A Survey of Australian Shepherd Breeding Practices and Genetic Diversity

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Abstract

A survey (n = 186) was conducted to study factors affecting litter size, health testing trends, and genetic diversity in Australian Shepherds. A voluntary Qualtrics survey was distributed via online links through Australian Shepherd Club of America, Australian Shepherd Heath and Genetics Institute, and social media from June through December 2017. Data used in analysis were obtained from survey results except coefficients of inbreeding (CQI), which were calculated using a 10 generation database (BreedMate PedX) from submitted registration names. A mixed model (SAS) was used to evaluate main effects of breeding method, dam weight, dam age, dam pedigree type, and gestation length on litter size, as well as differences in dam and sire CQI by pedigree type (Conformation, Working, Performance, Blended). Respondents represented breeders from North America, Europe and Australia. Breeders reported testing for hip dysplasia, elbow dysplasia, and eye defects in breeding stock 99, 91. 7, and 97. 2% of the time respectively. Multiple drug resistant gene (92. 8%)) and heredity cataracts (84%) were the most common genetic tests. The average litter produced 6. 6 puppies. Breeding method, dam weight, dam pedigree type, and gestation length had no effect on litter size. A quadratic relationship between litter size and dam age was observed with larger litters (P < 0. 05) in young dams (ages 2-3; 6. 9 ± 0. 34) and older dams (ages 6-7; 7. 5 ± 0. 42) compared to dams 3 to 5 years of age (6. 4 ± 0. 26). Dam CQI was higher in conformation pedigrees (14. 1% ± 1. 0) compared to working pedigrees (8.9% ± 1. 1; P < 0. 001) and blended pedigrees (11. 1% ± 1. 0; P < 0. 05). Sire CQIs in working pedigrees (9. 4% ± 1. 1) were lower (P < 0. 05) than blended (13% ± 1. 5) or conformation (12. 3% ± 0. 9) pedigrees. A more diverse and larger sampling, including pet breeders is recommended.

Objectives

This survey study was designed to evaluate:

1. **Health testing trends used by breeders**
2. **Factors affecting litter size**
3. **Genetic diversity in Australian Shepherds**

Materials and Methods

- ♂ A voluntary Qualtrics™ survey, consisting of 24 questions was distributed through social media; online links through Australian Shepherd Club of America (ASCA) and Australian Shepherd Health and Genetics Institute (ASHGI); and through breeder lists from June through December 2017.
- ♂ Litters from the United States, Canada, Europe and Australia whelped from January 1, 2000 through December 2017 were included.
- ♂ Coefficients of Inbreeding (CQI) were calculated using a 10 generation database (BreedMate PedX) from submitted registration names and performed by ASHGI.
- ♂ Statistical Analysis:
  - ♀ Mixed model, SAS was used to analyze the main effects of breeding method, dam weight, dam age, dam pedigree type and gestation length on litter size.
  - ♀ Differences between pedigree type in sires and dams were tested using Tukey-Kramer test.
  - ♀ Pearson's correlation coefficients was used to evaluate differences in litter size based on dam CQI.
  - ♀ Statistical significance was set at P < 0.05.

Results

- ♀ Health and genetic testing was widely used by breeders responding to this survey. Multiple Drug Resistance (MDR1) was the most frequently performed genetic test. See Table 1.
- ♀ Average litter size was 6.7 ± 2.39 puppies at birth and 6.4 puppies 24 hr. post whelping, with 22.4% of the litters reporting neonatal losses within 24 hrs.
- ♀ There was no difference in litter size based on breeding method; dam weight; or pedigree type. See Table 2.
- ♀ There was a trend (P = 0.07) for litter size to be negatively correlated with dam CQI.
- ♀ Young dams (ages 2-3; 6.9 ± 0. 34) and older dams (ages 6-7; 7.5 ± 0.42) had larger litters (P 0.05) compared to dams 3 to 5 years of age (6.4 ± 0.26). See Table 2.
- ♀ Dam CQI was higher in conformation pedigrees (14. 1% ± 1.0) compared to working pedigrees (8.9% ± 1. 1; P < 0. 001) and blended pedigrees (11. 1% ± 1. 0; P < 0. 05). Figure 1.
- ♀ Sire CQI was lower in working pedigrees (9. 4% ± 1. 1; P < 0. 05) compared to blended (13% ± 1.5) or conformation (12. 3% ± 0.9) pedigrees. Figure 1.

Fig. 1 Effect of Pedigree Type and CQI on Litter Size in Australian Shepherds

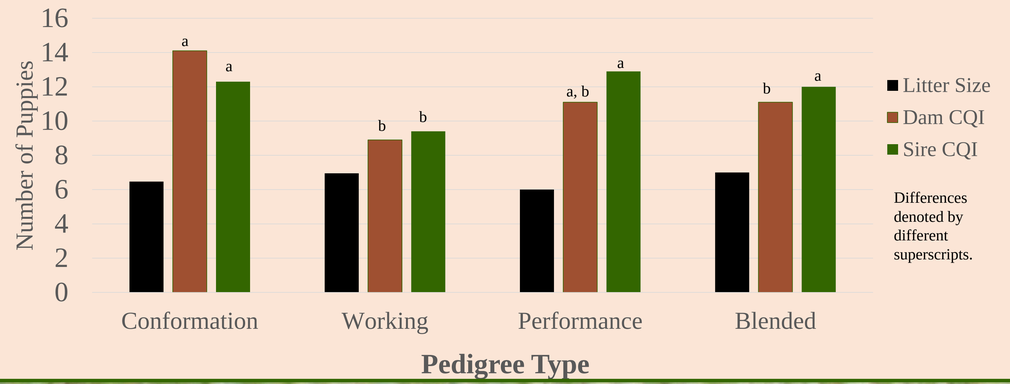

Table 1. Summary of Genetic Tests Reported by Australian Shepherd Breeders

Test Type	Disorder	Frequency of Reported Testing
Hips	**Hip dysplasia**	**99.0%**
Elbows	**Elbow dysplasia**	**91.7%**
Eye certifications	**Multiple disorders**	**97.2%**
Genetic Tests		
Multiple Drug Resistance	***MDR***	***92.3%***
Heredity Cataracts	***HC***	***84.5%***
Collie Eye Anomaly	***CEA***	***68.5%***
Degenerative Myelopathy	***DM***	***60.8%***
Progressive Retinal Atrophy	***PRA***	***54.7%***
Canine Multifocal Retinopathy	***CMR-1***	***37%***
Cone Degeneration	***CD***	***28.2%***
	None	***4.4%***

Table 2. Litter Size (number of puppies ± s.d. by variable. Within the same color box, variables with the different superscripts are different. Age and weight were estimated by breeder at time of whelping.

Variable	Litter Size	Significance
Live w/ tie	6.8 ± 0.21	N.S.
Cervical AI w/ fresh	6.8 ± 0.67	N.S.
Cervical AI w/ CST	7.0 ± 0.99	N.S.
Cervical AI w/ frozen	6.0 ± 0.81	N.S.
Surgical AI w/ CST	6.0 ± 1.70	N.S.
Surgical AI w/ frozen	6.4 ± 0.86	N.S.
Age 2 years	7.4 ± 0.52[a]	P < 0.05
Age 3 years	7.7 ± 0.40[a]	P < 0.05
Age 4 years	6.8 ± 0.30[b]	P < 0.05
Age 5 years	6.0 ± 0.38[b]	P < 0.05
Age 6 years	7.3 ± 0.50[a]	P < 0.05
Age 7 years	6.9 ± 0.62[a]	P < 0.05
Weight 13-16 kg	6.0 ± 0.50	N.S.
Weight 16-18 kg	6.6 ± 0.32	N.S.
Weight 18-20 kg	7.0 ± 0.36	N.S.
Weight 20+ kg	7.1 ± 0.44	N.S.
Conformation pedigree	6.5 ± 0.30	N.S.
Working pedigree	6.9 ± 0.38	N.S.
Performance pedigree	6.0 ± 1.0	N.S.
Blended pedigree	7.0 ± 0.33	N.S.

Pedigree type was determined by the breeder on one survey question. Conformation lines are bred for ideal structure and success in the show ring. Working lines are historically those bred with the specific purpose of performing ranch work. Performance lines are developing and consist of dogs specializing in sport competitions such as agility, obedience, dock diving and similar events. Blended pedigrees are those combining recent ancestors from different lines.