

## Influence of Epidemiological Factors on the Prevalence and Intensity of Infestation by *Hypoderma* spp. (Diptera: Oestidae) in Cattle of Potowar Region, Pakistan

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**Abstract.-** In the present study an epidemiological survey was conducted to determine the influence of epidemiological factors on prevalence and infestation rate of *Hypoderma* spp. in cattle of Potowar Region, Pakistan. A total of 1000 animals were examined on monthly basis by palpation method from the study area. The effect of age, sex, breed, management, previous exposure on hypodermosis was investigated. The mean number of nodules in the infested animals ranged from 1-35 (12.1±10.23). Higher prevalence was detected in young and female animals. The animals of local breeds, extensive grazing system and primoinfested showed higher infestation rate. Warbles were detected from September to January with a peak in December. The CHAID algorithm showed that grazing pattern as the most influencing factor for warble fly prevalence, followed by the district locality. Only previous exposure to the parasite had a significant influence on the intensity of parasitism. The management system is another contributing factor influencing the prevalence of hypodermosis. Despite the prevalence found in this study is moderate, the intensity of infestation is noticeable taking into consideration that Pakistan is a major exporter of skin, leather and their products warbles thus results in serious economic losses of the country.

**Key words:** *Hypoderma*, epidemiological factors, Potowar Region, hypodermosis, Warble fly.

### INTRODUCTION

**H**ypodermosis is a parasitic disease caused by the larvae of insect, belonging to genus *Hypoderma* (Diptera: Oestridae). *H. lineatum* and *H. bovis* are responsible for different diseases in cattle. Bovine hypodermosis is widely distributed in the northern hemisphere (Boulard, 2002).

Pakistan is an agricultural country with semi arid landscape and subtropical climate. Majority of people depend on livestock sector. Warble fly causes infection in goats, buffaloes and cattle in

hilly and semi-hilly areas of the Pakistan (Shah *et al.*, 1981; Ayaz and Khan, 1999). The nodule the formation starts in the beginning of September and damage in skin starts in month of November. These nodules disappear in mid of January. The highest prevalence of hypodermosis was recorded in December while lowest in July (Khan *et al.*, 2006). The prevalence of hypodermosis was 20-84% in goats and 22-24% in cattle in different endemic areas of Pakistan (Khan, 2004). Recently, Ahmed *et al.* (2012) detected an overall prevalence of 18.4% in cattle from northern Punjab. In this region (Chakwal district), the prevalence of hypodermosis in buffalo was 5.2% (Hassan *et al.*, 2007), whereas in Jhelum district was 3.2% (Ahmed *et al.*, 2013).

Hypodermosis is one of the causes of

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economic losses due to meat trim in slaughter animals and effect on hides (Hall and Wall, 1995). The hypodermosis is very important due to its economic importance in several countries of world like Denmark and United Kingdom (Bessley, 1974; Tarry *et al.*, 1993). Therefore, the official campaigns were started to eradicate, control and eliminate the warble fly infestation (WFI). The economic losses were suggested to be £13 million in Britain (Beesley, 1984) and more than £600 million in the USA (Drummond *et al.*, 1981; Webster *et al.*, 1997).

Keeping in view the importance of livestock in Pakistan, an epidemiological survey was conducted to determine the impact of risk factors on prevalence and intensity of infestation by *Hypoderma* sp. in Potowar region, Pakistan.

## MATERIALS AND METHODS

### *Location and sample size*

The present study was conducted in Potowar region of Punjab province, Pakistan. Potowar Plateau is bounded by Jhelum River in the east, Indus River in west, Kala Chitta Range and the Margalla Hills in north and Salt Range in the south. The ramparts of the Salt Range stretching from east to west in the south separate Potowar from the Punjab Plain. The Potowar Plateau includes the current four districts of Jhelum, Chakwal, Rawalpindi, Attock. The terrain is undulating. The Kala Chitta Range rises to an average height of 450-900 meters (3,000 ft) and extends for about 72 kilometers.

The sampling was carried out from different herds belonging to different ecological zones of Potowar Region were examined by the palpation method for the presence of warbles from August 2010 to February 2011 on monthly basis.

### *Epidemiological factors*

Some intrinsic factors (age, breed, sex, previous medications and infestations) and extrinsic factors (district, location and grazing pattern) were also taken into consideration (Ahmed *et al.*, 2012). The variable age was categorized for statistical analysis in 3 groups: 1-3 yr (n=380), 4-6yr (n=324) and 7-10yr (n=296), the breed was categorized in 3 groups: local breed (n=651), crossbreed (n=185),

Pure breed (n=96) having the Australian (n=8), Sahiwal (n=61), Neelibar (n=3) and Lahani (n=71); the sex was categorized in 2 groups: male (n=133), female (n=867), the medication was categorized in 2 groups; medicated (n=191), not medicated (n=809); the previous exposure was categorized in 2 groups; Reinfested (n=22), Primo infested (n=978); finally the grazing pattern was categorized in 2 groups: intensive management (n=378) and extensive Management (n=622).

### *Topography of sampling sites*

In the present study intrinsic (sex, age, breed, previous exposure) and extrinsic factors (district, topography, management, treatment) were also studied. These sites have plane areas, although some sites are semihilly. The climate of these areas is hot but has monsoon seasons as well. The breeding system is based on agricultural fields and open grazing sites. The intensive-extensive breeding is common in the study area. The management system (extensive system) of the animals in the study area is the major factor in contributing towards the onset of bovine hypodermosis.

### *Statistical analysis*

The risk of being infected by *Hypoderma* larvae was evaluated by using data mining classification tree (Kass, 1980), taking into account the factors previously indicated. Particularly, an exhaustive Chi-squared automatic interaction detector (exhaustive CHAID) as described in Lopez *et al.* (2011) was applied. Cattle were classified as positive (larvae detected in palpation) or negative (no larvae detected) and CHAID algorithm identified variables that divide cattle in subgroups with different positive/negative ratio. CHAID provided a way to identify mayor factors using as criteria the significance of a Chi-squared test and successively splitting data in increasingly homogeneous nodes in relation to dependent variable (larvae detection) until the classification tree is fully grown. Differences in the intensity of parasitisation were calculated by ANOVA.

Statistical analyses were performed with the statistical package SPSS for Windows 18.0 and SPSS answer Tree 3.1 (SPSS Inc., Chicago, IL USA).

## RESULTS

The present study showed that the rate of prevalence of bovine hypodermosis was moderate in Potowar Region, Pakistan.

There is a wide variation in the prevalence of bovine hypodermosis in different parts of Potowar region of Pakistan. The animals of local breed (primary infestation) were more infested. The prevalence rate in primary infested animals was lower than those having no previous exposure. The younger and female animals were more infested as compared to others groups while the animals reared under extensive grazing system were more infested as compared to intensive system grazing (Table I).

The CHAID algorithm showed the animal management as the most influencing factor for warble fly prevalence, followed by the district. The statistical analysis showed that animals in extensive management system were more infested than animals in intensive management system. In Intensive Management, district is not very important, since positive animals were detected in only one district (Rawalpindi). There is a possibility that these animals might be purchase from some other area, where this infection was common, while in Extensive Management system the animals of Jehlum, Rawalpindi and Attock districts were infested. The animals (younger age) of Jehlum and Attock district were more infested as compared to older ones. In Chakwal district the infested animals belongs to different locations. The results clearly showed that Animal Management is a major contributing factor that affects the prevalence and intensity of bovine hypodermosis in Potowar region, Pakistan. It may be due to the animals go to open grazing sites for grazing purpose, where they were more prone to disease. Another important factor influencing the prevalence of WFI is the districts, where extensive management is common. Whereas location and age factors were least contributing factors in the studied area (Fig. 1).

The number of nodules in the infested animals ranged from 1-35 ( $12.1 \pm 10.23$ ), whereas the number of nodules in primary infested animals was (1-25) and in secondary infested animal's ranged from (1-19). The nodules were observed on the back, hump and flank. First warbles were detected

in September with a peak in December. In January the number of warbles decreased dramatically to disappear in February (Fig. 2). All larvae collected from infested cattle were identified as *Hypoderma lineatum* (Zumpt, 1965).

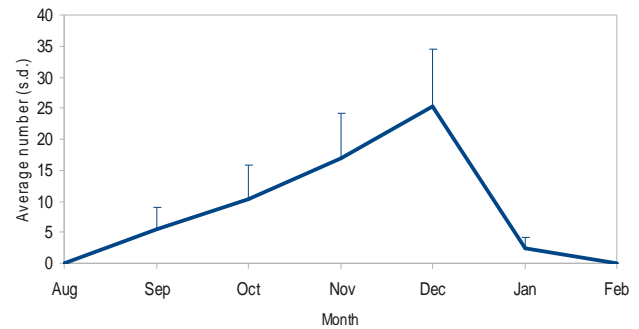


Fig. 2. Evolution of the intensity of infestation by *Hypoderma* in cattle from Potowar Region, Pakistan

The ANOVA showed no differences in the intensity of infestation with respect to different factors studied, except for previous exposure to the parasite ( $P=0.019$ ), so animals that had presented warbles in previous years showed less warbles than those non previously infested.

## DISCUSSION

In the present study, the rate of infestation was moderate having a significant difference ( $p < 0.05$ ) in the prevalence of bovine hypodermosis in cattle of Potowar Region. The intensive-extensive management grazing is the most influencing factor affecting the prevalence of bovine hypodermosis. The results showed that the animals kept at extensive grazing field for grazing having a significant difference in the prevalence of hypodermosis from different areas due to the age and location factors. The suitable climatic conditions in the higher prevalence areas might be the significant factors that favour the onset of disease. Our results were similar as the prevalence of hypodermosis in different areas of district Chakwal (23.5%) (Hassan *et al.*, 2008). The prevalence of cattle hypodermosis was recorded to be 21.62-29% (Shah *et al.*, 1981; Khan *et al.*, 1997). There was a wide variation in the prevalence of WFI

**Table I.** Influence of Epidemiological Factors (Sex, Age, Breed, Medication etc) on the intensity of infestation of hypodermosis in Potowar region based on palpation method.

S. No	Factor values	Levels	Examined Animal	Non Infested Animals	Infested Animals	Prevalence (%)
1	Sex	Male	133	111	22	16.55
		Female	867	705	162	18.68
2	Grazing pattern	Intensive management	378	373	5	1.34
		Extensive management	622	443	179	28.77
3	Medication	Medicated	191	178	14	7.32
		Non medicated	809	639	170	21
4	Previous exposure	Re-infested	22	6	16	72.72
		Primo-infested	978	810	168	17.17
5	Age	1-3 yr	380	285	95	25
		4-6 yr	324	270	54	16.66
		7-10 yr	296	261	25	8.44
6	Breeds	Local	651	491	160	24.57
		Cross	185	181	4	2.16
		Pure breed	96	88	8	8.33

(Shah *et al.*, 1981; Khan *et al.*, 1997, 2006; Ayaz, 1998). This variability might be due to the differences in the climatic factors that affects on developmental stages of the larvae (Tarry *et al.*, 1980; Panadero *et al.*, 2000). Previous insecticide treatments had also influence in the prevalence, but the grazing pattern was the most influencing factor, so that the prevalence of WFI was higher in those animals maintained in an extensive management system than those kept at home. Our results coincide with those of Otranto *et al.* (2001) who investigated that the free grazing practice is a major risk factor for hypodermosis positivity.

The prevalence of infestation is higher in animals of extensive/semi extensive region because the animals has extensive/semi extensive grazing then fly larvae and adults stages mature in that region having a greater chance of infection in that area. In Potowar Region the prevalence is moderate due to the extensive/semi extensive grazing pattern. In the district Rawalpindi, the higher infestation is due to the climatic conditions, location, management practices, treatment procedures, topography of the area and extensive grazing. Our

results were similar to Hassan *et al.* (2007) previously reported that WFI is an endemic disease in cattle of mountainous areas of Pakistan. In Chakwal district the semi hilly location is the most influencing factor affecting the prevalence of hypodermosis. So the semi hilly location in all the districts favors the onset of disease.

The higher infestation was found in younger (1-3 year) animals as compared to the older animals. These results could be due to their softer skin, that's makes easier for 1<sup>st</sup> instar in to their penetration as reported earlier by Scholl *et al.* (1989). On contrary, the destruction of the developing larvae by internal regulatory systems of the host and development of resistance by continuous exposure of animals to larvae could also explain the low prevalence in aged animals. Similar trends of age-wise prevalence of WFI have also been reported by Pruett and Kunz (1996).

Our results showed that warbles were first detected in September reaching a maximum in December and disappearing in January. Similar observations were reported by Khan *et al.* (2006) in different areas of Pakistan. There were no symptoms

of disease from March up to August, because during this season the larval stages develop inside the body of cattle, which led to decrease in infestation rate from March to July. In September the larvae started to appear and reaching at a peak in December. In contrary to our results as the peak of the emergence of warbles observed between January and March (Benkala *et al.*, 1999) and infestation rate was highest in March and lowest in June (Aaiz *et al.*, 2011), because there is wide variation in the biology of fly in different geographical areas of world.

Despite the moderate prevalence found in this study, the intensity of parasitization is significant, since Pakistan is the major exporter of hides, skins and leather products. These warbles inflict major economic loss to the country.

It is concluded that management is the most important factor affecting the prevalence of WFI. The extensive management in the animals of semihilly region has a very strong impact on infestation rate. It predicts that the larvae easily complete their lifecycles in hilly area and spread disease during the following season, whereas in plains the larvae were buried during ploughing time which resulted in high mortality of fly. The maximum infestation was observed during December due to the maximum number of nodules on the body of infested animals. Government should devise some strategies to control and eradicate this disease in Pakistan.

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