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Research Article

A STUDY ON EFFECT OF AGE, BREED AND SEX ON BLOOD SUGAR LEVEL OF DISEASED DOGS

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ABSTRACT: A study was conducted on the dogs with moderate to serious illness coming for treatment at the Dog Ward of West Bengal University of Animal and Fishery Sciences, West Bengal, India, to find out possible correlation between fasting blood sugar level with breed, sex and age of dogs. The study result implicated that the blood sugar level was not having any general tendency to increase with advancement of age of ailing dogs. The blood sugar level of ailing dogs was higher in small breeds of dogs, particularly in 0 to <4 year age group. The large breeds showed highest level of sugar in blood in disease condition at above the age 12 years or more. The blood sugar level of ailing dogs had a gender bias, as it was found more in females than males in all breeds and age groups.

Key Words: Dog, Blood sugar, Disease.

INTRODUCTION

The ailing dogs arriving to the hospitals with moderate to severe level of illness are expected to have different blood sugar level than normal dogs. In one side, infections in the body can drive blood sugar levels high. On the other hand, dogs with moderate and severe level of disease may not eat food sufficiently, so the fasting animals may have a reduced level of blood sugar. It was postulated that infections or diseased conditions can modify blood sugar levels, which may be due to pancreatitis resulting inability to produce insulin (www.petmed.com./dog/high blood sugar), influence of change of intestinal microflora (Akerblom *et al*., 2002). The gut immune system likely plays a central role in the pathogenesis of type 1 diabetes, because accumulating evidence suggests that the manifestation of autoimmune diabetes can be modifed by factors which influence the gut immune system. (Vaarala 1999). The gut and the pancreas are probably immunologically as well as anatomically linked and influenced by environmental factors such as intestinal microflora, infections and dietary factors. The

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environmental risk factors that are frequently implicated in type 1 diabetes are enteroviral infections and exposure to cow's milk proteins, both trigger the gut immune systems (Akerblom *et al.*, 2002).

Although extensive pancreatic damage is responsible for the development of diabetes in 28% of diabetic dogs, evidence of acute or chronic pancreatitis is found in a larger proportion (40%) of diabetic dogs. Obesity affects one quarter to one third of dogs presented to veterinary practices (Mason 1970, Anderson 1973, Edney and Smith 1986) and is associated with increased risk of pancreatitis (Hess *et al.,* 1999). As pancreatitis appears to be a common cause of diabetes in dogs (Alejandro *et al.,* 1988), this relationship between obesity and pancreatitis in dogs has relevance to the pathogenesis of canine diabetes (Rand *et al*., 2004). The majority of diabetic dogs appear to have a form of type 1 diabetes analogous to the latent auto-immune diabetes of adults (LADA) in humans (Fleeman and Rand 2001). At least 50% of diabetic dogs would be classified as type 1, because this proportion has been shown to have antibodies against beta cells (Hoenig and Dawe 1992, Elie and Hoenig 1995, Davison *et al*., 2003) The remainder probably has 'other specific types of diabetes' resulting from pancreatic destruction or chronic insulin resistance, or they have diestrus-induced diabetes (Rand *et al.,* 2004). The prevalence of diabetes in dogs has been estimated to be 0.32% in the UK (Catchpole *et al.,* 2005). The prevalence of canine diabetes has been estimated to be anywhere between 0.0005% and 1.5% (Catchpole *et al.*, 2005).

It is hypothesized that chronic ingestion of a high-carbohydrate diet promotes obesity and increases the demand on β-cells for insulin secretion, thereby predisposing individuals to hyper insulinemia, apoptosis, β-cell failure, and development of diabetes (Porte 1991). The present study was planned to study whether there is any effect of age, breed and sex on the blood sugar level of dogs in disease conditions. No dogs with any previous report of chronically suffering of Diabetes Mellitus were included in our study.

MATERIALS AND METHODS

Animals: The study was performed on the dogs (*Canis familiaris*) arrieved for treatment during the period of August 2011 to January 2014 in the Dog Ward of West Bengal University of Animal and Fishery Sciences, Kolkata, West Bengal, India with serious illness. The study was performed on 323 dogs. Dogs with no disease or with minute ailments were excluded from the study.

Procedures: Blood samples from the ailing dogs coming for treatment were obtained for estimation of blood glucose level. Glucose was estimated by using GOD-POD method described by Trinder (1969) using commercially available Glucose Test Kit (Span Diagnostics Limited, India). In the test, glucose oxidase oxidizes glucose present in the serum samples to gluconic acid and hydrogen peroxide. In presence of enzyme peroxidase, released hydrogen peroxide is coupled with phenol and 4 – amino antipyrine to form colored quinoneimine dye. Absorbance of colored dye was measured at 505 nm and it is directly proportional to glucose concentration in the serum samples tested.

Study Parameters:

1 . Study of effect of age

For statistical analysis, dogs were grouped

Table 1: Effect of overall age, breed type and gender of ailing dogs on blood sugar (mg/dl).

	Mean Value	Standard Error	No.of observation	P-value
Age (years)				
0 to <4 years	96.85	8.07	65	0.63
4 to <8 years	101.78	6.16	112	
8 to <12 years	89.10	7.76	104	
≥12 years	99.73	10.71	42	
Breed type				
Small	105.60	6.41	116	0.14
Medium	95.24	5.36	166	
Large	81.68	10.79	41	
Gender				
Male	86.10	6.08	128	0.019
Female	104.56	4.92	195	

into four age groups: 0 to <4 years, 4 years to <8 years, 8 years to <12 years and ≥12 years. Then the data analysis was performed to observe the effect of age on all types of ailing dogs, on male and female dogs and also on different breed types of dogs.

2. Study of effect of breed type of dog

The dogs were classified into small, medium and large sized breed dogs. Small breed group included Pug, Lhasa Apso, Pomeranian, Dachshund, Chihuahua and Spitz. Medium breed group included Labrador, Rottweiler, Cocker Spaniel, Golden Retriever, Beagle, Whippet, Dalmatian and Mongril, while large breed group included Alsetian, German Shepherd, Doberman Pinscher, Great Dane and Iris setter.

Then data analysis was performed on small, medium and large dog groups at all ages and also on small, medium and large dogs separately at different age groups.

3. Study of effect of gender

This study was performed by observing the comparative effect of males and females as a whole as well as separately at each age group.

The breed, age and sex of the ailing dogs were noted along with fasting blood sugar level. The collected raw data was analyzed using SAS (1999). Least square mean values of blood sugar have been presented in the Tables.

RESULT AND DISCUSSION

From our study, it appears that there is no direct detectable correlation between age and blood sugar level of ailing dogs (Table 1). But if we proceed towards detail analysis, some very interesting trends come out. In overall breed type analysis, the mean values for small,

Table 2: Effect of breed type in the different age groups of ailing dogs on blood sugar (mg/dl).

	Mean Value	Standard Error	No.of observation	P-value
0 to <4 years				
Small	135.21	14.30	16	0.0097
Medium	85.34	9.19	40	
Large	74.66	20.77	09	
4 to <8 years				
Small	93.18	14.57	22	0.43
Medium	101.38	7.59	81	
Large	71.44	22.78	09	
8 to <12 years				
Small	104.14	10.56	49	0.39
Medium	92.00	12.50	35	
Large	77.95	16.53	20	
≥12 years				
Small	97.24	11.49	29	0.23
Medium	89.40	19.58	10	
Large	158.33	35.75	03	

medium and large breed of dog were 105.60, 95.24 and 81.68 mg/dl, respectively, but the statistical effect was 0.14. It may be due to high variation in the range of data with standard error of 10.79 in the large breed of dogs (Table 1). The smaller breeds had a tendency to have higher blood sugar than medium breeds, and medium breeds had same tendency than the large breeds of dogs in disease condition.

A statistically significant effect (P=0.019) was found on the effect of sex on blood sugar level of diseased dogs. The female dogs had a mean value is 104.56 in contrast to the mean blood sugar of 86.10 for male dogs (Table 1). In the detail group based analysis, in the age group of 0 to <4 years, a significant effect (P=0.056) was observed for sex with the mean values of 80.66 and 109.88 for male and female, respectively (Table 3). The same tendency was found in 8 to <12 years age group (P = 0.10, sugar levels of 79.94 and 104.06 for male and female, respectively) (Table 3). The difference was not significant but wide for the age group of 12 years and more (male 89.06 and female 105.67) (Table 3), but such large difference was not found in 4 to <8 years group (93.88 and 99.61mg/dl. for male and female, respectively) (Table 3).

A highly significant effect (P= 0.0097) was observed in the blood sugar level among the breeds of dogs in 0 to <4 years of age group. The estimated values of least squire means for

Table 3: Effect of gender in the different age groups of ailing dogs on blood sugar (mg/dl).

Gender	Mean Value	Standard Error	No.of observation	P-value
0 to <4 years				
Male	80.66	11.21	30	0.056
Female	109.88	10.06	35	
4 to <8 years				
Male	93.88	10.32	44	0.66
Female	99.61	8.30	68	
8 to <12 years				
Male	79.94	11.74	39	0.10
Female	104.06	9.09	65	
≥ 12 years				
Male	89.06	16.25	15	0.41
Female	105.67	12.11	27	

Table 4: Effect of age of the males and females ailing dogs on blood sugar (mg/dl).

	Mean Value	Standard Error	No.of observation	P-value
Male				
0 to <4 years	80.66	7.36	31	0.64
4 to <8 years	91.54	6.10	44	
8 to <12 years	82.15	7.47	39	
≥12 years	89.06	10.92	15	
Female				
0 to <4 years	135.21	18.85	16	0.76
4 to <8 years	100.17	15.26	22	
8 to <12 years	101.44	13.16	49	
≥12 years	97.24	15.26	29	

small, medium and large breed of dogs of this age group were 135.21, 85.34 and 74.66, respectively (Table 2). Though not significant (P= 0.39), but the same type of decreasing tendency was also found in the 8 to <12 years age group with mean values of 104.14, 92.00 and 77.95 for small, medium and large breed of dogs, respectively (Table 2). But in the 4 to <8 years age group, the blood sugar level of small breeds was more than large breeds, but

medium sized breeds showed highest level of blood sugar (93.18, 101.38 and 71.44 for small, medium and large breeds, respectively) (Table 2). Interestingly, in the highest range of age (12 years and above), the result was opposite. The medium breeds had lowest level of sugar followed by small breeds and then large breeds (small 97.24, medium 89.40 and large 158.33). In that age group, the large breed of ailing dogs showed a high level of blood sugar (mean value was 158.33) (Table 2).

It was observed that among the large breeds of dogs, the blood sugar level increased with advancement of age (P= 0.0034), and particularly above 8 years of age. The mean values were 74.66, 71.47, 80.71 and 158.33 for 0 to <4, 4 to <8, 8 to <12, and 12 and more ages, respectively **(**Table 5). But among the small breeds, the mean value was highest in 0 to <4 age group and then decreased (135.21, 100.17, 101.44, and 97.24) (Table 5). On the other hand, the highest value was found in the 4 to <8 years age group among the medium sized breeds (107.82) (Table 5).

A very little number of reports of systematic study on blood sugar of dogs are available, and study on blood sugar level of ailing dogs is scanty. So our study report may be compared with the previous studies related with canine diabetes. It is reported that diabetes typically occurs in dogs between 5 and 12 years of age, with a median age of 9 years, illustrating that canine diabetes is generally a disease of middle-aged and older dogs (Catchpole *et al.*, 2005). In a study for insurance claim for dog diabetes, it was found that the mean age at 1st insurance claim for the diabetic dogs was 8.6 years (Tove Fall *et al.*, 2007).

Table 5: Effect of age of the different breed types of ailing dog on blood sugar (mg/dl).

	Mean Value	**Standard Error**	**No.of observation**	**P-value**
Small breeds				
0 to <4 years	135.21	18.85	16	0.39
4 to <8 years	100.17	15.26	22	
8 to <12 years	101.44	13.16	49	
≥12 years	97.24	15.26	29	
Medium breeds				
0 to <4 years	85.34	9.40	40	0.077
4 to <8 years	107.82	7.00	81	
8 to <12 years	75.62	12.27	35	
≥12 years	89.40	20.17	10	
Large breeds				
0 to <4 years	74.66	11.56	09	0.0034
4 to <8 years	71.46	8.95	15	
8 to <12 years	80.71	9.27	14	
≥12 years	158.33	20.03	03	

Fig.1: Effect of overall age of ailing dogs on blood sugar (mg/dl).

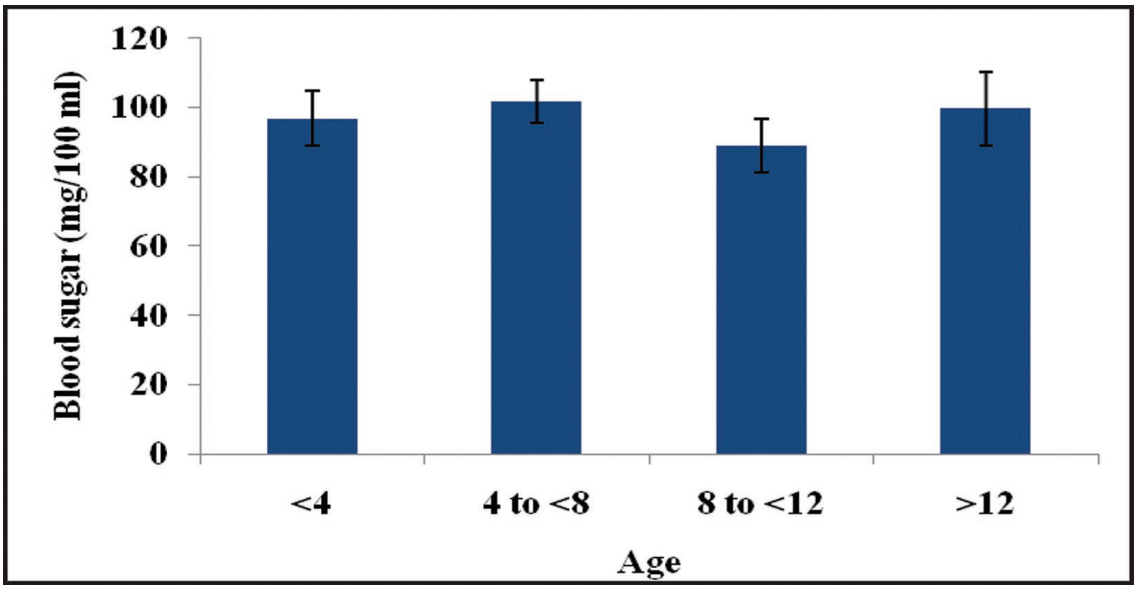
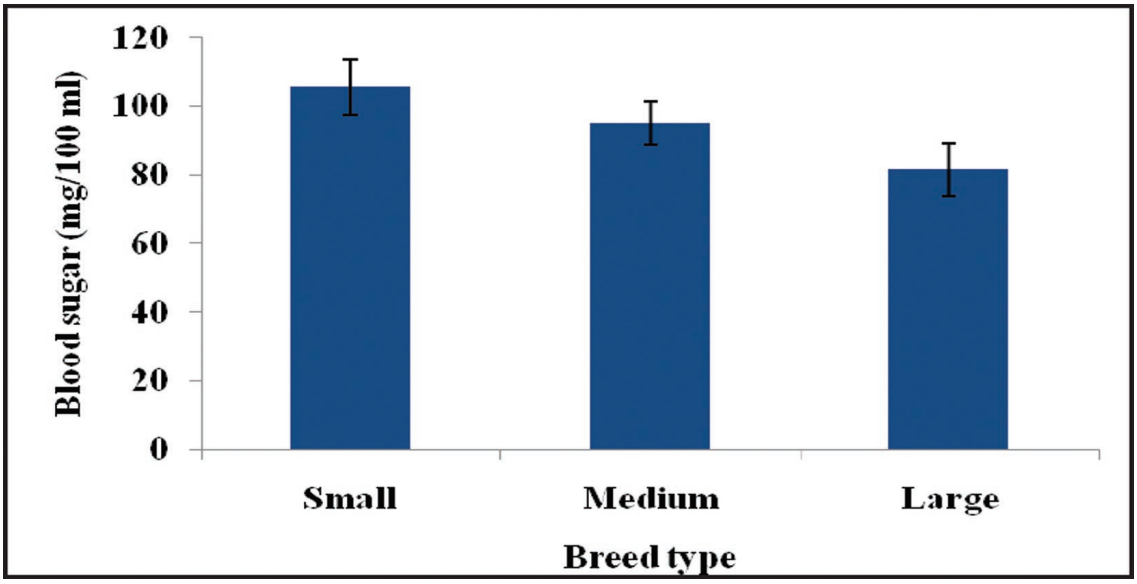


Fig.2: Effect of breed type of ailing dogs on blood sugar (mg/dl).



In our study, we did not find any such correlation of increase level of blood sugar in middle or older aged ailing dogs as a whole (Table 1 and Fig.1), but the highest level of blood sugar was found in the 0 to <4 year age group among small sized dogs (mean value 135.21), 4 to <8 year age group among middle sized dogs (mean value 107.82) and 12 years

Fig.3: Effect of gender of ailing dogs on blood sugar (mg/dl).

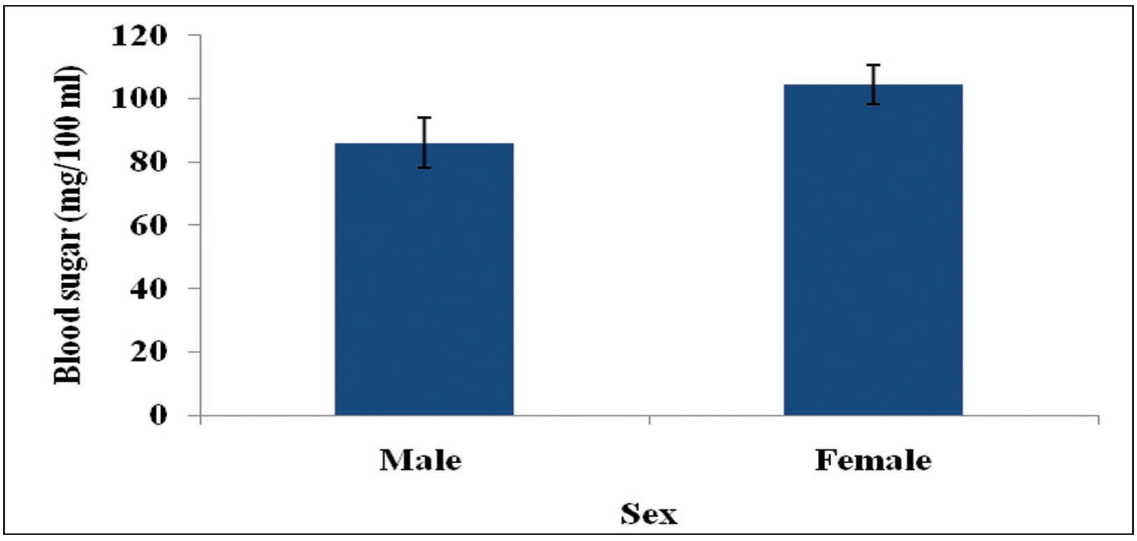
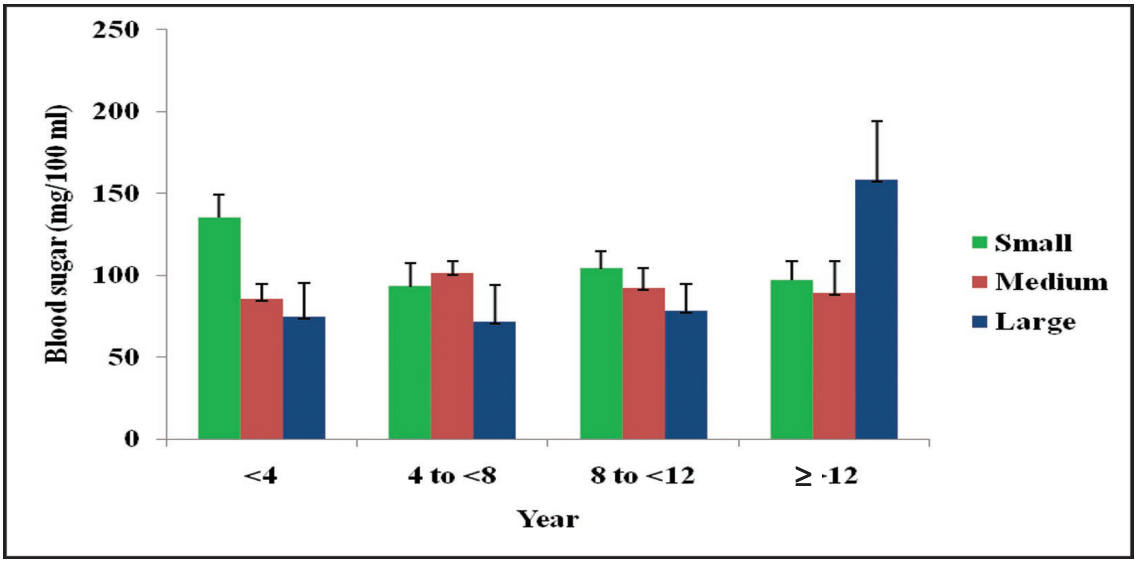


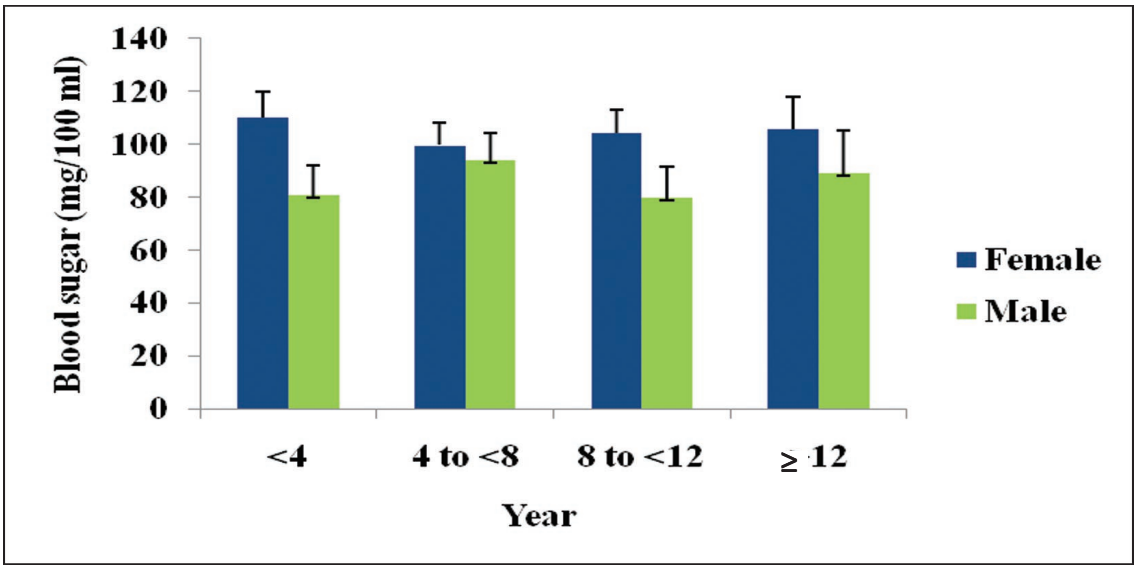
Fig.4: Effect of breed type in different age groups of ailing dogs on blood sugar (mg/dl).



and above age group among large sized dogs (mean value 158.33). (Table 5).

Though female ailing dogs showed a tendency of having higher level of blood sugar irrespective of age than male (Table 4), the study reveals that dogs, as a species, failed to show any significant effect of age on blood sugar level during illness (Table 1). This result did not correlate the previous study performed on dogs for identification of diabetes, as stated

Fig.5: Effect of gender of ailing dogs of different age groups on blood sugar (mg/dl).



earlier. Small type of dogs showed higher level of blood sugar at 0 to <4 year of age group in our study (Table 5), but according to the previous reports juvenile onset of diabetes is not common in dogs (Catchpole *et al*., 2005) though most of the cases of diabetes in dog is due to Type 1 diabetes with antibodies against beta cells (Rand *et al*., 2004).

In previous reports of study on canine diabetes, breed of dogs is considered as a predisposing factor for diabetes (Catchpole *et al.*, 2013). Breeds predisposed to diabetes include the Samoyeds, Tibetan Terrier and Cairn Terrier (Catchpole *et al.*, 2008), Australian Terriers, Swedish Elkhounds, and Swedish Lapphunds (Tove Fall *et al.*, 2007), Miniature Schnauzers, Miniature Poodles, Pugs, Toy Poodles (Hess *et al.*,2000), Beagles, Dachshunds (www. petmed.com, High blood sugar in dogs 2013), Cocker Spaniel, Keeshounds (Ehow.com, Signs of hyperglycemia in dogs 2013).

Boxer, German Shepherd and Golden Retriever dogs are likely to be less susceptible (Catchpole *et al.*, 2008). Diabetes is seen infrequently in Cocker Spaniels, Shepherds and Collies, (http://www.diabetes.co.uk/info/DogsWithDiabetes.htm 2013), Cavalier King, Charles Spaniel, Doberman, Jack Russell Terrier, Labrador Retriever, Mixed Breed, Rottweiler, West Highland Terrier (Wikipedia Diabetes in dogs 2013).

Breed differences in susceptibility to diabetes mellitus in dogs suggest an underlying genetic component to the pathogenesis of the disease and associations were found with three specific haplotypes. This haplotype is common in diabetes-prone breeds (Samoyed, Cairn terrier and Tibetan terrier) but rare in diabetes resistant breeds (Boxer, German shepherd and Golden retriever), which could explain differences in the prevalence of diabetes in these different

breeds (Catchpole *et al.*, 2008). Diabetes mellitus in dogs has been associated with major histocompatibility complex (MHC) class II genes (dog leucocyte antigen; DLA), with similar haplotypes and genotypes being identified in the most susceptible breeds (Catchpole *et al.*, 2013).

The blood sugar pattern of ailing dogs has some levels of similarity with previous reports of dog diabetes study where differences in breeds have effect on susceptibility to diabetes (Catchpole *et al.*, 2013). The dog breeds with small sized body showed highest level of sugar in blood followed by medium and then large sized dogs as a whole (Fig. 2) as well as in the 0 to -<4 year age group (Fig. 4).

Effect of gender among diabetic dogs was different in different studies. Among the diabetic dogs, females were 72% in a study (Tove Fall *et al.*, 2007), but it was reported 53% in another study (Catchpole *et al.*, 2005). It was also reported that the proportion of females with diabetes varied significantly among breeds. Dogs of Swedish Elkhound, Beagle, Norwegian Elkhound, and Border Collie breeds that developed diabetes were almost exclusively females (Tove Fall *et al.*, 2007). In our study, the female ailing dogs showed higher level of blood sugar as a whole (Fig.3) as well as in different age groups (Fig.5).

CONCLUSION

From our study, it was revealed that the blood sugar level of ailing dogs was higher in small breeds of dogs, particularly in 0 to <4 year age group. The large breeds showed highest level of sugar in blood in disease condition at the age of 12 years or more. The blood sugar level of ailing dogs was found more in females than males in all breeds and age groups.

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