Identification of factors associated with the development of insect bite hypersensitivity in horses in the Netherlands

Robin van den Boom [I, III], Bart Ducro [II] en Marianne M. Sloet van Oldruitenborgh-Oosterbaan [I]

Oorspronkelijk artikel

SUMMARY

An Internet-based questionnaire among horse owners was carried out to identify factors affecting the incidence of insect bite hypersensitivity (IBH) among horses in the Netherlands. Information was obtained for 794 horses of various breeds, but the breed distribution was not representative for the Dutch horse population. Of the horses for which information was available, 56% suffered from IBH and 44% did not. The most common clinical symptoms were pruritus, scaling, and hair loss, occurring mainly at the base of the tail and along the mane. Breed, age, region (and local habitat), stabling, type of bedding in the stable, use of the horse, deworming frequency, and season were associated with significant differences in IBH incidence. Knowledge of the factors influencing the incidence of IBH may make it possible to reduce the number of animals affected and help alleviate symptoms in affected horses.

SAMENVATTING

Om de factoren te identificeren die een rol spelen bij het voorkomen van staart- en-maneneczeem (SME, Engels: Insect Bite Hypersensitivity, IBH) bij paarden in Nederland is een internetenquête uitgevoerd. Informatie is verkregen van 794 paarden van verschillende rassen, hoewel de rasverdeling niet representatief was voor de Nederlandse paardenpopulatie. Van de paarden waarvoor resultaten beschikbaar waren was 56 procent lijdend aan SME en 44 procent niet lijdend aan SME. De meest voorkomende symptomen waren jeuk, schilfering en kale plekken, vooral rond de staartbasis en langs de manen. Ras, leeftijd, regio (en locale habitat), opstallen, type bodembedekking in de stal, gebruik, ontwormingsfrequentie en seizoen waren allemaal factoren die van invloed waren op het al dan niet voorkomen van SME. Kennis van de factoren die van invloed zijn op het al dan niet voorkomen van SME, zou het aantal lijders kunnen verminderen en kunnen helpen om de symptomen van paarden met SME te verlichten.

I Department of Equine Sciences, Faculty of Veterinary Medicine, Utrecht.
II Animal Breeding & Genomics Group, Wageningen University, Wageningen, the Netherlands.
III Corresponding author: Yalelaan 114, 3584 CM, Utrecht, the Netherlands. tel: + 31 30 2531350, fax: + 31 30 2537970 e-mail: r.vandenboom@uu.nl

INTRODUCTION

Insect bite hypersensitivity (IBH) is a seasonal, recurrent dermatitis of horses that is prevalent for about 8 months of the year (4). The disease is a serious welfare issue, regularly forcing owners to consider euthanasia of affected animals (14). It is one of the major causes of pruritus in horses (13) and the most common cause of summer pruritus (26). Although several insects can cause IBH, *Culicoides* species are most often incriminated. There are approximately 1000 species of *Culicoides* (9), with different species occurring in different geographical regions (3, 8, 10, 23, 27, 30). A recent study showed that *C. obsoletus* and, to a lesser degree, *C. pulicaris* occur most frequently in the vicinity of horses in the Netherlands (31). These two species are also most prevalent in Germany (21) and Belgium (18).

Although IBH can affect all breeds, some breeds are reported to be predisposed (5, 26). A genetic predisposition has been suggested (2) and appears to be linked to certain genes of the major histocompatibility complex (19). In the Netherlands, Friesian horses and Shetland ponies seem to be affected more often than other breeds, with a prevalence among mares of 18% for Friesians and 8% for Shetland ponies (32). Icelandic horses are also frequently affected, with a reported prevalence of 15% in Sweden (11) and 18% in Norway (16); the incidence is considerably higher (approximately 26%) among horses imported from Iceland (11, 16). There are no data on the occurrence of IBH in this breed in the Netherlands. Apart from the (supposed) genetic susceptibility, multiple factors are considered to play a role in the occurrence and severity of symptoms associated with IBH, such as geographical location (14, 20, 32), habitat (32), management (26), nutrition (24), age of the horse (2, 5, 17, 29), and age of first exposure to allergens (16). The relative importance of these different factors is incompletely understood.

Various treatments have been tried, usually with limited success, and avoidance of the allergens (i.e., the insects, mainly *Culicoides* midges) remains the mainstay of clinical management. This can be achieved by using rugs and stabling affected horses at times when midges are most active, i.e., in the evening around dusk (31). Any improvements in management and treatment will require a better understanding of the factors influencing the development of IBH.

The aim of the present study was to identify factors influencing the prevalence/incidence of IBH in horses in the Netherlands.

MATERIALS AND METHODS

A questionnaire was developed that could be completed via the Internet and which consisted of questions relating to the habitat, stabling, nutrition, management/care, health, and use of the horses. The questionnaire was intended for the owners of Friesian horses, as this is one of the breeds frequently affected in the Netherlands, but the owners of other breeds of horses also responded. Horse owners were alerted to the existence of the questionnaire through publications in horse magazines and breed society newsletters.

Information was obtained for 2005 and included data on horses affected and not affected by IBH. The diagnosis of IBH was based on a combination of typical lesions, their distribution, and (in particular) the strong seasonality of the disease.

STATISTICAL ANALYSIS

Analysis of variance was performed to determine whether the factors under study significantly influenced the incidence of IBH. Factors that were considered not significant ($P>0.05$) were excluded from the model, and the final model contained factors related to the animal (breed and age), to the region (region and habitat), and to the management (stabling, bedding, and deworming) and use of the horse. The analysis was performed using the GLM procedure (Statistical Analysis System, SAS INST., CARY, NC, USA, version 9.1).

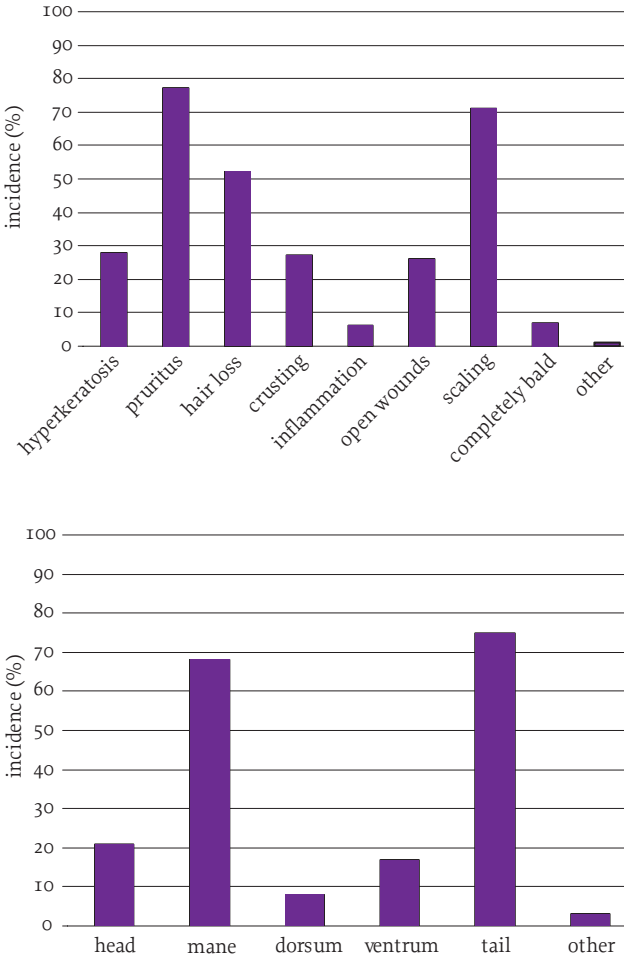

Figure 1. The incidence of presenting symptoms (a) and their distribution (b).

RESULTS

Number of horses

Information was obtained for 794 horses, 56% of which were reported to suffer from IBH. This allowed a comparison of risk factors between horses with and without IBH. Not all information was available for all of the horses.

Symptoms and localization

The percentage of horses showing the various clinical symptoms is shown in figure 1a. The most commonly reported symptom was pruritus (77% of cases) in association with scaling, hair loss, crusting, open wounds, and hyperkeratinization. Owners reported that the first symptoms were often papules/nodules, which were often difficult to detect. Also, many horses showed restless behaviour. Later, the skin showed scaling and became thickened, and hair was easily broken, leading to hair loss. Horses demonstrated itching behaviour and many would bite/groom each other, thereby exacerbating hair loss and creating new wounds that subsequently became infected. Horses that showed symptoms in successive years often developed hyperkeratinization and rougae (ridged skin).

More than 40% of affected horses showed signs along the mane and tail (figure 1b) and 15% showed signs around the tail only. Approximately 20% of horses also had symptoms on the ventral abdomen (ventral localization). When signs were present on other parts of the body, the head and/or mane were also invariably affected.

Breed

Horses (n=781) were categorized into six groups of breeds: Friesian (n=246); Haflinger, Welsh, New Forest, and Icelandic ponies (Haweforice, n=117); Coldbloods, Fjords, and Tinkers (Cofjortink, n=45); Shetland ponies (n=55); Warmbloods (n=190); and other breeds (n=128). Among the horses included in the present study the incidence of IBH among the different groups of breeds varied from 45% (Warmbloods) to 67% (Cofjortink). Warmblood horses were affected significantly less often (P=0.005) than Friesians, coldblood types (Coldbloods, Fjord, Tinker), and various pony breeds (Haflinger, Welsh, New Forest and Icelandic), and also less often than Shetland ponies and the remaining 'other' breeds, although this difference was not statistically significant. All breed categories included horses with and without IBH, which allowed a reliable comparison of factors between affected and unaffected horses to be made.

Age

The incidence of IBH in different age categories (n=770) is shown in figure 2. IBH was most prevalent in horses

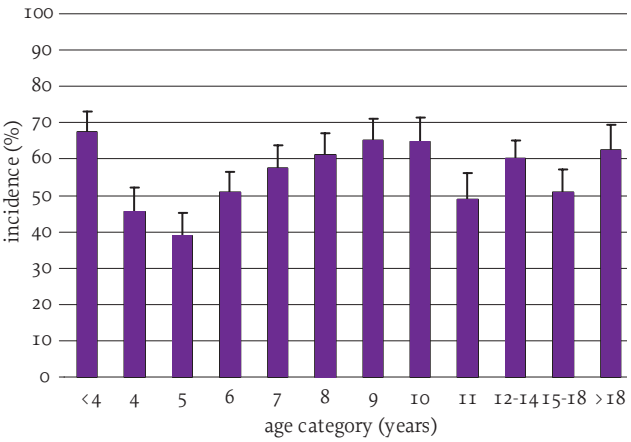

Figure 2. The incidence (mean ± sem) of IBH in different age categories.

younger than 4 years and least prevalent in 5-year-old horses. The incidence of IBH increased gradually in horses aged 5 to 10 years and thereafter remained more or less constant. Forty-five percent of horses were younger than 4 years when they developed IBH, 38% were aged 4–14 years, and 17% were aged 15 years or older.

Region

The prevalence of IBH for each region in the Netherlands for which data were available (n=661) was calculated. The prevalence differed significantly between regions ($P<0.05$) and was highest in Brabant and parts of Gelderland and lowest in Noord Holland and on the Wadden islands (figure 3).

Habitat

Information on habitat was available for 794 horses. There was a significantly higher incidence of IBH in horses kept in/near wooded areas (60%) compared to those kept in/near open or coastal areas (51%) ($P<0.05$).The type of soil did not influence the incidence of IBH (data not shown).

Management/stabling

Information on management and stabling was available for 754 horses. Of these horses, 51% were kept outside day and night (during the summer season), 31% were stabled at night, and 18% were stabled most of the time/always. Horses that were kept outdoors day and night had the lowest incidence of IBH (49%), significantly lower than that of horses stabled some or all of the time (figure 4).

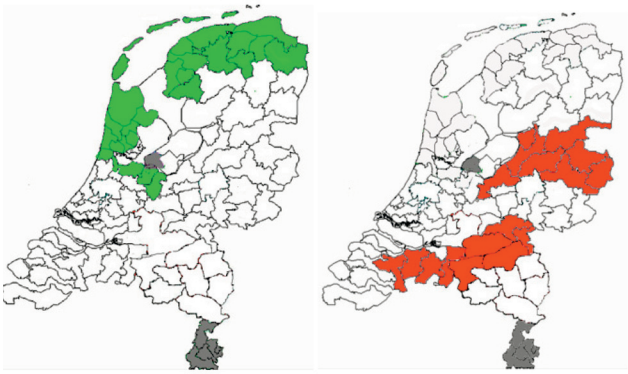

Figure 3. Map of the Netherlands showing the areas with the lowest (green) and highest (red) prevalence of IBH. For a number of areas (grey) not enough information was available to make a reliable estimate of the prevalence.

Management/bedding

Horses kept on straw (n=577) or without bedding (nothing or rubber mats, n=38) had a significantly lower incidence ($P<0.0001$) of IBH than horses stabled on wood shavings (n=67) or other bedding materials (n=38). There was no influence of the frequency of manure removal.

Use

For horses for which the use was known (n=794), those used for breeding had the highest incidence of IBH (71%), significantly higher than that of horses used in competition (52%) and those without a defined use (38%). There was no statistically significant difference in IBH incidence among horses used for dressage (51%), show jumping (46%), or driving (56%). The difference in incidence between horses used for riding at a recreational level (58%) and those kept for companionship (63%) was also not significant.

Management/deworming

Horses with the lowest deworming frequency (1–3 times/year) (n=111) had a significantly higher incidence of IBH than those dewormed more often (n=635). Horses dewormed with more than one type of deworming paste (n=463) had a significantly lower incidence than those treated with just one type (n=298).

Season

Of the horses with IBH, 45% developed the first symptoms in April, about 25% in May, and about 14% in June. Only a few horses showed the first signs in other months of the year (figure 5).

DISCUSSION

The respondents of this questionnaire should not be regarded as being representative for the entire Dutch horse-owner population since the owners of horses suffering from IBH are probably more likely to complete a questionnaire such as the one used in this study. They would be expected to be more motivated to help unravel the aetiology and try to find a cure or identify management factors that could reduce the suffering of their horses. Therefore, care should be taken when interpreting the reported prevalence, which is undoubtedly overestimated in this study. However, as about half the horses on which information was collected were free of IBH, a reliable comparison of factors that could influence the prevalence of IBH could be made. Similarly, the breed distribution was not representative for the Netherlands, with Friesian horses being overrepresented. This is because the questionnaire was initially intended for the owners of Friesian horses, as this is one of the breeds most

commonly affected by IBH in the Netherlands (32). The diagnosis of IBH was based on a combination of typical lesion distribution and (in particular) the strong seasonality of the disease. At the present time, the clinical diagnosis remains the 'gold standard' (7). The authors are confident that misdiagnosis was not a significant source of error in the present study.

As in previous reports, pruritus and scaling were the most common presenting signs of IBH. Lesions were mainly reported along the mane and at the base of the tail, although approximately 20% of horses also had signs on the ventral abdomen. The reported distribution of signs varies and seems to be related to the *Culicoides* species involved. For example, Anderson et al. (2) reported that the ventral midline was the most commonly affected site, in 83% of affected horses, in British Columbia. In that region C.obsoletus is most abundant (12), and this species is considered to bite most often in the ventral midline region (23). However, *C. obsoletus* is also the most common species in the Netherlands (31) but a ventral localization is seen much less often. This matter deserves further investigation.

As stated above, the prevalence of IBH reported here is much higher than the true prevalence, which has been reported to be 18% for Friesian mares and 8% for Shetland pony mares in the Netherlands (32). However, these results provide some insight into the breeds that are affected most. Warmbloods appear to be affected less often than Friesians, coldblood types (coldbloods, Fjord, Tinker), and various pony breeds (Haflinger, New Forest, Welsh, and Icelandic). This is in accordance with the findings of others (5, 10, 26, 29) and in line with the impression of the authors that Warmbloods are indeed affected less often, although they too can suffer from IBH. The difference in prevalence between breeds and the reported familial incidence (2, 15) suggests a genetic component. There is evidence to support such a genetic basis for IBH, which appears to be related (in part) to genes of the major histocompatibilty complex and which appears to be recessive in nature (19).

In the present study, the highest incidence of IBH was reported in the 1- to 3-year age group, with nearly half of the horses developing signs before 4 years of age, followed by a gradual increase in prevalence from 5 to 10 years. These findings are in line with studies in the literature reporting that most horses develop signs at a young age (2, 5, 17, 29), provided they are exposed to the allergen from birth (16), and that the incidence increases with increasing age (33). After the age of 10 years, the incidence remained more or less constant with small fluctuations, which may be related to owners instituting measures to minimize symptoms, euthanasia of severely affected horses, or some horses outgrowing the disease (2).
A surprising finding was the decrease in incidence from the youngest age group (1-3 years) to the 5-year-old group. This could be the result of the removal (i.e., euthanasia) of affected individuals from the population as the disease is considered to have a poor prognosis with most horses

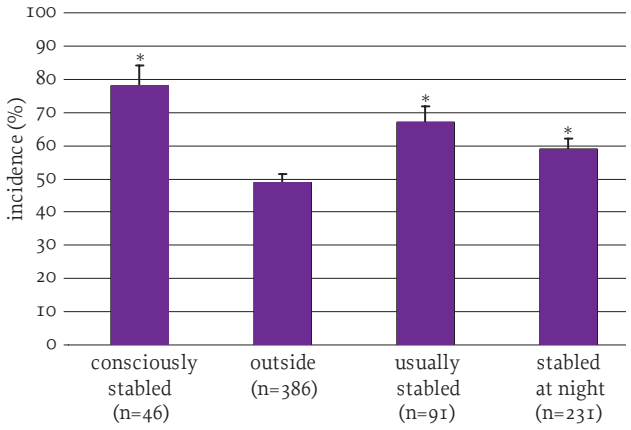

Figure 4. The incidence (mean ± sem) of IBH in horses stabled at different times of day and/or night, during the summer.

* Significantly different (P=0,0001) compared to horses kept permanently outside.

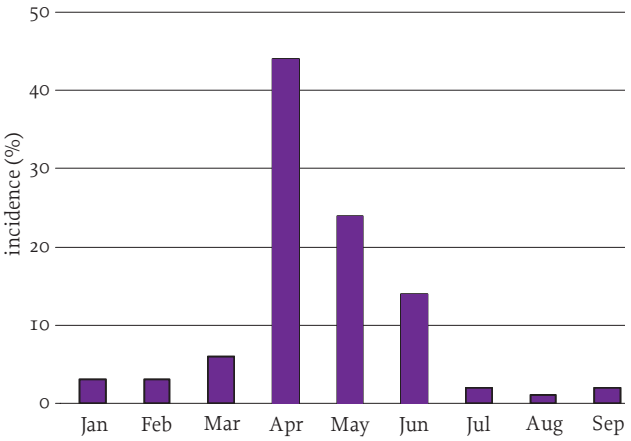

Figure 5. The percentage of horses showing first symptoms in each month.

showing (seasonally recurrent) symptoms for their entire life (33). The genetic susceptibility for IBH makes affected horses less suitable for breeding purposes and could also lead to their removal from the population. Another explanation for the reduction in prevalence may be that owners instituted measures to reduce exposure to the offending insects (e.g. stabling) or to otherwise alleviate clinical signs.

Within the Netherlands, the incidence of IBH varied considerably per region, with many of the areas with a low incidence being located along the coast. This is in accordance with the findings of van Grevenhof et al. (32), who reported a lower prevalence of IBH among Shetland pony and Friesian mares housed in coastal areas and appears to be related to the less suitable local habitat for *Culicoides* activity, survival, and reproduction. *Culicoides spp.* are poor fliers and generally are active at warmer temperatures. Along the coast there is usually more wind, less shelter, and fewer warm days per year than further inland (32). The life cycle of *Culicoides* requires stagnant or slow-running water and rotting organic matter, and these are more likely to be present in wooded than in coastal areas, which probably explains the lower incidence of IBH in the latter.

In addition, wooded areas provide more shelter from the wind. Van Grevenhof et al. also reported an increased IBH prevalence in areas with (sandy) clay soil, but soil type did not have an effect in the present study. This apparent discrepancy may be due to the much larger number of horses in the study of van Grevenhof et al. (n=6108) compared with the present study (n=794).

Horses that were kept outdoors day and night had the lowest reported incidence of IBH. This is almost certainly a reflection of the fact that owners tend to stable horses showing signs of IBH in an attempt to minimize exposure to *Culicoides* midges, as 24 hours of stabling often leads to dramatic improvement (26). The period during which affected horses should be stabled has not been determined exactly, but the time around dusk appears to be the most important in the Netherlands at least. This is when *C. obsoletus* and *C. pulicaris*, the most common species around horses in the Netherlands, are most active (31). Similarly, horses that did not have access to a stable or shelter showed the lowest IBH incidence. Ironically, shelters or stables that are largely/partly open may provide a more suitable environment for *Culicoides*, as the number of *Culicoides* entering a stable is proportional to the size of the door (6), and the closing and gauzing of windows leads to a 14-fold reduction in the number of *Culicoides* entering a stable (22).

The type of bedding appears to influence the incidence of IBH. The incidence of IBH was lower in horses stabled without bedding (or rubber mats on the floor) or straw than in horses kept on wood shavings or other types of bedding. The number of *Culicoides* caught inside is considerably less (approximately 6% of the total) than the number caught outside (1), but the number entering a stable is enhanced by the odours associated with a dirty stable (6). The type of bedding provided may have an effect on the attractiveness of a stable environment to *Culicoides*, although the frequency of manure removal did not have an affect on IBH prevalence in the present study.

Horses used for breeding purposes had the highest incidence of IBH in the present study, significantly higher than that of horses used for competition. This is surprising, and worrying, because a genetic component appears to play a role in the development of IBH (2, 5, 26), making the use of affected horses for breeding purposes undesirable. The findings may be explained by the fact that (severely) affected horses are less suitable for use in equine sports (1, 5). Alternatively, the high incidence seen in breeding horses may be related to the way in which breeding horses are kept. Broodmares are often kept at pasture day and night, and thus exposed to biting midges.

The frequency of deworming also influenced the incidence of IBH, with more frequent deworming proving preventive, as was the use of multiple deworming products. This could simply reflect better care/management or it could be the result of deworming. Excoriations or wounds resulting from rubbing induced by pruritus caused by *Culicoides* bites may become secondarily infected and this may contribute to further pruritus. This vicious circle of events may be broken by non-specific treatment of these wounds, and this is how management could influence IBH. Deworming is obviously intended to prevent/treat helminth infections and the presence of worms and/or their larvae may have an effect on the host's immune system. Research in the human field suggests that a certain level of antigenic stimulation helps prime the immune system (28), and therefore excessive deworming may be detrimental. The protective effect of deworming on IBH needs to be confirmed in other studies and investigated further in order to identify the underlying mechanism.

In temperate climates, as in the Netherlands, IBH is a seasonal disease with signs occurring between spring and autumn, when climatic conditions become suitable for *Culicoides* activity. Importantly, the ambient temperature needs to remain above a species-specific minimum, which has been show to vary between 10 and 18°C for a number of *Culicoides* species. The specific requirements for *C. obsoletus* (25), the most prevalent species attracted to horses in the Netherlands (31), have not been established. Apart from these minimum temperatures, the life cycle of *Culicoides spp.* also needs moisture, and the required combination of factors is most likely to be present from spring until autumn, when temperatures tend to drop below the required minimum again. Recent research in Belgium has shown that the number of *Culicoides* trapped decreases during the winter (18), when clinical signs of IBH invariably disappear, at least in Belgium and the Netherlands.

The present study identified a number of factors that appear to play a role in determining the incidence of clinical symptoms of IBH in horses in the Netherlands. Further studies are required to confirm the importance of these factors so that strategies to reduce the incidence or alleviate signs in affected horses can be suggested.

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