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Quantifying the Frequency of Hypodermosis and Evaluating Its Potential Economic Consequences for Livestock Farming

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Abstract

Worldwide illness hypodermosis is a serious hazard to cattle and the hide business. Studies examining India's economic consequences are few, despite the country's substantial contribution to the worldwide hide market. This study looks on the frequency of hypodermosis in cattle from Punjab's Rurki Budhsingh and Bangran. After undergoing medical checks, cattle selected at random from the prescribed longitudinal and latitudinal (*latitudes 30.30° N and 76.31° E*) coordinates had their larvae collected for additional investigation. The larvae were tested using an Enzyme-Linked Immunosorbent Assay (ELISA) kit and conventional diagnostic techniques. 90% specificity and excellent sensitivity were shown by the ELISA kit. The prevalence of hypodermosis in the chosen cattle was determined to be 48.9% (120/250) and 50.4% (126/250) based on ELISA kit results. A noteworthy distinction in the bulk of hypodermosis was found between the two diagnostic methods ($p<0.05$), underscoring the possible benefits of employing ELISA for illness identification. India's high rate of hypodermosis emphasizes the necessity of strict control methods in animal production. Hypodermosis, a global health risk and economic burden, is a significant issue in India, despite its significant contribution to the global hide industry. This study highlights the lack of knowledge about the financial damage caused by hypodermosis on livestock production and suggests future research to explore the financial losses associated with this condition.

Keywords: Hypodermosis, larvae, Traditional technique, ELISA kit, Punjab

INTRODUCTION

Animals that are infected with the parasite hypodermosis are brought by warble insects. These insects could result in losing weight or decreased productivity, as well as irritation and suffering (1). Chemical insecticides and parasiticides are examples of control methods; cleanliness and insecticidal ear tags are examples of management strategies that help stop infestations. Developments in veterinary medicine, geographic variations and agricultural practices can impact the knowledge and approach for treating hypodermosis (2). Eleven genera and thirty-two species are known to belong to the higher group Hypodermatidae family (3). Compelled parasites, hypoderma larvae spend several months feeding on host tissues while migrating. After secreting enzymes, they migrate through subcutaneous tissue after penetrating intact skin through salivary glands. Seven species of Hypodermatinae cause hypodermosis, a disease that affects the continents in the Northern Hemisphere (4). The skin of ruminants is affected by these species' myiasis, which is characterized by subcutaneous warbles. H. lineatum, H. bovis, H. sinense, H. tarandi and Przhevalskiana silenus are common species that cause Warble Fly Infestation (WFI) in cattle, buffalo, yaks and goats (5). Hypoderma larvae, which grow on cattle's backs, cause significant financial losses due to damage to flesh, amputation and scarring, reducing the value of the carcass and hide (6). Livestock suffering from the parasite illness hypodermosis can experience substantial losses in money due to decreased protein output, damaged leather goods, expensive medical expenses and resulting infections (7). It makes animals more vulnerable to secondary illnesses, which calls for more veterinarian supervision and care. Usually, integrated methods of pest management are used to control and prevent hypodermosis (8).

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The study (9) discovered that an average sero-positivity of 18.5% was during their investigation of the goat warble fly infestation in Pothwar, Pakistan. This was higher than the 12% found by using conventional methods. September is when the larvae appear and October, December and February are when the nodules form. The study found that serologic diagnosis produces more sensitive and precise outcomes than traditional methods. The paper (10) explores goat warble fly disease, which is epidermal myiasis caused by Przhevalskiana silenus eggs. Long-term economic damage makes detection earlier challenging. This work presents an enhanced indirect ELISA for early detection based on P. silenus synthetic HyC, providing an accurate and focused immunodiagnostic for nationwide monitoring. This is the first report of indirect ELISA-based GWFI sero-surveillance utilizing recombinant HyC as shown in Figure (1).

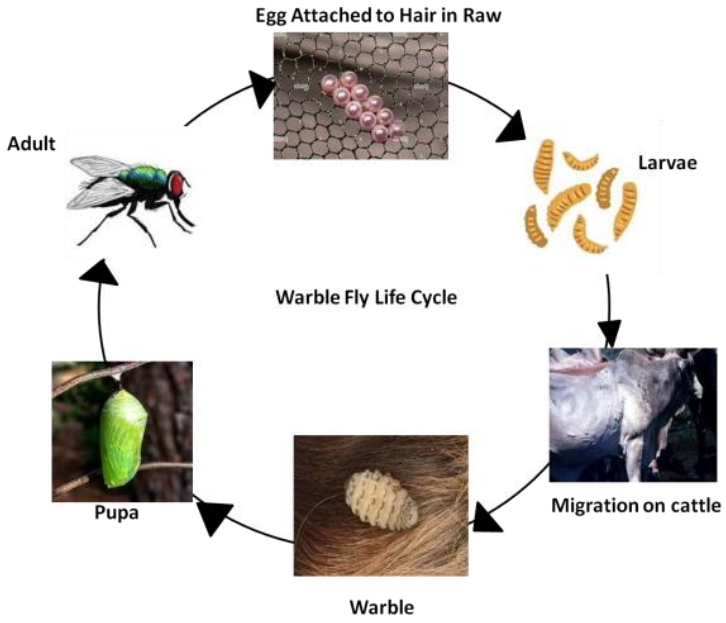

Figure (1). Life Cycle of the Cattle Grub (Source: Author)

The article (11) analysis in Wasit province, a study involving *536* cattle, revealed a clinical and serological prevalence of *21.83%* and *36.19%*, respectively. Instance, rates of warble infestations were higher in cattle that were locally bred, younger, older, females and seasonal factors. Specific anti-hyperemesis antibodies were present in high concentrations in both native and hybrid breeds. The study (12) examination Hypoderma lineatum larvae are to blame for the infestation of warble flies in cattle, which is found in northern India. For the milk and leather industries, this infestation results in significant financial losses. Ivermectin was administered to a crossbred cow with soft nodules after the larvae were squeezed out. According to research the paper (13), a warble fly infestation in southern Pakistan's Punjab region injured 18,000 cattle and 9000 buffaloes. The phenomenon was more common in slaughterhouses, among males and females, as well as among younger compared to old animals. The study was carried out in the districts of Dera Ghazi Khan and Rajan Pur. According to the survey, the infestation cost the economy Rs. 22.8 million a year in lost revenue. The paper (14) examined cytokines that promote inflammation and proteins associated with acute phase (APP) in cattle with trichophytons. Thirty cattle with trichophytosis had higher levels of haptoglobin, *SAA, TNF-α, IL-1, IL-6* and ceruloplasmin in their blood samples than the control group. The values of globulin, total protein and albumin were lower. The study (15) looks into the necessity of eradicating the harm that bloodsucking Dipteran insect, which carry pathogens that cause diseases in humans and animals in Russia. In subzones of southern taiga and small-leaved forests, it indicates times of mass flight and precautions for cattle, as well as the dates of these insects' summers in the Tyumen region. The incidence of brucellosis in cattle and small ruminants in Kazakhstan is examined in the paper (16), who found a Pearson correlation between the populations along with infected animals. It implies that people of more significant size are more vulnerable and recommends modifying breeding procedures and epidemiology surveillance techniques to take geographic variables into account.

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A private dairy farmer brought the current study to hypodermosis with the goal of ascertaining the frequency of hypodermosis in the Patiala region of Punjab's Rurki and to calculate the financial losses this illness has brought to India's cattle industry.

MATERIAL AND METHODS

We collected 250 cattle of different ages and sexes from Budhsingh and Bhangran of the Patiala district of Punjab (17) and studied the cattle suffering from hypodermosis as shown in Figure (2). Then, analyzing their larvae using the traditional method and ELISA kit method approaches to test the status of hypodermosis larvae of livestock, using risk factors to explore the hypodermosis disease, analyzing how it affects the animals and the economic condition of the country.

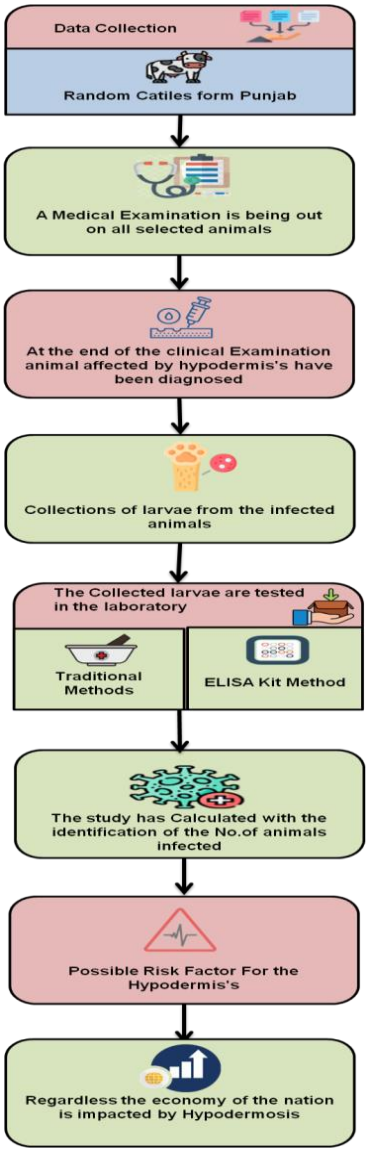

Figure (2). Study Flow (Source: Author)

Study Area

The present study set out to determine the prevalence of hypodermosis in the Patiala district of Punjab, namely in Rurki Budhsingh and Bangran (latitudes 30.30° N and 76.31° E) (17). Punjab, a subtropical wide area in India's northern part, has an average temperature of *22.5°C* and acquires *60–70%* of the nation's rainfall. Its climate, which includes humid summers, rain from the monsoons and colder winters, is conducive to the

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breeding of warble flies due to its altitude and farming practices. A high concentration of cattle distinguishes this region under investigation.

Animals and Gathering Larvae

The study involved 250 cattle of various ages and genders. Weekly parasitological examinations such as traditional techniques and hypodermosis measurements like the distribution ELISA kit (18) method were carried out to diagnose the hypodermosis. A militant fly is discovered from the cow's body, the growing stages are shown in the following Figure (3). When Hypoderma spp. Larvae were palpated on the backs of cattle and lacerations resembling cysts were found. An inventory of traits was recorded using a questionnaire, but farmer restrictions hampered sample collection. Comparable numbers of animals have been examined to look for early stages in the liver, heart, lungs, esophagus, nervous system, vertebral cartridge, udder, lymph nodes as well as other vital organs in the second and third instars of Hypoderma spp. Larvae were checked for on the hides.

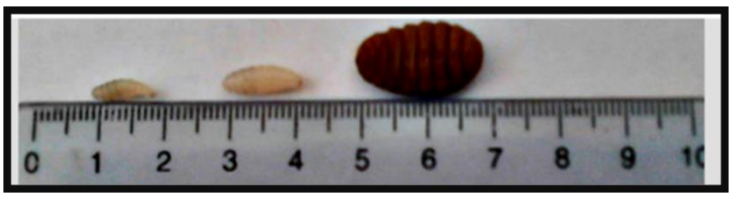

Figure (3). Larva stages
(Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8410209/)

Laboratory Test

Techniques for determining the larval stages of Hypodermosis entail looking closely at particular physical traits, like color, spiracles, body form and mouthparts. It is helpful to make similarities with taxonomy, direct sources of information and scientific literature. More precise approaches for identifying infectious caterpillars can be obtained by consulting with specialists, record keeping, technological improvements and the use of ELISA (18) kit methods for teaching and dissemination. The larvae are tallied, cleaned in a pharmacological sodium chloride (NaCl 0.947%) (19) and kept in a distinct jar with 60% alcohol along with a few drops of glycerin for every cadaver is a traditional technique to count the larvae's. ELISA kits identify chemicals, proteins, or antibodies in samples linked to larvae. Sensitivity together with specificity depends on antibody caliber furthermore researchers should combine molecular and morphological methodologies.

RESULT AND DISCUSSION

In the Rurki Budhsingh Bangran district of Punjab, the early diagnosis of hypodermosis was evaluated using the manual palpation approach and the hypodermosis serum ELISA kit. The ELISA kit had a 90% sensitivity and specificity. According to the ELISA kit, the prevalence was 48.9% (120/250) and 50.4% (126/250), respectively Table (1) & Figure (4). The bulk of hypodermosis differed significantly ($p<0.05$) between the two diagnostic techniques. The results from the hypodermosis studies were examined in SPSS Version 20.0 using a subsequent analysis Z-test with the correction for Bonferroni and Pearson's correlation coefficient χ^2test. While the post hoc Z-test looks into particular differences between groups or circumstances, the chi-squared test establishes significant associations between categorical variables.

Experimental result

The 250 animals in Rurki Budhsingh and Bangran, Punjab, were assessed for hypodermosis, a disease caused by warbler flies. Results showed differences in prevalence among villages, demonstrating the effectiveness of ELISA kits in diagnosing the condition. There is a mathematically substantial correlation between the two procedures, as indicated by the 19.05 χ^2 test values for palm touch traditional method and the commercial ELISA kit method. The *degree-of-freedom* (DF) is 4 and the *p-value* < *0.05*, which makes it unlikely that the observed frequency differences were the outcome of unpredictability. The null hypothesis is disproved, suggesting a substantial correlation between the method of diagnosis and the parameter of interest.

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Table (1). The Percentage of Cows with Hypodermosis Varies Depending on the Location (Source: Author)

Village in Punjab	No. of animals evaluated	Diagnostic techniques						total No. of larvae	Average number of larvae in each cow
		Tradition technique			Distribution ELISA kit				
		Non-Affected	Affected	Percentage (%)	Non-Affected	Affected	Percentage (%)		
Rurki Budhsingh	125	82	43	34.4	58	67	53.6	759	6.072
Bangran	125	48	77	61.6	66	59	47.2	912	7.296
Total	250	130	120	48.9	124	126	50.4	1671	6.684

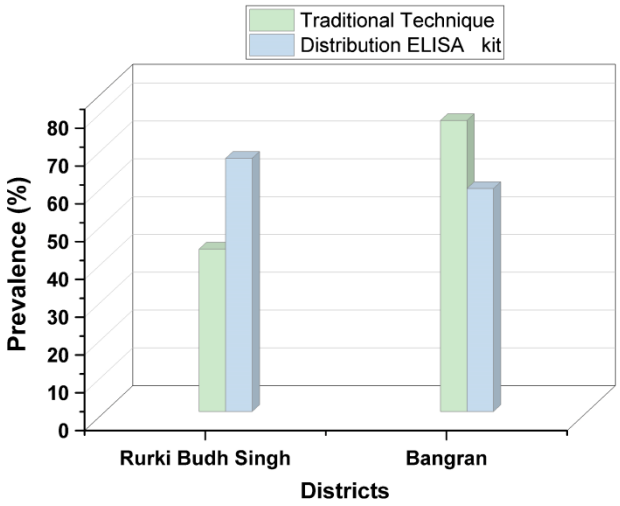

Figure (4). Frequency of hypodermosis as determined by traditional and standard ELISA kit methods (Source: Author)

Risk Factor

An overview of the hypodermosis evaluation outcomes over several months is shown in Table (2), which includes a Z-Test notation and information on the number of animals tested, hypodermosis-positive instances and positivity percentages. According to how the Table is interpreted, the months of January, February, March, October and November have the highest rate of hypodermosis-positive patients. Which months or groups are different based on the Z-test findings are shown by the Z-Test notation, which states that Z-tests were used to detect these significant differences.

Table (2). Punjab's Month-By-Month Hypodermosis Occurrence (Source: Author)

Months	No Animal Evaluated	Hypodermosis positive	Percentage (%)	Z-Test
January (J)	25	16	64	O, F, M
February (F)	20	9	45	-
March (M)	20	2	10	-
April (A)	20	0	0	-
May (M)	20	0	0	-
June (J)	20	0	0	-
July (J)	20	0	0	-

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August (A)	20	0	0	-
September (S)	20	0	0	-
October (O)	25	8	32	-
November (N)	20	11	55	O, F, M
December (D)	20	19	85	O, N, F, M

Potential risk factors for hypodermosis and the p-values associated with them according to chi-square evaluation ($\chi 2$) analysis. Using both conventional and ELISA approaches Table (3) compares non-affected versus impacted groups based on gender, age and season data. Table (3) lists potential hypodermosis hazards along with their p-values from a $\chi 2$. Using the conventional method, there was no discernible shift in the distribution of males, females, animals under a year old, those between a year and two years old, or animals over two years old between the non-affected coupled with affected groups. For the conventional method, there was no discernible seasonal variation. Gender did not alter the distribution between the impacted and non-affected categories. The distribution of affected and non-affected animals utilizing ELISA and conventional methods is correlated with gender, age and season; these correlations are shown in the Table.

Table (3). List of Hypothetical Hypodermosis Hazards and Corresponding P-Values Determined Via the Procedure of $\chi 2$ Assessment (Source: Author)

Factors	**Volume**	**Analyzed Cattle's**	**Diagnostic techniques**					
			Tradition technique			**Distribution ELISA kit**		
			Non-Affected	**Affected**	**P-Value**	**Non-Affected**	**Affected**	**P-Value**
Gender	Male	138	92	46	p=0.73	108	30	P=0.84
	Female	128	54	74		32	96	
Age	<1 yr	91	53	38	p<0.05	50	41	p<0.05
	1-2 yr	83	36	47		14	69	
	>2 yr	76	41	35		50	16	
Season	Summer	97	97	0	p<0.05	54	43	p<0.05
	Winter	153	33	120		76	77	

Financial Consequences

The agriculture sector and cattle output are impacted by the invasion of warble flies, known as hypodermosis. Animals that are infected can lose weight, produce less milk and be less productive (20). Livestock owners are burdened by treatment costs, which include veterinary supplies and parasiticides. The production of milk and meat could be impacted, which would lower dairy farmers' profits. As beef is processed, hypoderma larvae can harm animal tissues, reducing the quantity and quality of the meat produced. The sale of animal byproducts can result in lower profits for the leather sector. Insecticides, tools and labor are examples of additional expenditures associated with control methods to prevent and manage hypodermosis. In extreme circumstances, hypodermosis might raise mortality, which would directly cost livestock owners money (21).

DISCUSSION

Worldwide, hypodermosis is a disease that affects livestock and has a significant economic impact. Although India generates 8.8 million hides (22), no study has examined the financial harm that this epidemic has caused to

the country's hide business. Given that not all migratory larvae would have reached the back region of every animal at the same time, the smallest amount of hypodermosis in visual inspection of fatalities can result from this phenomenon (23). Its ELISA-detected migratory first-instar larvae could have been eliminated by the patient's immune reaction, which would have prevented their detection during a subsequent clinical-parasitic investigation (24). Thus, more hypodermosis surveys utilizing sensitivity and ELISA methodologies are necessary to determine an accurate rate of infection. P. silenus infection in goats is a severe parasite disease causing financial losses. Mass therapy or fly control is crucial, in L1 cases. Understanding the parasite's life cycle and lesions can aid in developing prophylactic and eradication strategies (25), while host tissue reactivity and pathology aid in treatment.

CONCLUSION AND FUTURE RECOMMENDATIONS

Hypodermosis is a disease in cattle that can be managed through treatment plans, preventive measures and ongoing observation. Potential solutions include vaccines, selective breeding, better diagnostic tools, educational initiatives, surveillance and specific therapy plans. Integrated management of pests involves integrating control methods like acaricides, pasture management, biological control and genetic resistance in cow breeds. Vaccination research could extend the remedy and reduce pharmacological regulation. "A Selective Management for Resilience" studies breeding plans for cow's sensitivity to hypodermosis. Advanced diagnostic technologies can help to identify hypodermosis early, enabling timely intervention. Training programs can increase knowledge about hypoderma flies, their life cycle and management methods. Monitoring and surveillance systems can track hypodermosis prevalence. Environmental management techniques can reduce infection risk.

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