Variability of mortality risk factors with age in puppies

H. Mila[1,2], A. Feugier[2], A. Grellet[2], S. Chastant-Maillard[1]

[1] UMR INRA/ENVT 1225 Host-pathogen interactions, Ecole Nationale Vétérinaire de Toulouse, France. h.mila@envt.fr
[2] Royal Canin, 650 Avenue de la Petite Camargue, Aimargues, France.

INTRODUCTION

Despite high mortality rate in breeding kennels (10-30%) (1), causes and factors impacting puppy mortality between birth and 2 months of age are poorly described. Different factors at different ages have been found crucial for survival in porcine species, as i.e. litter size for the first 3 days after birth and early weight gain for older piglets. **The aim of this study was to identify the risk factors for mortality in puppies at different ages.**

MATERIALS AND METHODS

- A total of **2288 puppies** from **390 litters** and from **22 different breeds** born in one breeding kennel were included in the study. Following factors were recorded: age of dam, season at birth, number of puppies present in the kennel at their time of birth (animal density), litter size, breed, sex and weight since birth until 3 weeks.
- Depending on adult body weight of the breed, puppies were classified into small (<10kg, n=722), medium (10-25kg, n=535), large (25-45kg, n=644) and giant (>45kg, n=387) sized breeds.
- The birth weight was encoded in quartiles defined separately for each breed size (Table 1).
- The impact of different registered factors on mortality during four different periods were tested with multivariable logistic models with dam as a random effect (SAS Institute Inc., Cary, N.C., USA).

Birth weight classification (g)				
Breed size	Q1	Q2	Q3	Q4
Small	< 160	160-184	185-220	> 220
Medium	< 215	215-254	255-310	> 310
Large	< 380	380-424	425-470	> 470
Giant	< 370	370-419	420-470	> 470

Table 1. Birth weight classification depending on breed size

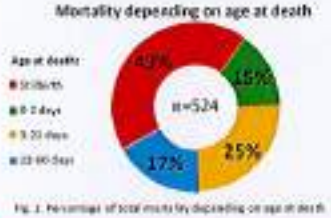

Fig. 1. Percentage of total mortality depending on age at death

RESULTS

- A total mortality rate in puppies between birth and 60 days of age was **22.9%** (524/2288).
- Among dying puppies (n=524), 43.1% (226) died at birth, 14.5% (76) between 0-2 days, 25.2% (132) between 3-21 days and 17.2% (90) between 22-60 days (Fig. 1).
- Factors influencing mortality differed according to puppies age (Fig. 2-7).
- Dam as a random term had a significant influence on mortality at all considered periods ($p<0.001$ in all four models).

STILLBIRTH

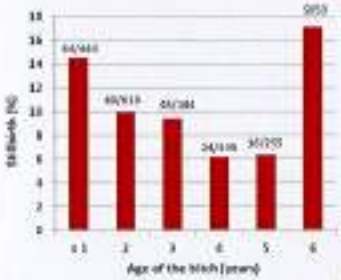

Fig. 2. Proportion of stillborn puppies depending on age of dam

Mortality due to stillbirth was influenced by age of the dam ($p=0.02$; Fig. 2). Stillbirth rate tended to be higher in giant breeds compared with small, medium and large breeds (16.0% vs 8.0%, 8.0%, 9.8%, respectively; $p=0.06$).

MORTALITY 0-2 days

Mortality between 0-2 days was influenced by birth weight ($p<0.001$; Fig. 3). Birth weight in puppies was negatively correlated with age of the dam ($r=-0.13$, $p<0.001$).

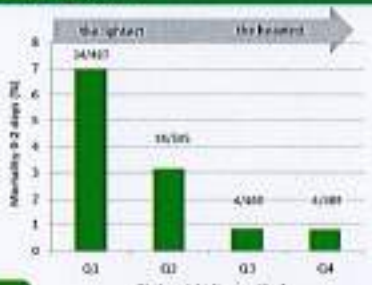

Fig. 3. Proportion of puppies dying between birth and 2 days of age depending on birth weight

Age of the dam
Dam
Dam
Birth weight
Dam
Dam
Age of the dam
Birth weight
Growth rate 2-21 days
Growth rate 0-2 days

MORTALITY 22-60 days

Mortality between 22-60 days was influenced by age of the dam ($p<0.001$; Fig. 6) and growth rate between 2 and 21 days of age ($p=0.002$; Fig. 7).

Fig. 6. Proportion of puppies dying between 22 and 60 days of age depending on age of dam

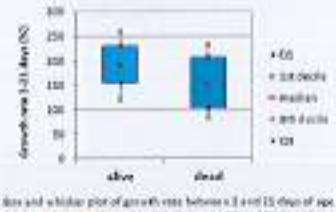

Fig. 7. Box and whisker plot of growth rate between 2 and 21 days of age in alive puppies and puppies dying between 21 and 60 days of age

MORTALITY 3-21 days

Mortality between 3-21 days was influenced by growth rate over the first 48 hours ($p<0.001$; Fig. 4) and birth weight ($p<0.001$; Fig 5).

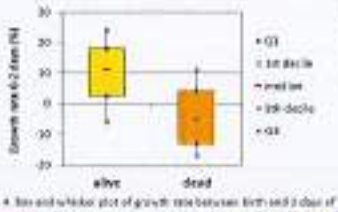

Fig. 4. Box and whisker plot of growth rate between birth and 2 days of age in alive puppies and puppies dying between 3 and 21 days of age

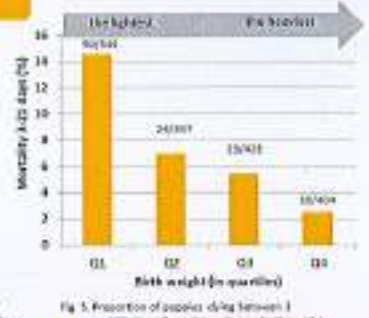

Fig. 5. Proportion of puppies dying between 3 and 21 days of age depending on birth weight

DISCUSSION & CONCLUSIONS

- The highest part of mortality in this kennel was due to stillbirth. This result is in accordance with other published data (2).
- The risk of death in puppies was increased in young dams and dams over 5 years old; however, the effect of parity remains to be tested.
- Risk factors appeared to differ according to the age of puppies, but the effect of the dam seems of major importance.
- Systematic weighing to detect low-birth-weight puppies and puppies with retarded growth could be advised from this study to detect puppies at risk of death.
- Specific nursing of puppies at risk, i.e. by additional feeding with milk replacer could help to decrease mortality rate in breeding kennels.

1) Lawler DF. Current Veterinary Therapy XIII (Ed) W.B. Saunders Co. Philadelphia 2000, 1125 - 1128. 2) Tönnessen R et al. Theriogenology 2012; 77(9):1786-1801.

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[1] Unité Toulousaine d'Elevage et Reproduction (UTER), Reproduction, UMR INRA/ENVT 1225, Ecole Nationale Vétérinaire de Toulouse, 23 Chemin des Capelles, Toulouse, France
[2] Royal Canin, 650 Avenue de la Petite Camargue, Aimargues, France
E-mail: h.mila@envt.fr

Introduction and aim. Despite high mortality rate in breeding kennels (10-30%) (1), causes and factors impacting puppy mortality between birth and 2 months of age are poorly described. Different factors at different age have been found crucial for survival in porcine species, as i.e. litter size for the first 3 days after birth and early weight gain for older piglets. The aim of this study was to identify the risk factors for mortality in puppies at different age.

Material and methods. A total of 2288 puppies from 390 litters and from 22 different breeds born in one breeding kennel were included in this retrospective study. Data concerning all puppies born between January 2000 and October 2006 included: age of their dam, season at birth, number of puppies present in the kennel at their time of birth (animal density), litter size, breed, sex and weight since birth until 3 weeks. Depending on adult body weight of the breed, puppies were divided in small (<10kg, n=722), medium (10-25kg, n=535), large (25-45kg, n=644) and giant (>45kg, n=387) size breeds. The birth weight was encoded in quartiles defined separately for each breed size. The impact of dam age, season, animal density, litter size, breed size, birth weight (in quartiles) and growth rate on mortality during four different periods (at birth, 0-2 days, 3-21 days, 22-60 days) were tested with multivariable logistic models with litter as a random effect (SAS Institute Inc., Cary, N.C., USA).

Results. The total mortality rate in puppies between birth and 60 days of life was 22.9% (524/2288). Among dying puppies (n=524), 43.1% (226) died at birth, 14.5% (76) between 0-2 days, 25.2% (132) between 3-21 days and 17.2% (90) between 22-60 days. The risk of stillbirth tended to be higher in giant breeds compared with other breeds (16.0% vs. 8.6%; $p=0.056$) and was significantly higher for younger dams (bitches <2 years old 14.4% vs. 8.6% in bitches between 2 and 7 years; $p<0.001$). The risk of death between 0-2 days was significantly increased in low birth weight puppies ($p<0.001$) and in giant breeds (4.9% vs. 3.4% in other breeds; $p<0.001$). The risk of mortality between 3-21 days increased with low growth rate over the first 48 hours (18.1% in puppies with negative growth rate vs. 3.1% with positive growth rate $p<0.001$) and tended to be influenced by the season (higher rate in summer and winter compared to other seasons; $p=0.077$). Risk of mortality between 22-60 days decreased when age of the dam increased (bitches <2 years old 13.1% vs. 3.4% in older bitches; $p<0.001$). None of the other factors tested (litter size, animal density) had any influence on mortality at any period. On the contrary, the litter as a random term had a significant influence on mortality at all considered periods ($p<0.001$ in all four models).

Conclusions. The high mortality rate observed in this kennel was mostly due to stillbirth. The risk of death in puppies was increased in young dams, however the effect of parity remain to be tested. Risk factors appeared to differ according to the considered period, but the effect of the dam (matching the "litter effect") seems of major importance. Systematic weighing to detect puppies at higher risk could be advised from this study to decrease mortality rate.

1) Lawler DF, *Current Veterinary Therapy*, Kirk,(Ed).W.B. Saunders Co. Philadelphia 1989, 1325 - 1333.

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