INFLUENCE OF LITTER SIZE, SEX OF THE FETUS AND BREED ON THE BIRTH WEIGHT OF PUPPIES

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[Received: 11.5.2018; Accepted: 19.11.2018]
{DOI 10.29005/IJCP.2018.10.2.123-126}

The study was conducted at TVCC, Nagpur Veterinary College, Nagpur. Prospectively a complete clinical evaluation was done in 60 cases from bitches with the objective to study relationship of litter size with that of mean birth weight of puppies delivered irrespective of breed, size, age and parity. The bitches having single fetuses irrespective of male or female has the highest with mean birth weight of 390.79 ± 26.51 gm followed by 5-8 litter size as 370.00 ± 11.75 gm, more than 8 litter size as 341.40 ± 1.80 gm and it was lowest in bitches of 2-4 litter size as 347.42 ± 23.64 gm with the statistically significant difference within the group. Irrespective of the sex of puppies overall mean birth weight in Pug was 152.50 ± 9.65 gm, 186.88 ± 11.54 gm in Spitz, 130 gm in Lhasa apso, 252.50 ± 1.12 gm in Cocker spaniel, 362.40 ± 3.04 gm in Labrador retriever, 405 ± 6.83 gm in German shepherd, 462.00 ± 2.28 gm in St. Bernard, 456.67 ± 6.74 gm in Great Dane while 525.00 ± 4.28 gm in Doberman breeds. In this the range of litter size from 60 bitches was in between 1- 10 numbers, irrespective of the breed.
Keywords: Birth weight, Bitches, Litter size.

Despite a long history of cohabitation between humans and dogs, there are still many aspects of canine reproduction that are not clearly stated anywhere. Even if there is a rising professionalism in dog breeding, the physiological range of birth weight in canines remains unclear (Groppetti *et al.,* 2017). In human beings, scientific evidence emphasizes the part of birth weight on the welfare of neonate, morbidity and mortality. In canines, normal ranges of birth weight are a harder task to define because of a great morphological variability in breed, size and body weight. Low birth weight can result from either a short gestation period or retarded intrauterine growth or a combination of both (Kramer, 1987) as reported for humans and animals of many polytocous species, including dogs (Wootton *et al.*, 1983).

Successful dog breeding could be defined as the number of puppies produced from one pregnancy, i.e. litter size. Even though mean litter size at birth varies within a breed, information on the expected mean litter size for a particular breed is useful both for breeders and veterinarians (Borge *et al.*, 2011). Moreover, to improve and optimize litter size knowledge of some factors which influence litter size in different breeds is essential.

Based on the hypothesis that the canine breeds and litter size may have a significant impact on the birth weight of the puppies for their survival, the present study was carried out with the aim to define the differences between the breeds, litter size, sex of puppies with that of mean birth weight of puppies.

Materials and Methods

The present research work was conducted at Teaching Veterinary Clinical Complex, Nagpur Veterinary College, Nagpur. The data relating to the present investigation were obtained from 60 bitches irrespective of age, size and breed with the history of completed gestation period. All the selected bitches studied for obtaining the litter size were from 9 different breeds, in which further analysis was done to find out relationship of litter size, breed and sex of puppies with that of mean birth weight of puppies.

Litter size was studied in 60 bitches from 9 different breeds to analyze relationship of litter size with that of birth weight of puppies. Bitches were categorized into 4 groups litter size as single puppy, 2-4 puppies, 5-8 puppies and a litter size having more than eight puppies. Weight of new born

puppies from all sixty bitches was studied relationship of birth weight of with that of breeds and litter size. The collected data was statistically analyzed using Student's T-test.

The data regarding relationship of litter size and mean birth weight from 288 puppies has been recorded and presented in Table-1.

immediately after birth in all puppies to study

Result and discussions

Relationship of litter size and sex wise mean birth weight of puppies:

Bitches (n=60)	Litter size	Puppies (n)	Mean birth wt of female puppies (gm)	Puppies (n)	Mean birth wt of male puppies (gm)	Puppies (n)	Total
19	Single	10	376.00±39.93	9	407.22±33.27a	19	390.79± 26.51a
11	2-4	9	343.33±39.21	22	349.09±29.18c	31	347.42± 23.64c
14	5-8	47	359.04±16.98	41	382.56±16.20b	88	370.00± 11.75b
16	> 8	64	340.16 ±2.71	86	342.33±2.41c	150	341.40± 1.80c
Total = 60	**Overall mean**	**130**	**349.35 ± 7.55**	**158**	**358.54± 7.12**	**288**	**354.39± 4.93**
CD			**--**	**23.66 (p<0.05)**		**18.67 (p<0.05)**	

Table-1: Relationship of litter size and sex wise mean birth weight of puppies

Table.1 presents the relationship of litter size with mean birth weight of male and female puppies studied and found that the bitches having single male fetus had the highest mean birth weight 407.22 ±33.27 gm and it was lowest in bitches in which litter size was more than eight with mean birth weight of 342.33 ± 2.41gm with significant difference within group (Fig.1).The bitches having single fetus irrespective of male or female fetus has the highest mean birth weight of 390.79 ± 26.51 gm.

A large dog may give birth to more number of puppies while the relative size of the foetus is larger in bitches of smaller breeds than that of larger breeds. But at some point, the linear correlation between litter size and breed size must level out due to biological factors, such as limited space in the uterus and a limited number of teats as also reported by Dodamani *et al.* (2017).

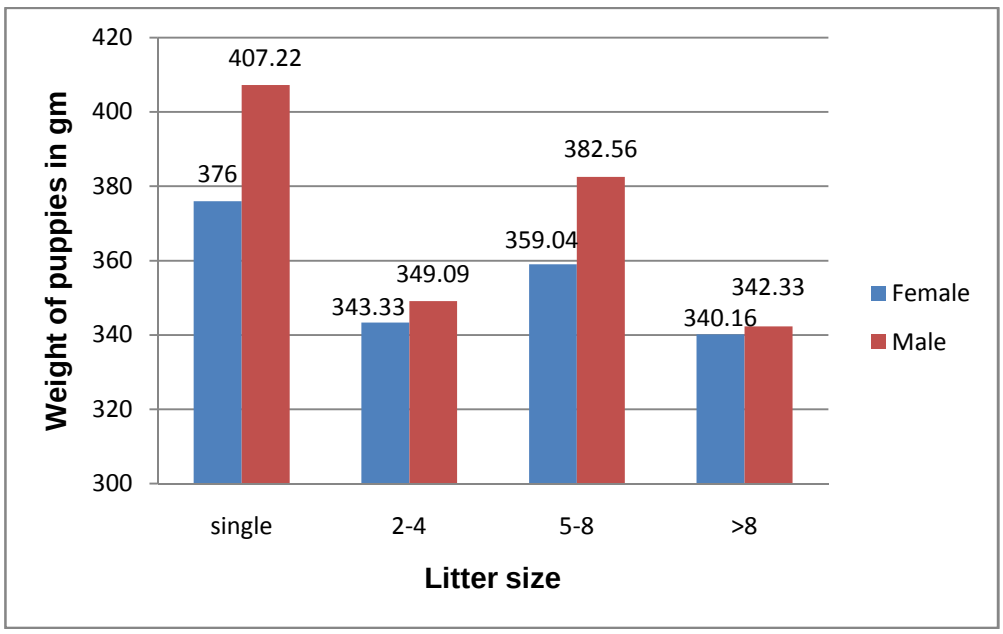

Fig.1 Relationship of litter size and sex wise birth weight of puppies

To date, despite the growing interest in breeding and selecting purebred dogs, no studies are available on the effect of birth weight affecting litter size and neonatal mortality as also mentioned by Dodamani *et al.* (2017). Birth weight is considered as an important survival determinant in most mammalian species as also recorded by Gatel, *et al.* 2011). Low birth weight is accompanied by immature development and adaptive postnatal failure that can predispose to neonatal mortality as also reported by Tonnessen *et al.* (2012).

Breed and sex wise mean birth weight puppies:

The breed wise data regarding birth weight of puppies recorded and presented in Table-2.

Table-2: Breed and sex wise mean birth weight of puppies

Name of breed (n=60)	Female puppies (n)	Mean birth wt of female puppies(gm)	Male puppies (n)	Mean birth wt of male puppies(gm)	Total puppies (n)	Overall mean birth wt of puppies (gm)
Pugs (n=6)	12	151.25±11.17^{d}	08	154.38±17.35^{e}	20	152.50±9.65^{e}
Spitz (n=4)	02	175.00±31.82^{d}	06	190.83±7.40d^{e}	08	186.88±11.54^{e}
Lhasaapso (n=1)	01	130	----	----	01	130±0.0
Cockerspa.(n=1)	00	----	02	252.50±1.77^{d}	02	252.50±1.12^{d}
Lab.Ret.(n=31)	88	362.16±4.28^{c}	110	362.59± 4.26^{c}	198	362.40±3.04^{c}
German Shepherd (n=13)	20	397.00±8.35^{bc}	22	412.27± 10.35^{bc}	42	405.00±6.83^{c}
St.Barnard (n=1)	02	446.01± 0.04^{b}	03	463.33± 3.60^{ab}	05	462.00± 2.28^{b}
Great dane (n=2)	2	447.50± 8.84^{b}	4	461.25± 8.90^{ab}	6	456.67± 6.74^{b}
Doberman (n=1)	3	525.00 ± 6.24^{a}	3	525.00± 4.71^{a}	6	525± 4.28^{b}
Over all mean	**130**	**349.35±7.55**	**158**	**358.54 ± 7.12**	**288**	**354.39 ± 4.93**
CD	**83.51 (p<0.01)**		**93.14 (p<0.01)**		**62.30 (0<0.05)**	

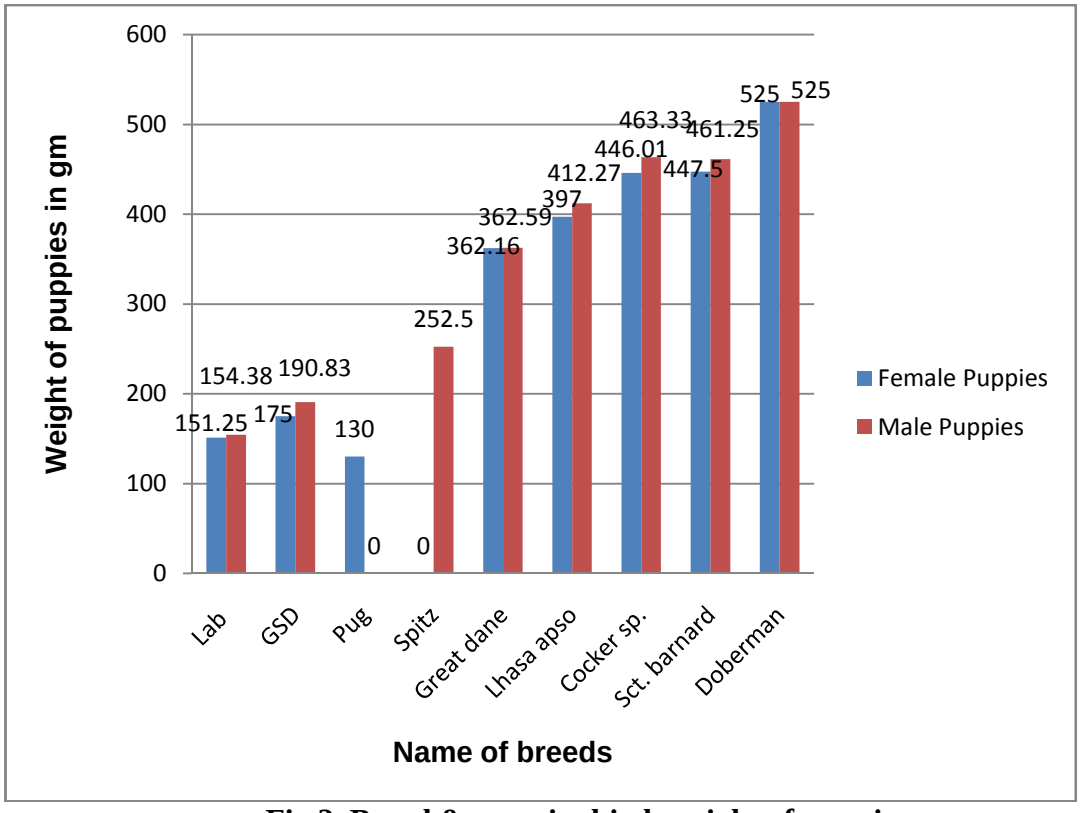

Fig.2. Breed & sex wise birth weight of puppies

Table 2 presents that, 60 selected bitches delivered more male puppies (158) than female (130) puppies and the male female ratio was 1 male to 0.822 female puppy. In contrast with the present findings, Oluwatoyin *et al.* (2012) reported more number of female puppies as compared to male puppies as 1.25 females to 1 male puppy. Some other authors also submitted contrary statement with the present findings and stated that there were usually many more females than males during the research investigation and further stated that sometimes there could be litters with all males or all females.

Data regarding relationship of the 9 breeds with the mean birth weight of the puppies in sixty bitches and found that the overall mean birth weight of male puppies irrespective of breeds was 358.54 ± 7.12 gm significantly higher ($p<0.01$) than the mean birth weight of female puppies (349.35±7.55 gm) using ANOVA one way classification of data. Table 2 also revealed that irrespective of sex of puppies highest mean birth weight was found in Doberman breed which was 525.00 ± 4.28 gm (Fig.2)

Besides, the size of the breed, the birth weight of new born is also reported to be influenced by variety of factors such as genetics, environment, nutrition and fetal uterine position as also reported by Bautista *et al.* (2015). Nielen *et al.* (2001) reported the definite role of genetics influencing the birth weight in case of boxer puppies. Further, birth weight was related to maternal size, weight and age as well as breeds and litter size with heavier puppies in small rather than larger litter from medium sized breeds as also reported by Gropetti *et al.* (2017).

The study has confirmed the hypothesis that larger breed bitches produce more litters even if there was a large intra-individual variations in the number of pups born in individual breeds. Additionally, the gender ratio in the puppies born in the analyzed breeds was almost equal, despite the fluctuations in the individual breeds.

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