GIS BASED FREQUENCY DISTRIBUTION OF WINGLESS INSECTS INFESTING DOMESTIC POPULATION OF DOGS IN LAHORE, PUNJAB, PAKISTAN

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ABSTRACT: The intent of the present study was conducted (January, 2020 to December, 2020) to estimate the prevalence of wingless insects in dog population and to identify the potential risks factors in selected areas of Lahore, Punjab, Pakistan. Results of the study revealed an overall prevalence of wingless insects 50.16% (1204/2400) in dogs of study area. Among various insects, fleas were found predominant (28.5%; 684/2400; P<0.05) as compared to lice (21.66%; 520/2400). Among the reported species 4 were wingless insects (Ctenocepahlides (Ct.) felis, Ct, canis, *Linognathus setosus* and *Trichodectes canis*). Breed, age and sex of host were not found to be related with risk factors (P>0.05) affecting incidence of wingless insects. These inscets effect different body parts differently as highest prvelance was noted at neck (15%) and back (11.5%) followed by abdomen (10%) and ear (7.4%). Prevelence of the ectoparasites was found to be 6.2% at forelegs and 4% in congenital area, 4% around the shoulder and 6% around the hind legs, however, tail area was minimally affected (1.2%). Prevelance of Ct. felis was noted to be 35.96, Ct. canis 68.43%, *Linognathus setosus* 21.1% and *Trichodectes canis* 78.8%. Town wise incidences were found to be highest in Shalimar Town (62.91%) followed by Wagha Town (59.58%), Aziz Bhatti(59.16%), Data Ganj Bakhsh (55.41%), Nishtar Town (46.66%), Samanabad (44.3%), Iqbal Town (43.6%), Ravi Town (42%), Lahore Cantonment (41.6%) and Gulberg (40.4%). Rate of ectoparasites infestation was observed higher (P<0.05) in stray dogs (80.36%) followed by guard dogs (63.7%), hunting dogs (37.5%) and pet dogs (35.66%). Amongst the different seasons, rainy season showed higher lice prevalence (26.1%; 157/600), fleas (37.8%; 227/600), as compared to summer season and spring. Though, summer season was found to be unfavourable for the increase of almost all these insects. Comparative results of blood profile revealed significant difference (P<0.05) between non-infested and infested dogs, in the sort of lower value of infested/infected animals. To control the prevelance and ultimate effect of wingless insects on dog population applicable a well planned and control startegies as well as extension facilities should be arranged. Pet owners should be provided awareness about the significance of controlling the wingless insects to keep the pets and owner healthy.

Key words: Prevalence, Risk factors, Dog, Wingless Insects, Lahore.

(Received 14.09.2022 Accepted 16.12.2022)

INTRODUCTION

Dogs (*Canis lupus familiaris*) are considered very close to human beings because of their sophisticated social behaviors. Dogs domestication was started from gray wolves a 15 thousamds years past (Ugbomoiko *et al*., 2008). They have recognized to be helpful in a number of works i.e. niffer dogs used to solve the criminal cases and customs, hearing and dogs also provide assistance to disabled persons, farm dogs are used for the stock works and hunting purpose. Most important are the pet dogs which are mans' companion and guide dogs for the blind etc. (Savolainen *et al*., 2002; AVMS, 2004). Dogs were selected from a domestic specimen of Europ. Because of an international ban yet there is not any evidence of presence of dog in the Antarctic (polars), though domestic dogs now reside nearly every country. Nearly 450 recognized breeds of domestic dogs are found through out the world which shows marvel physiological, social and behavioral adaptations (Vila *et al*., 1997).

Wingless insects can cause damages and disturb the behavior of dogs i.e. high frequency of scratching or rubbing which may lead to reduction in feeding time. In

some situations, infested dogs might help to self-wounds, predominantly when wingless insects are present in higher density (Berriatua *et al.*, 2001; Matthysse, 1946). Several wingless insects can also be vectors of protozoa, bacteria, nematodes, cestodes, rickettsia, and viruses, causing diseases zoonotic concern in human being (Parola *et al.*, 2005; Rehbein *et al.*, 2003; Uilenberg, 1995; Arends *et al.*, 1990; Pegram *et al.*, 1987). Wingless insects are documented to cause serious losses to pets (Raoult and Roux, 1997; Niyonzema and Kiltz, 1986; Petney *et al.*, 2007) causing severe toxicosis, allergy and irritation.

Various blood suckling arthropods (lice and fleas etc) of domestic/pet dogs are main source of their skin problems (Segun, 1998; Araujo *et al*., 1998) which could be mange, hypersensitivity syndromes and dermatitis. Aadditionally, these can transmit numerous pathogens in humans, domestic dogs and cats, as well as other domestic animals (World Health Organization, 1984). Ectoparacites may conquer the host's nest and its surrounding and attack the hosts occasionally and/or they may live perpetually on their host (Shaw *et al*., 2004). Such type of host-parasite interaction is not a novel mechanisms through which parasites chase, recognize and keep in touch them with hosts (Gonzalez *et al.*, 2003; Alcaino *et al.*, 1999).

The prevelance of fleas (Insecta: Siphonaptera) in dog populations may inconstant with the geographical location which can effect protocols of flea controlling, the risk of flea-borne pathogens or parasitic transmission and/or the occurrence of flea-borne dermatitis, not only restricted to dogs however also to humans and other pets (cats etc). Historically the *Ctenocephalides canis* (dog flea) is reported to be related with numerous other canids as well as cats (Durden and Traub, 2002). *Ctenocephalides canis* are reported to be the causative agent of *yersinia pestis* (Dryden, 1993; Rust *et al*,. 1971), Rickettsia typhii (endemic typus, murine typhus), Rickettsia felis (flea fever), bartonella species (cat-scratch disease), moreover fleas are host helminths including: *Hymenolepis diminuta* and *Dipylidium caninum.* In tropical countries/areas Tunga penetrans (Tungiasis) is a disease of humans having a direct link to the parasitic infestation in humans due to fleas (Reiss, 1966; Chomel *et al*., 2006; Stenseth *et al.*, 2008; Billeter *et al.*, 2008).

Anemia may occur in hosts because of activity of bloodsucking lice (Anoplura; *linogathus setosus,* in various cases of lice infestation (Eckert *et al*., 2008). Mallophaga; *Trichodectes canis* (Biting louce) are active when roving over the hairs, however the blood-suckling lice are in general merely visible when some-one sees at the base of hairs, wherever they feed on the skin and with the help of claws are fasten at the hair. In both of the cases (Mallophaga and Anoplura) spread of parasites occurs from one dog to another dog, practically entirely when dogs play with one another. Since the bloodsucking lice can live just for a couple of hours distant apart/away from their hosts and so avoiding dropping down from hosts (Mehlhorn and Mehlhorn 2008; Martini, 1946; Eckert *et al*., 2008;). Yet, lice are prevailed and damage the health of dogs specifically those of youngs and/or when they are suffered in an immuno-suppressed condition which oftenly also assists infestation/infection with Demodex folliculorum and/or Sarcoptes scabiei (Rommel, 2000; Eckert *et al*., 2008; Mehlhorn 2008; Mehlhorn and Mehlhorn 2008; Lane and Crosskey 1993;). Insects infestation in diversity of animal have been considered/recognized in various areas of Pakistan (Kakar and sulemankhel, 2008; Durrani and Kamal, 2008; Sajid *et al*., 2008; Hussain *et al.*, 2006). However Still, GIS based frequency distribution of wingless insects infesting domestic population of dogs in Lahore, Punjab, Pakistan needed to be searched/explored. Therefore, periodic exploration of the prevalence and associated/related risk factors of wingless insects are needed for planning an effective control program in the Lahore.

Therefore, the present study was conducted to estimate the prevalence and related risk factors of wingless insects infesting dogs of Lahore (Pakistan). The purpose of the study is also investigating the epidemiological factors intensity and prevelence of wingless insects (lice and flea in domestic dogs (shepherd, stray, house, hunting etc) and association between the parasites.

Objectives of the study

- Determination of prevalent Wingless insects infesting dog population of Lahore
- Determination of associated risk factors in the study area

MATERIALS AND METHODS

The present study was designed to determine the prevalence and related determinants of wingless insects infesting/infecting the dog populations in Lahore area. A stratified simple random sampling was done from January, 2020 to December, 2020.

Selection of animals: The dogs for the study were selected from dog population of Lahore. Samples were slected randomly and stratified. Towns of the study area (including; Shalimar Town, Wagha Town, Aziz Bhatti, Data Ganj Bakhsh, Nishtar Tow, Samanabad, Iqbal Town, Ravi Town, Lahore Cantonment and Gulberg were considered as study area. The map grid method was used for the selection of specific area within the strata.

Geographic information system (GIS): It is a conceptualized delepoed frame-work that offers the capability to analyze and detect the spatial geographic

data. Computerized based tools which let users to generate interactive questions, edit store and analyze non-spatial and spatial data, and visually sharing the consequences of these processes by representing them as plots. In the present study GIS map was developed to approach the accurate sample/specimen.

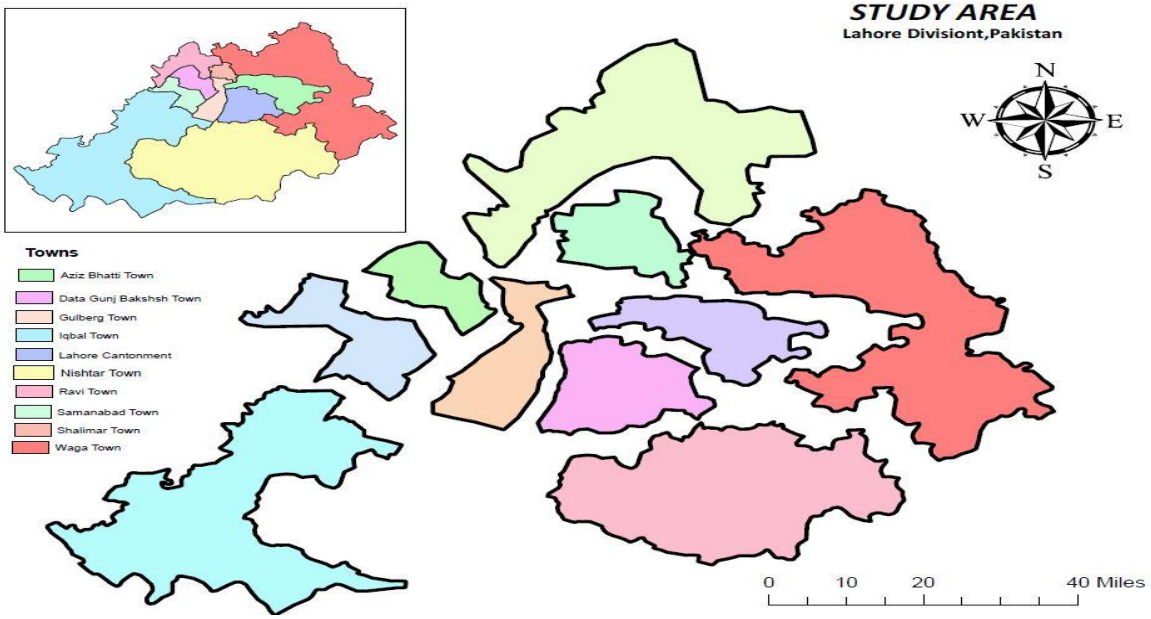

Figure 2.1 GIS mapping to approach the accurate sample/specimen

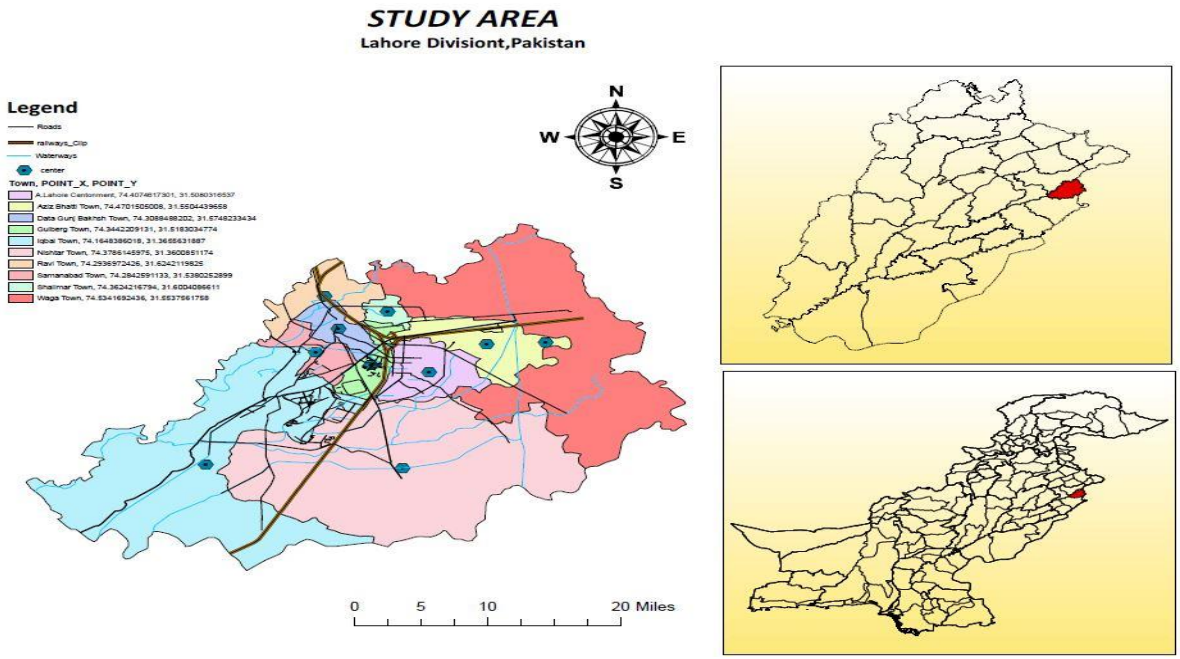

Figure 1.2 Map of the executive partitions of the Lahore

Associated determinants: On the basis of the age, the dogs population of the Lahore was divided into various categories i.e. 1 month to 6 month group (includes pups), 6 month to 12 month group (includes young), 1 year to 3 years group (includes adult) and the dogs older than three years group (including olds). Animals of both sexes (male and female) of any age were included in this study. Various dog breeds of Lahore i.e. Bullterrier, German Shepard, Doberman, Russian, Alsatian, Pointer, and Labrador were checked for infestation. Study area of Lahore is comprised of Shalimar Town, Wagha Town, Aziz Bhatti, Data Ganj Bakhsh, Nishtar Tow,

Samanabad, Iqbal Town, Ravi Town, Lahore Cantonment and Gulberg. A total of 2400 dogs were screened the prevelance of fleas and lice. The prevalence of wingless insects was also estimated keeping in view localities i.e. rural and urban. Parasitic burden was also recorded in different ways/levels of dogs keeping which includes Guard, Hunting, Pet and stray dogs. Association of season with the prevalce of wingless insects in dog population was also determined including four seasons summer, autumn, winter and spring seasons. For this cumulative as well as individual prevalence rates for each wingless insects were observed. Head, back, neck, abdomen, foreleg, shoulder, ear, congenital areas, the tail and hind legs were inspected for wingless insect infestation.

Designing of Questionnaire: A questionnaire (having closed or dichotomous type question) was designed to obtain data regarding the related risk factors affecting the prevalence of insect infectation in dog population in Lahore. This Questionnaire was then further improved testing (Thursfield, 2008).

Examining the Parasites

Ante mortem examination: The elected dogss were fortnightly checked for ante-mortem examination to detect incidence of wingless insects with the help of a magnifying glass. Infected/infested dogs were then separated to collect insects from them. History of infestation/infection and overall husbandry conditions these dogs were maintained/recorded/documented. The prevelance and infestation of dogs recorded categorically through scrutinizing the evidences of wingless insects on various body parts as described by Herenda *et al.* (2000) i.e. from hind limbs to mouth and closely inspected using magnifying glass as described by Wall and Shearer, (2001).

Collection and Toxonomic identification of specimens: Every dog was carefully observed for his/her all body parts.

Lice and fleas were collected with the help of forceps without destroying the mouthpart (Soulsby, 1982). Lice and flea were collected through hand (covered with gloves) or by using forceps (Soulsby, 1982). The samples collected were preserved in glycerine alcohol (5 parts glycerin and 95 parts of alcohol) in McCartney bottles as mentioned by Soulsby (1982), then these samples were transported to the Department of Parasitology, Riphah College of Veterinaray Sciences, Lahore.

These samples (specimens) were identified (taxonomically) using microscope (stereoscopic) with the help of keys and description described by Soulsby, (1982); Furman and Catts, (1982) and Wall and Shearer, (2001).

Blood Profile

Blood collection: A 5ml of blood sample was collected (via jugular vein) in vaccutainer tubes containing 5mg EDTA (as preservative) using a disposable syringes (Benjamin, 1978).

Transportatio of the samples: Samples were then carefully transported under the recommended protocol to the Parasitology lab, Riphah College of Veterinary Sciences (RCVetS), Lahore.

Haematological parameters: To study blood chemistry, blood samples were taken from both (infested and/or non-infected) dogs to determine the blood profile and an electronic counter was used to determine Haemoglobin, packed cell volume (PCV), Total Erythrocytes Count (TEC), Total leucocytes Count (TLC), Lymphocytes and Eosinophils (Benjamin, 1978)

Statistical analysis: The data collected were analyzed using MLR (multiple logistic regressions). For this, factors/variants of paired features were analyzed using Odd's Ratio. All the statistical analyses were executed using SAS 2004 at 95% confidence level as described by Schork and Remington, (2010).

RESULTS

Wingless ectoparasites prevalence: The prevalence of wingless insects was studied during whole year period 1 year (Janury, 2020 to December, 2020). Dogs for the study purpose were selected randomly without any personal choice. Overall prevalence of wingless insects in dogs was documented as 50.16% (1204/2400) as shown in table 3.1. Among various insects, fleas were found predominant (28.5%; 684/2400; $P<0.05$) as compared to lice (21.66%; 520/2400).

Table 3.1: Over all prevalence of wingless insects in dog population of Lahore.

Ecto-parasites	Infested animals (n)	Total animals Screened (N)	Prevalence %
Fleas	684	2400	28.5
Lice	520	2400	21.66
Over all	1204	2400	50.16

Prevalence %= n/N×100

Among species of fleas, the prevalence of *Ctenocepahlides (Ct). canis* was found high (68.43%; 438/684, $P<0.05$) as compared to *Ct. felis* (35.96%; 246/684). In lice, *Trichodectes canis* (78.8%; 410/520 $P<0.05$) was noted to be higher than *Linognathus setosus* (21.1%; 110/520) as shown in Table 3.2.

Table 3.2: Prevalent species of wingless insects infesting dog population of Lahore.

Associated factors/ determinants	Variable	Levels	Percent prevalence	Odds Ratio	P-value
Species of Wingless Insects	Fleas	*Ctenocepahlides (Ct). canis*	68.43% (438/684)	1.94	0.002
		Ct. felis	35.96% (246/684)	-	-
	Lice	*Trichodectes canis*	78.8% (410/520)	2.01	0.004
		Linognathus setosus	21.1% (110/520)	-	-

Associated determinants: Dogs age was found to be significant (P>0.05) risk factors effecting prevalence of wingless insects. Sex of insects were observed to be interlinked (P>0.05) with risk factors) affecting the incidence of wingless insects.

There was non-significant difference (P>0.05) of prevelance of insects observed amongst various dog breeds. The prevelance percentage was observed to be highest in the Doberman (73.71%), followed by Alsatian, Bullterrier, Russian, Pointer, Labrador and German Shepard whilst lowest prevelance was (6.66%) observed in cross-bred.

Prevalence was found to be highest in Shalimar Town followed by Wagha Town, Aziz Bhatti, Data Ganj Bakhsh, Nishtar Town. Samanabad, Iqbal Town and Gulberg. Results of the study revealed that prevelance of wingless insects were found to be meaningfully higher (61.83%) in villages (rural areas) as compared to the urban areas (38.16%).

Parasitic burden was also recorded in different ways/levels of dogs keeping and prevalence was highest in dogs kept as Guard followed in order by those kept for Hunting, kept as Pet and lowest in stray dogs.

As far as season is concerned prevalence of wingless insects was found highest in Autumn season followed in order by spring and winter and lowest in summer season.

Association of various risk factors with the dissemination of wingless ectoparasites in the dog population of study area is shown in Table 3.3.

Month wise prevalence of flea in dog population of Lahore is described in Figure 3.1 which shows that it was highest in August and lowest in November. Similarly, Month wise prevalence of lice in dog population of Lahore is described in Figure 3.2 which shows that it was highest in November and lowest in June.

Table 3.3 Association of various risk factors with the dissemination of wingless ectoparasites in the dog population of Lahore.

Variable	Level	Prevalence
Age	G1, 1-6 Months	30.92%
	G2, 6-12 months	19.16%
	G3, 1-3 Years	11.39%
	G4, More than 3 Years	3.57%
Sex	Male	13.05%
	Female	18.97%
Breeds	Pointer	22.91% (22/96)
	German Shepard	17.18% (22/128)
	Alsatian	54.93% (434/790)
	Russian	34.14% (28/82)
	Cross	6.66% (2/30)
	Labrador	21.42% (6/28)
	Doberman	73.71% (746/1012)
	Bullterrier	42.85% (102/238)
Area	Aziz Bhatti	59.16
	Shalimar Town	62.91
	Wahga Town	59.58
	Samanabad Town	44.16
	Ganj Bakhsh	55.41
	Nishtar Town	46.66
	Iqbal Town	43.6

Location	Ravi Town	42%
	Lahore Cantonment	41.6%)
	Gulberg Town	40.4%
	Urban	38.16%
	Rural	61.83%
Dog keeping	Guard	63.69%
	Hunting	37.5%
	Pet	35.66%
	Stray	80.36%
Season	Summer	29.66%
	Autumn	64%
	Winter	50.33%
	Spring	56.66%

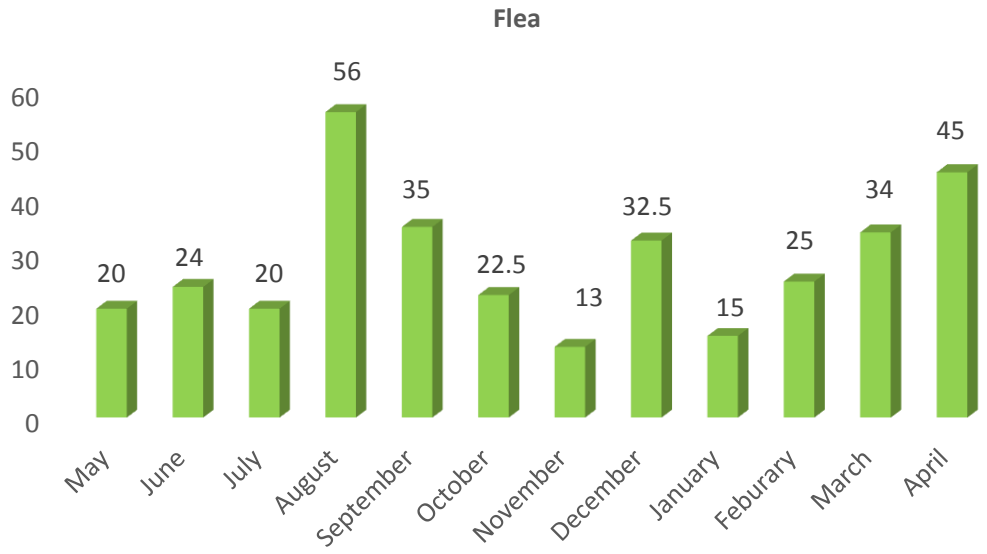

Figure 3.1 Month wise prevalence of flea in dog population of Lahore

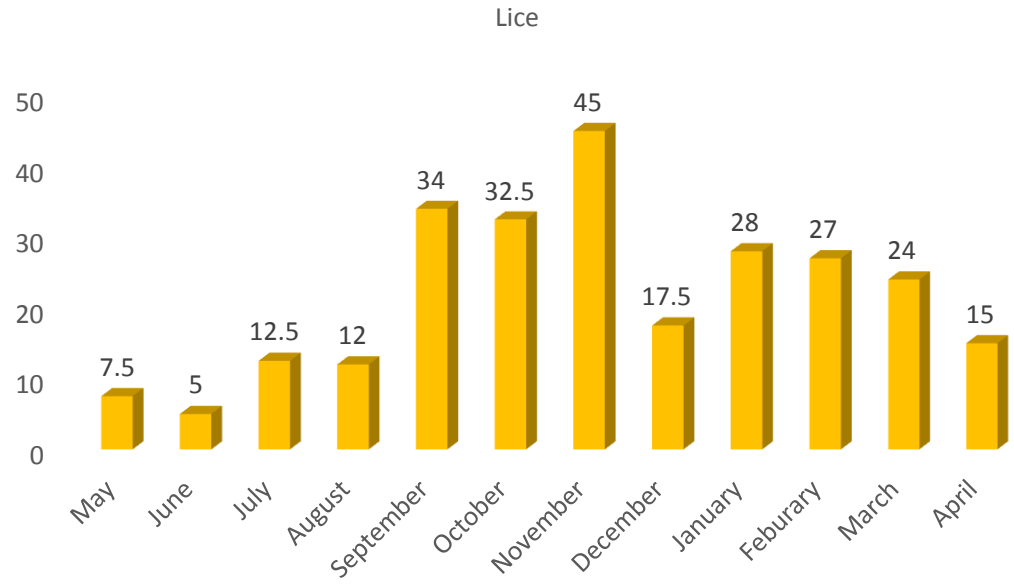

Figure 3.2 Month wise prevalence of lice in dog population of Lahore

Various parts of body of the infested dogs including. hind leg, foreleg, ear, back, abdomen, shoulder, neck, congenital areas and the tail were inspected for the presence of flea and lice. Higher infection/infestation rate was recorded at neck (15%) and lowest prevelance was found to be 1.2% (tail) as shown below in figure 3.3.

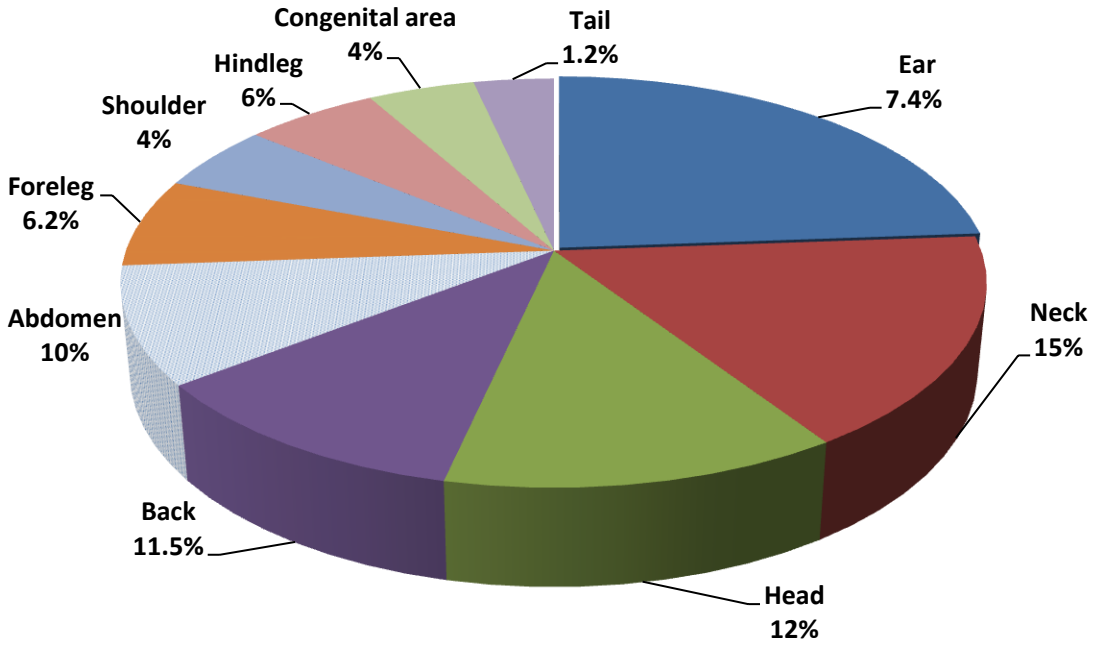

Figure 3.3 Prevalence % of wingless insects at different body sites of dog.

Haematological parameters: A total of 500 random blood samples were taken from juglar vein from infested dogs for comparative study of blood profile of non-infested and infested dogs. The blood profile of infested and noninfested dogs is depicted in the table 9.

Table 3.4 :Hematological values of insects infested dog of Lahore.

Ser. No	Blood parameters	Infested dogs (Mean ± S.E.)	Healthy dogs (Mean ± S.E.)
1	Hemoglobin (g/100ml)	10.79± 0.73	14.5± 0.13
2	Packed Cell Volume (%)	41.02± 0.95	47± 0.22
3	TEC (10^6/mm^3)	5.59± 0.44	6.7± 0.7
4	TLC (10^3/mm^3)	9.97 ± 0.32	13± 0.16
5	Lymphocytes (10^3/ ul)	4.90± 3.2	3.9± 0.87
6	Eosinophil (10^3/ul)	2.10± 1.17	1.10± 0.7

DISCUSSION

In Pakistan, among dog population infestation of wingless insects is a tarnished jeopardy. For studying epidemiological parameters in dog population, research was conducted on the ectoparasitic infestation prevalence and risk that are associated with it. Infested as well as non-infested animals were also observed to determine and analyze the wingless insect impact on hematological parameters that eventually show the threats experience by the owner of dogs in Lahore, Punjab, Pakistan. In the present study, for dogs (56.75%) in Lahore a very high prevalence of wingless insects were recorded. This generality indicates that within the study area wingless insects are very common and there are many problems related to health and usage and performance of these animals as Yonas (2008) and Melkamu,

(2008) support this statement. Factors that have major impact on the growth of wingless insects are temperature fluctuation and humidity at different places. Also observations of Alcaino *et al.* (2002; Aldemir (2007); Beck *et al.* (2006); Rinaldi *et al.,* (2007) support these findings.

In various countries, prevalent fleas species that are infesting the population of dog were reported such as 76 % *C. canis* in Albania as reported by Xhaxhiu and coworkers (2009), 98% infestation rate in Argentina as reported by Gonzalez and coworkers (2004), 69 % infestation rate in brazil (Pilger *et al.,* 2008), 39% infestation in Chile as mentioned by Alcaino and coworkers 2002), 6% infestation rate in Australia (Schloderer *et al.,* 2006), 10% prevelance in France as reported by Franc and coworkers (1998), 42% prevelance in Denmark (Haarlov *et al.,* 1977), and 0.9% infestation rate in Germany as reported by Beck and coworkers (2006). Some other fleas species which are most prevelant in dogs are P. irritans (prevelannce rate 8%) in Albania as mentioned by Xhaxhiu and coworkers 2009, 85% prevelnce rate of *C. felis* in Australia as reported by Schloderer and coworkers 2006, 81% prevelnce rate of *C. felis* in Austria as observed by Supperer and coworkers 1986, 69% prevelnce rate of T. penetrans in Brazil as reported by Pilger and colleagues (2008), 64% prevelnce rate of *C. felis* in Brazil as has been determined by Rodrigues and coworkers 2008) and 0.1% prevelnce rate of *P. irritants* in Germany as reported by Beck and coworkers (2006).

Prevalence of lice are reported in different countries such as 8.73% prevelnce rate of Heterodoxus spinigera is reportedin Iran as in study of Mosallanejad *et al.* (2012) is reported, in the study of Kumsa *et al.* (2019) a 4 % prevelnce rate of *Heterodoxus spiniger* is reported in Ethiopia, and Ugbomoiko *et al.* (2008) determined 10.6% prevelnce rate of *Trichodectes canis* in Nigeria. Results of studies conducted by other scientist such as Perret *et al.,* (2000); Teel *et al.,* (1996); Springell, (1974); Jouda *et al.,* (2004) also revealed the precence of a variety of factors which determine the percentage of ectoparasitic infestation in animals.

The overall wingless insects' rate of infestation was higher in females than in males. Studies of Edward and Kristensen (1969); Kristensen *et al.* (1978); Alcaino and coworkers (2002) and González and coworkers (2003), also support the observation of greater susceptibility of female wingless insects. For this tendency some female behavioural factors would be responsible for this susceptibility. The most important female behavioural factor is hampering of females during breeding period could favor re-infestations by wingless insects in the nearby surrounding areas. Other factor is the longer lifespan of female than males. Males as compared to female individuals spend more times off the host and that is why more susceptible to starvation. Among young and adult dogs there is a noteworthy difference ($P < 0.05$) detected in prevalence of ectoparasite infestation (Eckstein & Hart 2000). The reason may be the poor immune system in old and young dogs that also favours the wingless insects to grow at animals that may be the cause of increase infestation rate in these animals.

Wingless insect specially high fleas load were found in dogs throughout the period of rainy as well as dry months respectively.Maximum temp and minimum temp seemed to effect the population of flea while is was problematic to isolate temperature effect due to rainfall.Temperature in range of maximum lower and higher minimum,heavy load of flea was obsereved during this time.

Sedentary habits of female dogs during their care of offspring is also consider s a fact that newborns were infested by flea. Correspondingly in reference to gender female dogs were more prone to ectoparasites as compared to male dogs.while comparing their ages adolescents dogs were more susceptible than the adult and young ones. .Adult dogs were highly infected by ectoparasites as compared to young dogs.Adolescents dogs were more susceptible than other as they freely left for roaming arbitrarily influencing them to come in contact with flea while attention and special care is given to young dogs so are less likely to be infested by flea.

Breeds such as Alsatian and mixed shows lower infestation in comparison to stray dog infestation. These conclusions with respect to local and exotic breed reported high infestation of flea in local breeds. Alsatian dogs were kept by people providing attention such as sanitation and their health care due to their ability to afford all the expenses for such a exotic breed.Economical impact of Alsatian dogs are high due to their services and efficient intelligence than others.

Most crossbreeds and mixed breeds are more exposed to flea due to recurrent contact with fleas. Temperature and humidity fluctuation within the study area divided into four different seasons. Development of wingless insects was favoured by different type of season (Soulsby, 1982).This enhances the no of flea and lice in summer and winter respectively.

In the current study, the problem of ectoparasite during respective months of the study period stayed identical, which was due to equal consideration of the owner throughout the entire year but a little changes in warm season has been perceived.During sampling in warm season as in spring and summer the rate of overall ectoparasites was considerably increases.

In Egypt in comparison to warm and cold seasons a large number of wingless insects were found in spring and summer. Amin (1966). Higher temperature and increase in humidity, from November-May that were the most deliberated favourable months for *C. canis*, while from July-October the unfavourable period was due

to lower temperature and decrease in humidity. In El Cairo Amin (1966) discussed about the peaks of wingless insects and their abundance one peak for spring as a consequence increase in temperature following winters and the other peak as a outcome due to increased in humidity subsequently summer. Our interpretations indicates that species of wingless insects found on domestic/stray dogs in lahre Pakistan during the whole year but the population of *C. canis* increses in higher temperature season (spring and summer)

Total erythrocyte counts (TEC) were considerably lower in infested animals in comparison to healthy one.erythrocytes were consumed by wingless insect and hence indicates the patent detoriation while RBCS counting has been reported. Previously have also stated decreased in erythrocyte/RBC count in case of wingless insects in dogs (Hogg, 1979; and Sharma *et al*., 1990). In infested animals, the level of haemoglobin was considerably lower in animals infested by parasites because of low rbcs count and HCV(Jain, 1986) or because of toxaemia affected by wingless insects (Pas'Ko & Chotchaev, 1974). PCV was also decreased in infested animals which may leads to decrease in cellular contents after infestation in blood. Eosinophilia representation shows the allergic reaction by infestation of lice and flea and due to immune system activation (Jain, 1986).

In conflicting to the findings of current study, Chineme *et al*. (1979) detected that animals having parasitic infestation has no change in the blood. The cause of discrepancy may be accredited to the fact that animals having balanced nutritious diet there will be no ill effect produced in blood profile. Considerably lower values of Erythrocyte Sedimentation Rate and TP were detected in groups of dogs of good health in comparison to the infested group.

Prevalence with reference to urban and rural areas, wingless insects in rural areas has high prevalence as compared to urban areas, as pet/dogs are mostly retained in close locality of other animals also including ruminants.Moreover, dog may reach the infestation from the piles of animals dung, as it was the primary source for growth of larval stages of wingless insects.

No substantial disparity was perceived in the 10 towns of Lahore. Because of identical enviornmental condition and good husbandry management/practices in the study zone. Furthermore, the geographical locality of the area is such that, there is no inconsistency of in the environment.

Considerably, high prevalence of wingless insects due to wandering habits in stray dogs at different places. Wingless insects were taken by dogs and can be the source of transmission and cause of high prevalence in the vicinity. In guard dogs 2nd highest prevalence was noted, which was because of the captivity of these stray dogs at the specific habitation. In the current study, the load of wingless insects during respective month of the experimental period remained identical, which was due to equal consideration of the owner throughout the whole year.

Recommendations and conclusions: On the basis of the results of the present research it is highly recommended that a sustainable but effective ectoparasites control programm should be developed to avoid the transmission of diseases of zoonotic concerns in pet owners also for the wefare of the dogs as well. For this a wide scale extension programm should be provided for the awareness of dogs owners.

Following recommendations are: Results of the study revealed that the dog breeds which are less vulnerable to wingless insects and have high resistance against these parasites should be selected for breeding.The cost of anthelmentics should be kept lower in case if less susceptible dog breeds are used in breeding programm. Dogs should be given specia care and attention before the onset of summer to avoid fleas and lice infestation. Furthermore, precautionary therapeutic measures should also be followed to minimize the infestations in summer.Insects habitat controlling management can successfully used by lice and flea management programms.Further research on role of insect infestation in prevailing the protozoan diseases and estimatimated economic/welfare losses of dogs should be planned in localaties having high risks of infestation.

Moreover, a widespread epidemiological survey and future research should be planned for dog population of Lahore to conduct cost effective research techniques to provide the baseline data for an effective parasitic control programme in this large city of Pakistan and also generating information about the unforeseen pandemics in future.

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