (100) |
| Method 3 and 4 | 13 (35.1) | 24 (64.9) | 37 (100) |
| Method 2 and 3 | 3 (23.1) | 10 (76.9) | 13 (100) |
| Method 5*[5] | 20 (44.4) | 25 (55.6) | 45 (100) |
| Total | 111 (43.5) | 144 (56.5) | 255 (100) |
| Distance | | | |
| 0-100 meters | 65 (41.9) | 90 (58.1) | 155 (100) |
| 101-500 meters | 16 (39) | 25 (61) | 41 (100) |
| More than 500 meters | 30 (50.8) | 29 (49.2) | 59 (100) |
| Total | 111 (43.5) | 144 (56.5) | 255 (100) |
| intervals of feces collection | | | |
| 1 to 2 times a day | 48 (45.3) | 58 (54.7) | 106 (100) |
| 1 to 3 times a week | 42 (43.3) | 55 (56.7) | 97 (100) |
| Other *[6] | 21 (40.4) | 31 (59.6) | 52 (100) |
| Total | 111 (43.5) | 144 (56.5) | 255 (100) |
| City | | | |
| Shushtar | 25 (53.2) | 22 (46.8) | 47 (100) |
| Bavi | 6 (28.6) | 15 (71.4) | 21 (100) |
| Ahvaz | 39 (38.2) | 63 (61.8) | 102 (100) |
| Susangard | 6 (28.6) | 15 (71.4) | 21 (100) |
| Abadan | 21 (58.3) | 15 (41.7) | 36 (100) |
| Ramhormoz | 14 (50) | 14 (50) | 28 (100) |
| Total | 111 (43.5) | 144 (56.5) | 255 (100) |

*[1] Method 1: Use of fan or ventilator or air conditioner
*[2] Method 2: Use of spraying poison or insecticide or anti-insect pad
*[3] Method 3: Use of dried feces smoke or Esfand
*[4] Method 4: Use of blue wall paint or turn off the lights or spray of diesel or spray with diluted surface disinfectant or put straw under the foot of the animal and do not use feces
*[5] Method 5: Lack of insect control
*[6] Other: not collected in summer and once every two months in winter, 2: only when wet underfoot (replacement of wet feces with dry), and 3: once every 40 days in summer and once a week in winter
*[7] P< 0.05
*P> 0.05

Immunoglobulin E: ELISA test on the studied animals showed that the mean (±standard deviation) of total IgE of healthy and affected horses was 0/87±0/38 and 1/37±0/99 units per milliliter, respectively. Statistical analysis showed that there was a significant difference between healthy and affected groups in terms of total IgE and the amount of this substance in affected animals was higher than in healthy horses (P<0.05).

**Discussion**

In the present study, among 255 Arabian horses examined, 144 (56.5%) had one or several symptoms related to the disease. The prevalence of the disease has been varied widely in various IBH related studies: In 1953, Riek et al. estimated the prevalence in Queensland at 60 %. In a study by Anderson et al. (1988), 3% of horses in Britain were diagnosed with IBH. Littlewood (1988) reported that 37.7% of German Shire horses had IBH. In two study by Marti et al. (2003) and Torsteinsdottir et al. (2018), the prevalence of IBH in Icelandic horses exported to Sweden and European countries was 50%. The prevalence of the disease in Peeter et al. study (2014) was 10%.

Note that some researchers believe that the rate of IBH worldwide is 3 to 5 %, which can vary depending on the breed and geographical area of horse keeping (Halldórdsóttir and Larsen, 1991; Marti et al., 2003). In addition to environmental factors and the level of activity and density of insects, another group considers genetics and type of data collection methods as reasons for differences in the reported figures (Schurink, 2012).

Looking at the prevalence of the disease in the present study as well as other aforementioned studies, it is clear that the rate of prevalence in horses in Khuzestan province is very significant. The following points can be made to explain the reason for this difference:

- The long period of heat in Khuzestan province as well as the presence of water resources in most of its areas (such as rivers, canals, and catchment areas due to drainage of agricultural lands and rural wastewater) cause suitable conditions for reproduction and the survival of insects causing disease, for a long time of the year.
- According to the significant presence of insects at the level of horse breeding centers, it seems that the current methods of combating them are ineffective.
- Maybe the degree of inbreeding and genetic similarity of the horses involved also play a role in the high prevalence of the disease. A possibility that requires further studies to prove.

Role of risk factors

Age: In this study, although the prevalence of the disease in horses aged 2 to 10 years was higher than the other two age groups (2< and ≤10 years), the difference between these three groups was not statistically significant (P> 0.05). Some published studies on IBH have claimed that the first age prevalence of the disease was mainly 2-4 years (McCing, 1973; Scharink et al, 2012) and symptoms of the disease are rarely seen in horses less than 2 years old (Pilsworth and Knottenbet, 2004). Another group of researchers estimates that the age prevalence of IBH is 1 to 2 years old (Baker and Quinn, 1978; Littlewood, 1998). In a study by Halldodsottir and Larsen (1991), the average age of prevalence of IBH in Icelandic horses born in Norway was 5.3 years. In this study, by dividing horses into three age groups of less than 7 years, 8-14 years, and more than 14 years, it was found that the most conflicts belonged to the group older than 14 years, the difference between different age groups was statistically significant (P<0.05). In a study by Reiher et al. (2004), the prevalence of the disease in younger horses, less than 3 years of age, was lower than in older horses; so, age was identified as a risk factor for prevalence of disease. Peeter et al. (2014) had similar results in the horses they examined, and IBH was recorded more often in horses older than 3 years than in other groups. The researchers concluded from their study that the relationship between age and disease was significant and the prevalence of the disease at different ages was significantly associated with the number of times a trained horse. Because horses less than 3 years old are either not trained at all or are less involved in the training process compared to the age groups older than 3 years.

Contrary to the results of these studies and similar to our results, Schurink et al (2013) with valuation of 10,527 horses showed that the relationship between age and the prevalence of the disease was not significant. Regarding the cause of differences in the results of different studies (related to the importance of age in the prevalence of IBH), it seems necessary to mention that the degree of prevalence can depend on factors such as environmental conditions, activity, and density of insects, as well as the genetic status of the studied animals. For example, the duration of insect activities in Khuzestan province may have caused horses of different age groups to have approximately the same chance of being exposed to the insect that causes the disease; Therefore, this longer exposure may have reduced the effect of other possible factors in the " age differences". It is noteworthy that Halldodsottir and Larsen (1991) also did not know the reason for the higher prevalence of diseases in animals older than 14 years, and their greater susceptibility to IBH but they have suggested that the reason for this finding could be a long exposure of this group of horses to allergens and being in an environment conducive to insect activity.

In the present study, the age of the youngest case was similar to that reported by Riek (1953), i.e. 4 months.

Gender: In this study, despite the higher prevalence of IBH in mares (compared to stallions), no significant difference was found between them (P>0.05). Different views have been expressed about the role of gender in the frequency of insect bite hypersensitivity; for example, in some studies, the prevalence of the disease in stallions is higher than mares (Erikson et al., 2008), and in some studies, mares and gelding were higher than stallions (Brostrom et al. 1987; Halldorsdottir and Larsen, 1991). Some researchers emphasize the role of gender in the prevalence of IBH, due to differences in the hormonal status of both gender and compositions in their perspiration (Brostrom et al, 1987) or different rates of exposure to Culicoides in different keeping systems for male and female horses (Eriksson, 2008). However, despite differing views on the relationship between gender and IBH, in most studies (such as the present study), the role of this factor on the prevalence of the disease has been declared ineffective (Anderson et al, 1988; Halldorsdottir and Larsen, 1991; Peeter et al, 2014, Rashmir-Raven, 2017).

Bloodline: Although in the present study, the prevalence of IBH in imported Arabian horses was much higher than purebred Iranian Arab horses and Partbred, but based on the results of statistical analysis, the difference between these three groups was not significant (P>0.05). Unfortunately, by searching the available sources, no similar studies were found to discussed the influence of different bloodlines of a breed (especially Arab) on the prevalence of the disease. However, many sources have mentioned the role of breed and genetics as two risk factors for IBH:

Some researchers have reported that although insect bites hypersensitivity is seen in major breeds of horses and ponies but Thoroughbred, Arab, Quarter, Friesian, Draft, and Warmblood breeds are more susceptible than other breeds (Yeruham et al, 1993; Geriner et al, 1990; Littlewood, 1998). In two studies by Van Grevenhof et al. (2007) and Schurink et al. (2013) Friesian mares were significantly more sensitive than Shetland ponies. Van Grevenhof et al. (2007) attribute the observed differences between the animals studied to IBH to differences in their genetic status. The assessments made by Knottenbelt (2009) also showed that the two breeds Shire and Welsh ponies were more susceptible to the disease among studied breeds.

Contrary to the previous research, Anderson et al. (1988), with an evaluation of 209 horses of the Thoroughbred, Quarter, Morgan, Arab, and Apollonian breeds, reported that the role of breed in the

prevalence of the disease is unimportant, although, Morgan and Thoroughbred horses had the highest and lowest prevalence of IBH, respectively. Also, in Reiher and Byornsdottir's study (2004), there was no statistically significant difference between the prevalence of IBH in Icelandic horses born in a country other than Iceland and other breeds kept in those countries. Although the authors of the textbook Equine Internal Medicine do not consider the breed to be a predisposing factor in the development of IBH, they claim that the disease is more common in some breeds such as Frisian, Arab, Quarter, and Icelandic than other breeds (Rashmir-Raven, 2017).

In some sources, the importance of "genetics" in insect bite hypersensitivity has been considered; factors that can be used to study the effect of bloodlines of a breed on the frequency of this disease. Some researchers have suggested that IBH is more common in some breeds, such as Shire and Welsh ponies, and genetic is a risk factor for disease. (Knottenbelt, 2009). Another group found that in different horses using same pasture, only a few with them became infected; therefore, genetic was considered an important factor in developing IBH (Brostrom et al, 1987; Anderson et al, 1988; Constable et al, 2017). A number of other researchers have also considered the possible role of obesity in the prevalence of the disease and the effect of genetic on BCS and the effect of heredity on the formation of IBH has been mentioned (Scharink et al, 2012). Older sources said that disease susceptibility is inherited from mother to the child (Riek, 1953). Notably, according to McCing (1975), in affected horses, usually one of the parents, grandfather, or grandmother of the animal was involved in IBH. In the present study, it seemed that a number of horses with close family relationships were infected at the same time. Obviously, proving this claim requires more studies.

Coat color: In this study, even though the prevalence of IBH was higher in horses with bay and chestnut colors than black, white, and Nile horses, but no statistically significant difference was observed between animals with different colors. Lang et al. (2005) examined 490 Icelandic horses in northern Germany and found that chestnut and gray horses were less likely to get the disease than a bay, black, and piebald horses. In a study conducted in 2013 on Friesian horses and Shetland ponies was found a significant relationship between IBH and the coat color, and dark coat color animals are more likely to get the disease than light coat colored horses (Scharink et al, 2013).

Contrary to the above studies and in line with the present study in most available studies, the coating color did not play a role in the prevalence of the disease. Anderson et al. examined 209 horses that were divided into dark and light colored groups, and concluded that the coat color did not play a role in IBH. However, in the dark horses of his research, the cases of the disease were more than the light colored horses (Anderson et al, 1988). Studies conducted in Norway on Friesian horses and Shetland ponies also emphasize the lack of effect of color in insect bites hypersensitivity (Halldorosdottir and Larsen., 1991 and Van Grevenhof, 2007). Peeter et al. (2014) examined 3409 horses and placed them in groups of gray, chestnut, black, and brown, they found that the highest and lowest prevalence of IBH was in gray and black horses, respectively. However, the difference between these groups was not statistically significant.

Body condition score: In the present study, the relationship between body condition score and IBH was not found to be significant ($P>0.05$). Scharink et al. (2012) in the study on affected horses and ponies reported that cases of IBH in patients with higher or lower than normal body condition scores compared higher than in the group with normal BCS; therefore, it is

recommended that BCS be kept in the normal range to minimize clinical signs.

It is said that in obese people the risk of allergies increases to some extent due to immunological changes because in these people, adipokinase and cytokinin secreted by white adipose tissue, cause reduce the immune tolerance to antigens and deviate the immune response to Th2 (Hersoug and Linneberg, 2007). Also seen, the secretion of specific inflammatory mediators (such as IL-6, TNF-α, and leptin) is significantly increased in obese people with allergies compared to skinny individuals (Canöz et al, 2008). Some sources have reported such conditions in obese horses and an increase in inflammatory cytokines (resulting in disease) in them (Vick et al, 2007; Adams et al, 2009). In a study by Peeter et al. in Belgium, although the frequency of IBH in horses with BCS lower or higher than normal was higher than normal horses, no statistically significant relationship was observed between body mass score and disease frequency (Peeters et al, 2014).

Type of use: In the present study, the relationship between the type of horse use and the prevalence of IBH was not statistically significant ($P>0.05$). Other studies do not mention the type of use as a risk factor for insect bite hypersensitivity.

Stud size: In this study, a statistically significant relationship was observed between the number of horses kept in the studied horse breeding centers and IBH ($P<0.05$). In the only available study on the relationship between stud size and disease prevalence, Peeter et al. (2014) reported that as the population of the herd increased, the risk of developing the disease decreased. They explained their reasons as follows: In large herds (with more than 10 horses), breeders may choose horses that are resistant to IBH. Also, in these herds, the management is done by the grooms, and therefore the horse owner does not have accurate information about the disease status of his livestock. The third reason given by these researchers is that horse owners are less honest about the disease status of their horses because these horses are their livelihood and expressing their IBH reduces the economic value of horses. The reason for this finding is not clear to the authors, but the reason for this is definitely not the findings of the study by Peeters et al. (2014).

Methods of control of insects: However, in order to reduce the insect population, different types of methods have been used alone or simultaneously in the farms of this study, but based on statistical tests, not only there was no significant difference between the prevalence of IBH in horses with different fighting methods, but also, no such difference was recorded between this group of animals and horses that were deprived of fighting methods ($P>0.05$). Peeter et al. (2014) evaluated various methods to reduce the horse's exposure to insects, including keeping horses in stables, using insect repellents, moving horse to other areas, and applying a blanket, they stated that there was no significant relationship between the use of these methods and the degree of involvement with IBH. This finding is contrary to the views of Anderson et al. (1988) and Bjornsdottir et al. (2006) who stated that the use of the blanket, keeping animals in stables, and moving susceptible horses to other areas are considered to be most effective in reducing the prevalence of the disease.

Distance from the horse breeding centers to the water source: Given that female insects need a moist environment to lay eggs (Peeter et al, 2014) and water sources are among the most suitable places for them to lay their eggs and on the other hand, the flying power of Culicoides is low (maximum 800 and 400 meters from birth for male and female insects, respectively) (Lillie et al, 2012), therefore, in cases of prevalence with IBH in an area, paying attention to the distance between horse breeding centers and water resources will be of particular importance (Marsella, 2015; Littlewood and Heidmann, 2006).

Accordingly, it seems that the proximity of the horse breeding center to these areas increases the risk of disease prevalence. Bjornsdottir et al. (2006) examined 330 Icelandic horses exported to Germany, Denmark, and Sweden and showed that proximity to water sources increased the risk of insect bites hypersensitivity.

Contrary to the above theory and the finding of Bjornsdottir et al, in the present study, the relationship between horse breeding centers distance with water sources and IBH was not statistically significant (P>0.05). In this case, it seems that the presence of other risk factors, especially the longtime of insect activity (both during the day and during the year) has caused the role of this factor (distance to water sources) to decrease in the prevalence of the disease.

Times of fecal collection in the horse breeding centers: However, no studies have been published on the effect of fecal collection frequency on the prevalence of the disease but given the role of this factor in insect reproduction, it was expected that there might be a relation between fecal collection frequency and IBH. However, statistical tests did not reveal such a relationship in the present study (P>0.05).

Geographical location of the horse breeding centers (city): In the present study, the highest rate of IBH prevalence was recorded in Bavi and Susangard and the lowest in Abadan. Also, the difference between different cities was statistically not significant (P>0.05).

- The management conditions horse breeding centers in the province have significant similarities.
- The geographical situation of the place where horses are kept in this study, is also similar, at least in terms of its effect on the frequency of IBH. Regarding some sources of differences in rainfall (Anderson et al, 1993), amount of soil moisture (Peeters et al, 2014), sunlight (Meiswinkel et al, 2000), and even the type of plants in the pastures (Peeters et al, 2014) different regions, including the causes of differences in the prevalence of IBH in these regions emphasizing the role of the geographical area in the formation of the disease, they have stated that even in different parts of a province, the frequency of IBH may be different (Bojrnsdottir et al, 2006).

In some other studies, the role of the geographical area in the rate of prevalence with IBH has been considered: Brostrom et al. (1987) by studying Icelandic horses kept in Sweden found that the prevalence of insect bites hypersensitivity varied from 7.7% to 53.8% in different parts of the country which was similar in neighboring areas. In a similar study by Halldodsottir and Larsen (1991), the prevalence of IBH in Icelandic horses in Norway, Denmark, and Iceland was different. Littlewood (1998) by the study of Shire horses in Germany and the province of British Columbia in Canada claimed that the prevalence of the disease in Germany was three-fold higher than in British Columbia. He attributes this finding to the better German conditions for the growth and reproduction of the culicoides. A study conducted in the Netherlands on 6,108 Frisian horses and Shetland ponies indicates that the prevalence of IBH in different parts of the country has a statistically significant difference. The researchers in this study attributed their findings to differences in climatic conditions (number of hot and cold days and rainfall) in these areas and finally stated that the disease is more common in hot and dry areas of the Netherlands (Van Grevenhof et al, 2007). Another study conducted in this country by Schurink et al. (2013) on 10,527 horses and ponies also showed that the frequency of IBH in different parts of the country had a statistically significant difference and in areas with clay with woody plants and the number of days with low rainfall but high heat is more prevalent.

Contrary to the above studies and the present study, Peeter et al. (2014) surveyed 3409 horses in Belgium and claimed that the prevalence of the disease in different

provinces of the country was not statistically significant. He attributed the finding to the limitation of his study in a particular region of Belgium.

Immunoglobulin E: The results of this study showed that the total IgE of animals with IBH was significantly higher than animals without symptoms. In explaining the cause of the above finding, it seems useful to pay attention to the pathogenicity of the disease: according to researchers, the reason for IBH is the increased sensitivity to allergens (caused by insect bites), which is more related to the immediate type. It is noteworthy that type I or an immediate type of hypersensitivity is formed by IgE (Fadock and Greiner, 1990; Sloet Van Oldruitenborgh - Oosterbaan, 2009); so, higher levels of this substance in the blood of affected animals would be expected.

In a study on Icelandic horses, Hellberg et al. (2006) found that culicoides-specific IgE levels in horses with IBH were significantly higher than those in healthy horses. Also, in another study on Shetland ponies, the specific IgE level of absolute culicoides in horses with insect bite hypersensitivity was significantly higher than that in healthy horses (Meulenbroeks et al, 2013). In a study conducted by Novotny et al. (2021) on 347 horses, the IgE level of horses with clinical signs of the disease was significantly higher than horses without clinical signs. Contrary to the above studies, Frey et al. (2008) performed ELISA on blood samples of healthy and affected horses with IBH and claimed that there was no significant difference between the two groups in the value of IgE.

Conclusion: The results of this study showed that there is a high prevalence of insect bite hypersensitivity among horses kept in horse breeding centers in Khuzestan province. It seems that the lack of significant effect of many known risk factors for IBH in different groups of horses (such as age groups or horses with different coat colors) has occurred due to this significant frequency.

**Acknowledgment**

The authors would like to acknowledge the Vice-Chancellor for Research of the Shahid Chamran University of Ahvaz for financial support

**Conflict of interest**

The authors declare that there are no conflicts of interest.

**Funding**

The financial support of this researh was provided by the Vice-Chancellor for research of the Shahid Chamran University of Ahvaz through grant.

**Reference**

Adams, A.A., Katepalli, M.P., Kohler, K., Reedy, S.E., Stilz, J., Vick, M.M., Fitzgerald, B.P., Lawrence, L.M & Horohov, D.W. (2009). Effect of body condition, body weight and adiposity on inflammatory cytokine responses in old horses. *Veterinary Immunology and Immunopathology*, 127(3-4): 286-294.

Anderson, G.S., Belton, P & Belton, E. (1993). A population study of *Culicoides obsoletus* Meigen (Diptera: Ceratopogonidae), and other Culicoides species in the Fraser Valley of British Columbia. *The Canadian Entomologist*, 125(3): 439-447

Anderson, G.S., Belton, P & Kleider, N. (1988). The hypersensitivity of horses to *Culicoides* bites in British Columbia. *The Canadian Veterinary Journal*, 29(9): 718-723.

Baker, K & Quinn, P. (1978). A report on clinical aspects and histopathology of sweet itch. *Equine Veterinary Journal*, 10(4), 243-248.

Bjornsdottir, S., Sigvaldadottir, J., Brostrom, H., Langvad, B & Sigurosson, A. (2006). Summer eczema in exported Icelandic horses: influence of environmental and genetic factors. *Acta Veterinaria Scandinavica*, 48(1): 1-4.

Brostrom, H., Larsson, Å & Troedsson, M. (1987). Allergic dermatitis (sweet itch) of Icelandic horses in Sweden: an epidemiological study. *Equine Veterinary Journal*, 19(3): 229-236.

Canöz, M., Erdenen, F., Uzun, H., Müderrisoglu, C & Aydin, S. (2008). The relationship of inflammatory cytokines with asthma and obesity. *Clinical and Investigative Medicine*, 31(6): 373-379.

Constable, P.D., Hinchcliff, K.W., Done, S.H & Grunberg, W. (2017). Veterinary Medicine, 11th ed, Elsevier, Missouri, PP: 1559-1560.

Eriksson, S., Grandinson, K., Fikse, W., Lindberg, L., Mikko, S., Broström, H., Frey, R., Sundquist, M & Lindgren, G. (2008). Genetic analysis of insect bite hypersensitivity (summer eczema) in Icelandic horses. *Animal*, 2(3): 360-365

Fadok, V. A & Greiner, E. (1990). Equine insect hypersensitivity: skin test and biopsy results correlated with clinical data. *Equine Veterinary Journal*, 22(4): 236-240.

Frey, R., Bergvall, K & Egenvall, A. (2008). Allergen-specific IgE in Icelandic horses with insect bite hypersensitivity and healthy controls, assessed by FcεR1α-based serology. *Veterinary Immunology and Immunopathology*, 126(1-2): 102-109.

Greiner, E.C., Fadok, V.A & Rabin E.B. (1990). Equine Culicoides hypersensitivity in Florida: biting midges aspirated from horses. *Medical and veterinary entomology*, 4(4): 375-381.

Halldórdsóttir, S & Larsen, H. (1991). An epidemiological study of summer eczema in Icelandic horses in Norway. *Equine Veterinary Journal*, 23(4): 296-299.

Hellberg, W., Wilson, A., Mellor, P., Doherr, M., Torsteinsdottir, S., Zurbriggen, A., Jungi, T & Marti, E. (2006). Equine insect bite hypersensitivity: immunoblot analysis of IgE and IgG subclass responses to *Culicoides Nubeculosus* salivary gland extract. *Veterinary Immunology and Immunopathology*, 113(1-2): 99-112.

Hersoug, L.G & Linneberg, A. (2007). The link between the epidemics of obesity and allergic diseases: does obesity induce decreased immune tolerance? *Allergy*, 62(10): 1205-1213.

Knottenbelt, D.C. (2009). Pascoes: Principles and Practice of Equine Dermatology, 2th ed, Sunders. Elsevier, United Kingdom, PP: 284-286.

Kleider, N & Lees, M. (1984). *Culicoides* hypersensitivity in the horse: 15 cases in southwestern British Columbia. *The Canadian Veterinary Journal*, 25(1): 26-32.

Lange, S., Hamann, H., Deegen, E., Ohnesorge, B & Distl, O. (2005). Investigation of the prevalence of summer eczema in Icelandic horses in northern Germany. *Berliner und Munchener Tierarztliche Wochenschrift*, 118(11-12): 481-489.

Langner, K.F., Darpel, K.E., Drolet, B.S., Fischer, A., Hampel, S., Heselhaus, J.E., Mellor, P.S., Mertens, P.P & Leibold, W. (2008). Comparison of cellular and humoral immunoassays for the assessment of summer eczema in horses. *Veterinary Immunology and Immunopathology*, 122(1-2): 126-137.

Lillie, T.H., Marquardt, W.C & Jones, R.H. (1981). THE Flight range of *Culicoides variipennis* (Diptera: Ceratopogonidae). *The Canadian Entomologist*, 113(5): 419-426.

Littlewood, J.D. (1998). Incidence of recurrent seasonal pruritus ('sweet itch') in British and German shire horses. *The Veterinary Record*, 142(3): 66-67.

Littlewood, J.D & Heidmann, P. (2006). The skin. In: Higgins, DJ and Snyder, JR. (Eds). The Equine Manual, 2th ed. Elsevier, China, PP: 369-372.

Marsella, R. (2013). Equine allergy therapy: update on the treatment of environmental, insect bite hypersensitivity, and food allergies. *Veterinary Clinics: Equine Practice*, 29(3): 551-557.

Marsella, R. (2015). Ventral dermatitis. In: Sprayberry, KA and Robinson, NE. (Eds). Robinsons Current Therapy in Equine medicine. 7th ed. Elsevier, United states, P: 549.

Marti, E., Horohov, D.W., Antzak, D.F., Lazary, S & Lunn, D.P. (2003). Advances in equine immunology: havemeyer workshop reports from Santa Fe, New Mexico, and Hortobagy, Hungary. *Veterinary Immunology and Immunopathology*, 91(3-4): 233-243.

Marti, E., Urwyler, A., Neuenschwander, M., Eicher, R., Meier, D., De Weck, A.L., Gerber, H., Lazary, S & Dahinden, CA. (1999). Sulfidoleukotriene generation from peripheral blood leukocytes of horses affected with insect bite dermal hypersensitivity. *Veterinary Immunology and Immunopathology*, 71(3-4): 307-320.

McCaig, J. (1973). A survey to establish the incidence of sweet itch in ponies in the United Kingdom. *The Veterinary Record*, 93(16): 444-446.

McCaig, J. (1975). Recent thoughts on sweet itch. *Veterinary Annual*, 15: 204-206.

Meiswinkel, R., Baylis, M & Labuschagne, K. (2000). Stabling and the protection of horses from *Culicoides Bolitinos* (Diptera: Ceratopogonidae), a recently identified vector of African horse sickness. *Bulletin of Entomological Research*, 90(6): 509-15.

Mellor, P., Boorman, J & Baylis, M. (2000). *Culicoides* biting midges: their role as arbovirus vectors. *Annual Review of Entomology*. 45(1): 307-340.

Meulenbroeks, C., Van der Meide, N.M., Zaiss, D.M., Van Oldruitenborgh-Oosterbaan, M.S., Van der Lugt, J.J., Smak, J., Rutten, V.P & Willemse, T. (2013). Seasonal differences in cytokine expression in the skin of Shetland ponies suffering from insect bite hypersensitivity. *Veterinary Immunology and Immunopathology*, 151(1-2): 147-156.

Morris, D.O & Lindborg, S. (2003). Determination of 'irritant' threshold concentrations for intradermal testing with allergenic insect extracts in normal horses. *Veterinary Dermatology*, 14(1): 31-36.

Novotny, E.N., White, S.J., Wilson, A.D., Stefánsdóttir, S.B., Tijhaar, E., Jonsdóttir, S., Frey, R., Reiche, D., Rose, H & Rhyner, C. (2021). Component-resolved microarray analysis of IgE sensitization profiles to Culicoides recombinant allergens in horses with insect bite hypersensitivity. *Allergy*, 76(4): 1147-1157.

Peeters, L., Janssens, S., Coussé, A & Buys, N. (2014). Insect bite hypersensitivity in Belgian warmblood horses: prevalence and risk factors. *Vlaams Diergeneeskundig Tijdschrift*, 83(5): 240-249.

Pilsworth, R & Knottenbelt, D. (2004). Equine insect hypersensitivity. *Equine Veterinary Education*, 16(6): 324-325.

Rashmir-Raven, A. M. (2017). Disorders of the skin. In: Reed, S. M, Bayly, W. M and Sellon, D. C(Eds). Equine Internal Medicine. 4th ed, Elsevier, Missouri, PP: 1190-1191.

Reiher, R & Björnsdóttir, S. (2004). The prevalence of summer eczema in Icelandic horses born in Germany. In: International Symposium on Diseases of the Icelandic Horse, Veterinary Association Icelandic (Ed.). International Veterinary Information Service, Ithaca NY, USA. P.

Riek, R. (1953), Studies on allergic dermatitis (Queensland itch) of the horse: I-description, distribution, symptoms and pathology. *Australian Veterinary Journal*, 29(7): 177-184.

Schurink, A (2012). Insect bite hypersensitivity in horses: genetic and epidemiological analysis. PhD thesis, Wageningen University, the Netherlands, 978-94-6173-356-6.

Schurink, A., Podesta, S.C., Ducro, B.J., Van Arendonk, J.A & Frankena, K. (2013). Risk factors for insect bite hypersensitivity in Friesian horses and Shetland ponies in The Netherlands. *The Veterinary Journal*, 195(3): 382-384.

Sloet van Oldruitenborgh-Oosterbaan, M.M., Van Poppel, M., De Raat, I.J., Van Den Boom, R & Savelkoul, HF. (2009). Intradermal testing of horses with and without insect bite hypersensitivity in the Netherlands using an extract of native *Culicoides* species. *Veterinary Dermatology*, 20(5-6): 607-614.

Torsteinsdottir, S., Scheidegger, S., Baselgia, S., Jonsdottir, S., Svansson, V., Björnsdottir, S & Marti, E. (2018). A prospective study on insect bite hypersensitivity in horses exported from Iceland into Switzerland. *Acta Veterinaria Scandinavica*, 60(1): 1-10.

Van Grevenhof, E., Ducro, B., Heuven, H & Bijma, P. (2007). Identification of environmental factors affecting the prevalence of insect bite hypersensitivity in Shetland ponies and Friesian horses in the Netherlands. *Equine Veterinary Journal*, 39(1): 69-73.

Vick, M., Adams, A., Murphy, B., Sessions, D., Horohov, D., Cook, R., Shelton, B & Fitzgerald, B. (2007). Relationships among inflammatory cytokines, obesity, and insulin sensitivity in the horse. *Journal of Animal Science*, 85(5): 1144-1155.

Wagner, B., Childs, B.A & Erb, H.N. (2008). A histamine release assay to identify sensitization to *Culicoides* allergens in horses with skin hypersensitivity. *Veterinary Immunology and Immunopathology*, 126(3-4): 302-308.

Yeruham, I., Braverman, Y & Orgad, U. (1993). Field observations in Israel on hypersensitivity in cattle, sheep and donkeys caused by *Culicoides*. *Australian Veterinary Journal*, 70(9): 348-352.

Received: 03.11.2023
Accepted: 12.03.2024

DOI: 10.22055/IVJ.2024.421368.2643

# بررسی فراوانی ازدیاد حساسیت به نیش حشرات (IBH) در اسبان استان خوزستان، ایران

بهاره سلیمانی[۱]، علیرضا قدردان‌مشهدی[۲*]، محمدرحیم حاجی‌حاجیکلائی[۲]، مسعود قربانپور[۳]، محمد راضی‌جلالی[۲] و رحیم چینی‌پرداز[۴]

[۱] دانش‌آموخته دکترای تخصصی بیماری‌های داخلی دام‌های بزرگ، دانشکده دامپزشکی، دانشگاه شهید چمران اهواز، اهواز، ایران

[۲] استاد گروه علوم درمانگاهی، دانشکده دامپزشکی، دانشگاه شهید چمران اهواز، اهواز، ایران

[۳] استاد گروه پاتوبیولوژی، دانشکده دامپزشکی، دانشگاه شهید چمران اهواز، اهواز، ایران و گروه پاتوبیولوژی، دانشکده دامپزشکی، دانشگاه شهرکرد، شهرکرد، ایران

[۴] استاد گروه آمار، دانشکده علوم ریاضی و کامپیوتر، دانشگاه شهید چمران اهواز، اهواز، ایران

تاریخ دریافت: ۱۴۰۲/۸/۱۲ تاریخ پذیرش: ۱۴۰۲/۱۲/۲۲

## چکیده

ازدیاد حساسیت به نیش حشرات یک درماتیت راجعه و مزمن اسب است که عمدتا به واسطه واکنش آلرژیک به نیش گونه‌های جنس کولیکوئیدس ایجاد شده و لذا در مناطقی که امکان رشد این حشرات وجود دارد، شانس مواجهه با بیماری نیز افزایش می‌یابد. شرایطی که در استان عمدتا گرم و مرطوب خوزستان (واقع در جنوب غربی ایران) وجود داشته و باعث می‌شود که دامپزشکان به فراوانی با اسبان واجد نشانه IBH مواجه گردند. هدف از تحقیق حاضر، ارزیابی فراوانی ازدیاد حساسیت به نیش حشرات در بین اسبان این استان بوده است. این مطالعه روی ۲۵۵ رأس اسب نژاد عرب نگهداری شده در ۲۱ واحد اسبداری واقع در ۶ شهرستان این استان به انجام رسید. اسبان تحت بررسی، از نظر داشتن یا نداشتن ضایعات پوستی معاینه گردیده، وجود ضایعات جلدی، همراه با مشخصات فردی دام در فرم‌های مربوطه به ثبت می‌رسید. نمونه‌های سرم تهیه شده (۳۲ رأس اسب سالم و ۶۱ رأس اسب واجد ضایعات) از نظر میزان IgE تام با استفاده از آزمایش الایزا، بر اساس دستورالعمل شرکت سازنده کیت ارزیابی شدند. نتایج نشان داد که از میان ۲۵۵ رأس اسب بررسی شده، ۱۴۴ رأس (۵۶/۵ درصد) واجد نشانه‌های بالینی IBH بودند. همچنین ارزیابی‌های آماری مشخص ساخت که از بین فاکتورهای میزبانی (شامل سن، جنسیت، خط خونی، رنگ پوشش خارجی، امتیاز توده بدنی و نوع کاربری) و فاکتورهای مدیریتی و محیطی (شامل اندازه گله، نحوه مبارزه با حشرات، فاصله اسبداری تا منبع آب؛ فواصل جمع‌آوری مدفوع در اسبداری و موقعیت جغرافیایی محل نگهداری اسب)، تنها اندازه گله واجد تأثیر معنی‌دار در میزان ابتلا به IBH بوده است و در سایر موارد، ارتباط معنی‌داری بین میزان وقوع بیماری و فاکتور ارزیابی شده وجود نداشته است. همچنین نتایج مشخص نمود مقدار IgE تام در دام‌های بیمار، بیشتر از اسبان سالم بوده است. نتایج این بررسی نشان داد که ازدیاد حساسیت به نیش حشرات با فراوانی قابل توجهی در بین اسبان نگهداری شده در اسبداری‌های استان خوزستان وجود دارد.

**کلمات کلیدی**: ازدیاد حساسیت به نیش حشرات، الایزا، اسب، استان خوزستان

* نویسنده مسئول: علیرضا قدردان مشهدی، استاد گروه علوم درمانگاهی، دانشکده دامپزشکی، دانشگاه شهید چمران اهواز، اهواز، ایران

E-mail: a.ghadrdan@scu.ac.ir