
Growth of Australian Cattle Dog puppies in the neonatal period and its relation to birth and parent weight and litter size.

Crescimento de filhotes da raça Australian Cattle Dog no período neonatal e a relação com peso ao nascer e dos pais e tamanho da ninhada.

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ABSTRACT

The monitoring of behavior as well as growth and development during the neonatal period allows to guide the health of the puppies, contributing to the adoption of measures capable of reducing risks and thus contributing to animal welfare. The aim of this study was to identify relationships between growth, birth weight, mean number of puppies in the litter and weight gain of Australian Cattle Dog (ACD) puppies in the first 45 days of life with parental weight. The study was conducted in a prospective, longitudinal manner, 17 8 litters born in 2020, totaling 100 pups, a 1.17:1 male/female ratio was observed, in a FCI kennel. The mean number of pups per litter was 5.88 and mean birth weight was 258.98g. Lower birth weight and lower weight gain indicate diminish performance in the period. Average daily weight gain was strongly related to the average birth weight.

Keywords: Dog 1; Growth Curve 2; Cinology 3;

RESUMO

O acompanhamento do comportamento bem como do crescimento e desenvolvimento durante o período neonatal permite orientar a saúde dos cachorros, contribuindo para a adoção de medidas capazes de reduzir os riscos e assim contribuir para o bem-estar animal. O objetivo deste estudo foi identificar relações entre crescimento, peso ao nascer, número médio de filhotes na ninhada e ganho de peso de filhotes de cães da raça Australian Cattle Dog (ACD) nos primeiros 45 dias de vida com o peso dos pais. O estudo foi realizado de forma prospectiva, longitudinal, 17 8 ninhadas nascidas em 2020, totalizando 100 filhotes, uma relação macho/fêmea de 1,17:1 foi observada 9, em um canil FCI. O número médio de filhotes por ninhada foi de 5,88 e o peso médio ao nascer foi de 258,98g. Menor peso ao nascer e menor ganho de peso indicam diminuição do desempenho no período. O ganho de peso médio diário foi fortemente relacionado ao peso médio ao nascer.

Palavras-chave: Cão 1; Curva de Crescimento 2; Cinotecnia 3.

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INTRODUCTION

The Australian Cattle Dog (ACD) is a Cattle Dog classified in Group 1 section 2 (FCI, 2021; DIAS, 2019; SERPELL and DUFFY 2014). Selected based on the need for a resistant dog to drive cattle in adverse conditions, the breed has fixed characteristics of medium size, robust and agile (AKC, 2020; FCI, 2012; CICCARELLI et al., 2021) having the size defined in the standard of 43 cm. to 51 cm measured at the withers. Smooth, double-coated dog with a short, dense undercoat (FCI, 2012).

Obtaining specific growth rates for each breed throughout life is particularly relevant in the early stages, including the neonatal period. Characteristics such as birth weight, average number of pups per litter and average and daily weight gain patterns, contribute to a personalized zootechnical management and to reduce the high losses observed in the species, helping owners, breeders, management routines and veterinarians in clinical practice. (Mila et al., 2017; Mila et al., 2015; Lawler, 2008).

Specific information on ACD is scarce and it is known that dogs with different morphological characteristics have developmental patterns influenced not only by size in adulthood, but also by temperament and coat type, resulting in different growth curves (PETERSON, 2011). Analysis of the growth and development of pups in the neonatal period will contribute to the reproductive success and conservation of the breed.

Growth curves available in the canine species are related to breed, age, sex and food, and it is important to know the expected patterns not only in the neonatal period, but also in the other phases of the animal's life. Such conservation are able to provide relevant studies both for nutritional studies and development in genetic improvement and pure breeds (TRANGERUD et al., 2006; ARDELEAN, 1999; HOSKINS, 1999). The aim of this study was to relate weight to weight, mean number of puppies in the litter and weight gain of Australian Cattle Dog puppies in the first 45 days of life with parent weight.

MATERIAL AND METHODS

The study was conducted in a prospective, longitudinal manner, including 17 litters of Australian Cattle Dogs born in 2020, in a kennel located in the city of Pelotas,

registered in the CBKC/FCI system. The parents were weighed using a digital scale and measured by measuring the height at the withers (cm) using a rigid meter. Such data were obtained prior to coverage. The animals received uniform handling, super premium feed and periodic control of endo and ectoparasites and during the gestational period, abdominal ultrasound examinations were performed at 30 and 55 days after mating for monitoring and review of the fetuses. The delivery was monitored and the pups were weighed at birth using a portable digital scale with a precision of 3 houses. The vitality of the pups was analyzed using the modified APGAR test (VASSALO et al., 2015; VERONESI, 2016) at 1 and 60 minutes after birth. Litters whose delivery was normal, without interventions and whose pups presented APGAR scores between 7 and 10 were included in the study. The weighings were repeated after 12 and 24 hours of birth using a precision digital scale. A daily monitoring routine was established, keeping the weighing time uniform until the 45th day of life.

In order to analyze the data obtained, the litters were grouped according to the number of pups and the results obtained were tested for normality using the Shapiro Wilk test; to homoscedasticity by the Hartley test and to the independence of the residuals by means of graphical analysis. Then, they were submitted to analysis of variance using the F test ($p \leq 0.05$). With statistical significance, the effects of litters were compared using the Tuckey test ($p \leq 0.05$).

To establish the growth behavior of each of the groups, the average weight of the pups in relation to the days of weighing were adjusted through the regression model ($p \leq 0.05$): $y = y_0 + ax + bx^2$, where y =response variable ; y_0 = corresponding response variable at the minimum or maximum point of the curve; a = maximum estimated value of the response variable; b =slope of the curve; x =day after birth.

Pearson's correlation was performed between the variables mean daily weight gain (GPMD), number of pups (NF), birth weight (PN), mother's weight (PM), father's weight (PP)

RESULTS AND DISCUSSION

All parents showed measurements within the stipulated breed standard (FCI). Dams aged between 18 and 70 months, of which eight primiparous, seven mothers of second birth and two of third partuition were evaluated. The average weight of mothers at the time of mating was 13.5 ± 1.4 kg (ranging from 10.4 to 16.7 kg) and the average weight of fathers was 16.05 ± 1.67 kg, (ranging from 13.1 to 18.5 kg).

In all, 17 litters born in 2020 were followed, totaling 100 puppies, 54 males and 46 females. In our study a 1.17:1 male/female ratio was observed. The ratio of 1:1.25 (male/female) showed a higher proportion of females in the local Nigerian population studied by Ajala et al. (2012), and Grailovic et al. (2008) observed values close to 50% of males in the Drever breed. Tedor and Reif (1978) suggested that the ratio between males and females may have a genetic origin, being influenced by breed.

The mean number of pups per litter was 5.88 ± 1.93 , with litters ranging from 2 to 10 pups. Gavrilovic et al. (2008) point out the influence of the number of litters and the mother's age on litter size.

The mean weight of the pups at birth was 258.98 ± 47.19 g). In his study, Alves (2020) when evaluating different pure breeds, obtained results in pure breeds of Group I (FCI) in the Shetland Shepherd breed with 4 puppies and weight between 200 and 280 g; Belgian Shepherd Laekenois with litters between 6 and 8 puppies and average weight ranging from 240 to 410 g and the Old English sheep dog breed with litters ranging from 2 to 10 puppies and weight between 265 and 500 g. Mutembei et al. (2000) reported in their studies litters with an average number of 6.34 ± 0.4 , ranging from 1 to 14 pups, while Chatdarong et al. (2007) observed litters with an average of 6.6 ± 2.8 pups with mean weight of 505.9 ± 77.3 g also in the German Shepherd breed, emphasizing in their observations the effect of the breed on the number and mean weight of puppies. Although dogs can also be grouped by size, it is possible to observe significant differences in puppies' birth weights (Mugnier et al, 2019)

The registration, identification and control of risk factors are essential for the full reproductive success of purebred dogs. Low birth weight is recognized as a risk factor in the neonatal period (INDREBO et al., 2007; GROPETTI et al., 2017; MUGNIER et al., 2021)

with an inverse relationship between litter size and average pup weight in animals polytocic (SCHELLIN et al., 2019).

Alves (2020) points out that even in the same litter, puppies with heterogeneous weights can be observed. In our study, no significant differences were identified in relation to average birth weight in most groups established by the number of puppies in the litter, which is in agreement with what was observed by Gropetti et al. (2015) litter and birth weight, while Ajala et al. (2012) observed an inverse relationship between the number of pups and average birth weight in their studies (TABLE 1).

A pattern similar to that obtained with birth weight was also observed in the periods evaluated at 21, 30 and 45 days, where it is possible to observe that in the group of 8 pups, with lower mean birth weight, it remained lower (TABLE 1). Alves (2020), when evaluating 345 puppies from 60 litters of 19 breeds, observed that 45% of the followed puppies were able to gain weight from birth, while a third did not show gains or losses greater than 20% in the first 48 hours of life. In our study, 19% of the puppies showed some weight loss in the first 48 hours of life. Although the growth observed in the analyzed population has pointed to differences in relation to the mean values, the observed linear model explains the weight gain of the different groups (Figure 1).

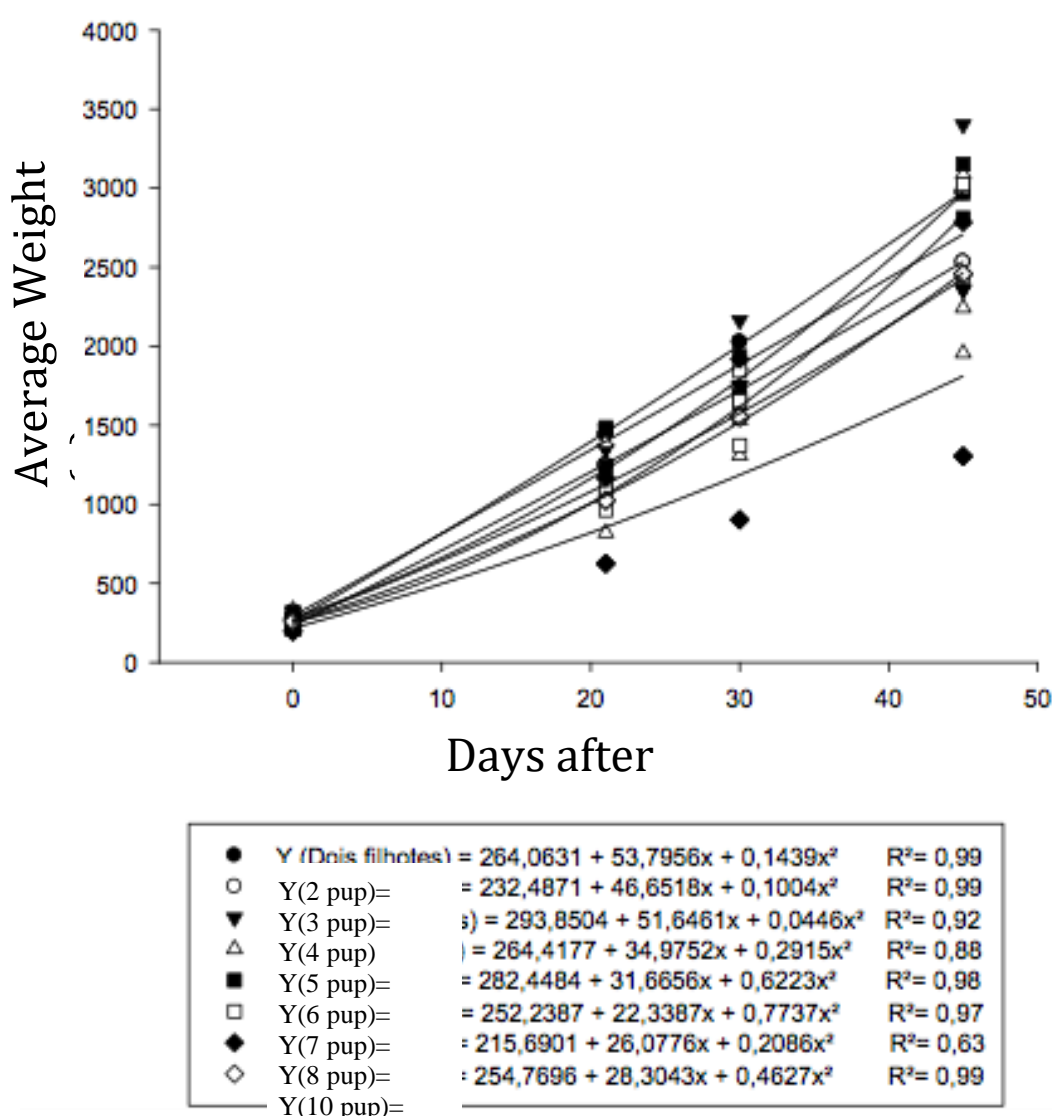
Table 1. Average weight (g) of pups from the eight litter groups, on days (0, 21, 30 and 45 days after birth).

N Pups	N Litters	Days after birth			
		0	21	30	45
Two pups	1	ab 266,50±40,3	a 1.442,0±8,49	a 2.024,5±112,43	a 2.972,0±236,17
Three pups	1	b 234,00 ±8,19	ab 1.247,0±19,80	ab 1.753,6 ±22,63	ab 2.532,5 ±40,31
Four pups	1	a 294,63 ±13,57	a 1.393,2±90,83	ab 1.888,9±108,90	a 2.706,9 ±98,70
Five pups	4	ab 264,07±63,32	ab 1.129,6±289,09	ab 1.573,6±399,42	ab 2.429,2 ±714,14
Six pups	4	a 276,89±39,56	ab 1.256,6 ±257,39	ab 1.753,6±340,57	a 2.977,3 ±565,00
Seven pups	3	ab 252,76±33,88	ab 1.059,3 ±135,80	ab 1.622,4 ±253,99	a 2.823,4±351,02

Eigth pups	2	b 223,63±52,50	b 805,7 ±372,46	b 1.241,3±531,77	b 1,797,8 ±936,25
Ten pups	1	ab 259,33±45,13	ab 1.024,7 ±199,59	ab 1.552,3 ±325,43	ab 2.457,5±544,87
CV (%)		12,78	14,88	15,88	17,18

Means followed by the same letter in each column did not differ, comparing the mean weight of litters on the days of weighing, by Tukey's test ($p \leq 0.05$). Fonte: Dode, Dode e Corcini (2022).

Figure 1. Linear regression analysis of weight in g of different groups of Australian Cattle Dog puppies from birth to 45 days.



Fonte: Dode, Dode e Corcini (2022).

Although birth weight is a characteristic influenced by numerous factors (SCHELLIN et al., 2019; GROPETTI, et al., 2017), weight gain during the neonatal period can be considered an important parameter for identifying puppies at risk, contributing to to adopt support measures and reduce neonatal mortality (KHAM et al., 2009; GROPETTI et al., 2015; MUGNIER et al., 2019)

The average daily weight gain of the pups in the eight groups analyzed during the first 45 days of life ranged from 60.12 to 40.16g. Puppies with lower birth weight and lower weight gain during the period did not achieve the same performance as those whose growth was maximal (Table 2, Figure 1).

The demand for energy and maternal skill in litters with a greater number of pups are higher than those with a smaller number of neonates, favoring more patient and experienced mothers in the management of larger litters.

Table 2. Average daily weight gain (g) of the eight litter groups of Australian Cattle Dog puppies during the first 45 days of life.

Litter	Daily weight gain (g)
Two pups	a 60,12±2,08
Three pups	ab 51,08 ±1,40
Four pups	cd 46,12 ±2,12
Five pups	bc 53,23 ±7,12
Six pups	ab 57,13 ±5,63
Seven pups	ab 57,12 ±3,58
Eigth pups	d 40,16 ±8,85
Ten pups	bc 48,85±4,99
CV (%)	18,14

Means followed by the same letter in each column did not differ, comparing the mean weight of litters on the days of weighing, by Tukey's test ($p \leq 0.05$). Fonte: Dode, Dode e Corcini (2022).

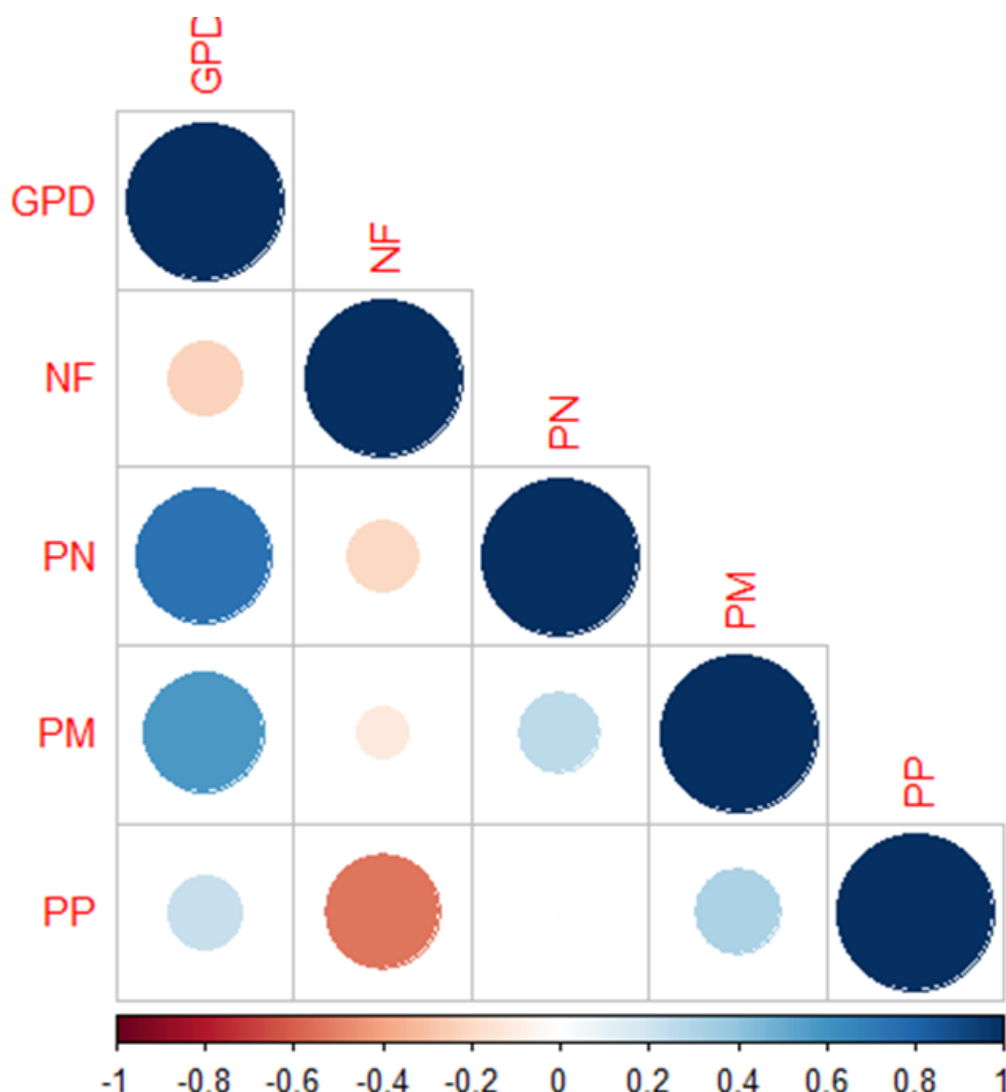
The group of 8 pups, with the lowest average birth weight, maintained a significantly lower weight throughout the evaluated period. A lower average daily

weight gain was also observed (Table 2, Figure 1) corroborating information from Alves (2020) who infers that pups keep their growth within limits, and thus, changes in this pattern are not recovered in the first 21 days of life, a fact that was also observed during the period of our study that followed the groups up to 45 days of life. Litters with larger numbers of pups require higher milk production in order to meet the demand of all offspring. Considerations about individual maternal behavior including during the breastfeeding period were also highlighted by Alves (2020) and Boutigny et al. (2016).

The average daily weight gain in the different groups was more strongly related to the average birth weight and moderately to the mother's weight and weakly related to the father's weight. (FIGURE 3; TABLE 3). In their studies Gropetti et al. (2017) observed a relationship between the mother's weight and size and birth weight in puppies of different pure breeds (FIGURE 2). Willham (1972) highlights that growth from birth to weaning is related to factors intrinsic to the litter and extrinsic in which the mother is included.

Gowane et al. (2014) in their review on sheep highlight the importance of maternal care after delivery. Obtaining an adequate growth curve for the breed can contribute to breeding programs as well as adaptations of zootechnical and nutritional management of the litters, contributing to the preservation of pure breeds.

Figure 2- Pearson's correlation matrix between daily weight gain (GPD) and the variables number of pups in the litter (NF); birth weight (PN), father's weight (PP) and mother's weight (PM).



Fonte: Dode, Dode e Corcini (2022).

CONCLUSIONS

Growth followed by daily weight gain was related to mean birth weight, mother's weight and more weakly related to father's weight. Although the population effectively analyzed in the present study is still small when compared to large population studies developed by different authors, the importance of integral monitoring of the reproductive process of purebred dogs, since reproductive success is not limited to fertilization or the number of puppies born in a litter. Numerous steps must be taken until the puppy overcomes the main risk phases. Thus, the registration and extensive monitoring will

provide veterinary and breeder auxiliary tools and achieve reproductive success in the breed.

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