

AVERAGE LIFE EXPECTANCY, THE MOST COMMON CAUSE OF DEATH AND ILLNESS OF GIANT DOG BREEDS*

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The aim of this study was to analyze the most common diseases and genetic defects that occur during the lifetime of giant dog breeds, to determine the average lifespan and the cause of death/euthanasia. Data were obtained through a survey and concerned the health of 241 individuals of giant dog breeds held in the Czech Republic. Evaluated items involved an average lifespan, an average lifespan per gender, cause of death, reasons for euthanasia, cause of mortality (especially in selected Mastiff type breeds), life expectancy per breed and incidence of diseases among giant breeds during the lifetime. The average lifespan in giant breed dogs was found to be 7.60 years. A significant difference ($P < 0.05$) was found between life expectancies in males and females, with female dogs reaching 1.42 year higher age (8.10 years) than males (6.68 years). The most common cause of spontaneous death among giant breeds was gastric dilatation and torsion (28% of dogs) and for euthanasia osteosarcoma (38% of dogs). The cause of mortality especially in selected Mastiff type breeds of dogs was gastric dilatation and torsion (30% of dogs). This is the first broad analytical study concerning this topic published in the Czech Republic.

Canis lupus familiaris, Molossian type, Irish Wolfhound, lifespan, cause of death, reason for euthanasia



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INTRODUCTION

According to the International Canine Federation (FCI), dog breeds with body weight over 40 kg are considered to be giant breeds. In these individuals, however, the weight in adulthood often surpasses the average weight of a human (Barányiová et al., 2009). While each of dog breeds originated through targeted selection for certain traits, unwanted selection of individuals and entire breeds prone to certain hereditary diseases was still underway. Additionally, the process of each breed formation involved a bottleneck effect. Consequently, the series of bottlenecks left genetic footprints in the breeds that have been manifested in a high prevalence of diseases in certain breeds (Lindblad-Toh et al., 2005).

It has been shown that the lifespan of large dog breeds is shorter and these causes are relatively well documented in dogs (e.g., Favier et al. 2001; Bartke, 2017). One of the possible reason for the 'aging' effect is related with a higher level of the growth hormone (GH) in correlation with plasma IGF-1 concentrations in comparison with the smaller breeds of dogs (Bartke, 2017). Another problem of the giant breeds is a small breeding base. Due to inbreeding, genetic diseases are more prevalent (Janis, 2007).

Giant and large breed dogs with a deep chest are more predisposed to the gastric dilatation and volvulus (GDV) syndrome (Uhríkova et al., 2012), although there is evidence of similar cases in small and miniature breeds of dogs in the case studies (Thomas, 1982). Examples of deep-chested breeds include Great Dane,

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Table 1. Average lifespan of giant dog breeds

Breed	<i>n</i>	Male	Female	Average lifespan
English Mastiff ¹	13	5	8	7.81
Irish Wolfhound ³	48	15	33	7.52
Leonberger ²	20	2	18	9.50
Great Dane ¹	107	38	69	7.05
Newfoundland Dog ²	13	4	9	9.88
St. Bernard Dog ²	16	7	9	7.13
Total	217	71	146	
Weighted average lifespan				7.60

¹group FCI 2.1., section: Molossian type, subsection: Mastiff type; ²group FCI 2.2., section: Molossian type, subsection: Mountain type; ³group FCI 10. Sighthounds

Greyhound and Setter dogs (Glickman, 2000). High risk of mortality resulting from GDV threatens mainly large and giant breeds (Evans, Adams, 2010). In dogs weighing over 45 kg, the susceptibility to this syndrome is 20% higher than in other breeds (Beck et al., 2006). The close inbreeding among individuals who underwent the disease even increases the subsequent risk of potential GDV syndrome (Glickman, 2000).

Giant breeds of dogs are 20 times more likely to develop osteosarcoma than smaller breeds. In this regard, breed-specific predisposition does not play any major role; the size and weight of the individual are much more important. Rosenberger et al. (2007) calculated the statistics for various dog breeds affected by osteosarcoma. In addition, they studied age and gender as risk factors in three dog breeds in which the incidence of osteosarcoma was the most frequent. The greatest prevalence was found for Irish Wolfhound (21/339 – 6.2%), Rottweiler (51/969 – 5.3%) and Great Dane (13/297 – 4.4%). Egenvall et al. (2007) report Irish Wolfhound, St. Bernard Dog and Leonberger being the breeds of the greatest risk of exposure. Gender was not identified as a risk factor for osteosarcoma to develop; rather, the risk increased with age in each of the breeds.

Dilated cardiomyopathy (DCM) forms another common cause of death in large and giant breeds of dogs. It results in heart failure with subsequent death (Meurs et al., 2012; Wess et al., 2012). Breeds such as Doberman, Newfoundland, Portuguese Water Dog, Boxer, Great Dane, Cocker Spaniel, and Irish Wolfhound show a higher prevalence of this disease (Broschek, Distl, 2005). Further, a very high prevalence of the disease is indicated for Irish Wolfhound in the study by Philipp et al. (2012).

The current study focuses on the analysis of the most common diseases, the causes of death and the life expectancy of giant breeds in the Czech Republic. The Czech Republic ranks among a breeding ground with a high number of dogs per capita, therefore initial analysis of the state is crucial and may contribute to improving the breeding of these breeds.

MATERIAL AND METHODS

Data were collected from 15 veterinary clinics located in various cities of the Czech Republic, a survey from databases of veterinary clinics, from practicing veterinarians who were able to cooperate in the research. Veterinary practitioners recorded a summary of diagnosis of the disease as well as the cause of death or the reason for euthanasia, where appropriate, from an inserted list of individual code numbers for each disease. Data were collected only if they concerned pure breeds with FCI pedigree and covered only animals that had died. Data were retrieved of 241 individuals of the breeds listed below: English Mastiff, Dogue de Bordeaux, Fila Brasileiro, Bullmastiff, Irish Wolfhound, Caucasian Shepherd Dog, Komondor, Landseer, Leonberger, Great Dane, Newfoundland Dog, Central Asian Shepherd Dog, St. Bernard Dog, Tibetan Mastiff, and Spanish Mastiff. All dogs were born after January 1, 1998. The survey was asking for elementary data relating to the health of the dogs – breed, gender, history of diagnosed diseases, lifespan reached and cause of death, as well as the information whether the dog had spontaneous death or died via assisted euthanasia. The data were collected in 2012–2015; all the owners lived in the Czech Republic.

Statistical analysis

For the needs of later statistical processing, the sourced data were transferred from words into a numerical form with each character and its replacement assigned a specific number. Data converted into numbers were processed using Statistica version 9 (StatSoft, Czech Republic s.r.o.). The statistical evaluation was done using t-test, Scheffé's test, Shapiro-Wilk test using R program, non-parametric Wilcoxon signed rank test (also known as Mann-Whitney U test), ANOVA test and testing for P-value from binomial distribution. Differences were considered significant at $P < 0.05$.

RESULTS

Average lifespan

The average lifespan in giant breed dogs (both genders) was 7.60 years ($n = 241$, confidence interval 7.22–8.00) (Table 1).

Lifespan by gender

The average lifespan was 6.68 years for male dogs ($n = 85$, confidence interval 6.01–7.36) and 8.11 years for female dogs ($n = 156$, confidence interval 7.65–8.57). There was a significant difference ($P < 0.05$) in life expectancy between male and female dogs.

The results are summarized in Figs. 1 and 2.

Cause of death

Spontaneous death for various reasons occurred in 62% of dogs (149 animals), while assisted euthanasia was carried out in 38% of dogs (92 animals). The most common cause of spontaneous death was gastric dilatation and torsion (28% of all the dogs that died without applying assisted euthanasia, i.e. 41 out of 149 animals), while death from unknown causes was the second most frequent cause when 17% of dogs died of natural decrepitude (25 animals). Circulatory diseases formed the third leading cause with 10% of dogs dying of the condition (15 animals). As regards assisted euthanasia, osteosarcoma was the most common cause with 38% of animals so treated, i.e. 35 dogs out of the 92 cases of euthanasia applied. Musculoskeletal disorders formed the second most common reason for euthanasia, which was applied in 18% of dogs (17 animals), while gastric dilatation and torsion was the third most frequent cause with euthanasia applied in 12% of dogs (11 animals).

Also in young dogs up to 4 years of age ($n = 25$), as in the whole sample, dilatation and gas-

tric torsion were the most common cause of death ($n = 8$). In the second and third place were diseases of the circulatory system ($n = 3$) and poisoning and injuries ($n = 3$).

Only breeds ranked by group FCI II – as section 2 Molossian type, subsection 2.1 Mastiff type were selected for the sample, i.e. English Mastiff, Dogue de Bordeaux, Fila Brasileiro, Bullmastiff and Great Dane. In this group, gastric dilatation and torsion formed the most common cause of death. Out of the total of 127 animals of Molossian type, subsection 2.1 Mastiff type dogs, 48% of dogs died as a result of the syndrome (38 animals).

Life expectancy per breed

The computation was limited to breeds with at least 10 representatives to ensure that the results are statistically significant. After testing at the $P = 0.05$ significance level, one can definitely conclude that there is a statistically significant breed-specific variation as regards the average lifespan. More attention was subsequently given to testing the statistical significance. To this end, Scheffé's test was employed where life expectancy per breed was the variable. The detailed assessment based on Scheffé's test shows that there is a statistically significant difference only between Great Dane and Leonberger breeds.

Table 1 makes it evident that the highest lifespan is reached by Newfoundland Dog (9.88 years) followed by Leonberger (9.50), while the shortest lifespan is that of Great Dane (7.05 years).

Prevalence of diseases during the lifetime as per giant dog breed

The R program tested increased/decreased levels of representation of diseases per breed (applied only to breeds represented by more than 10 individuals) (Table 2).

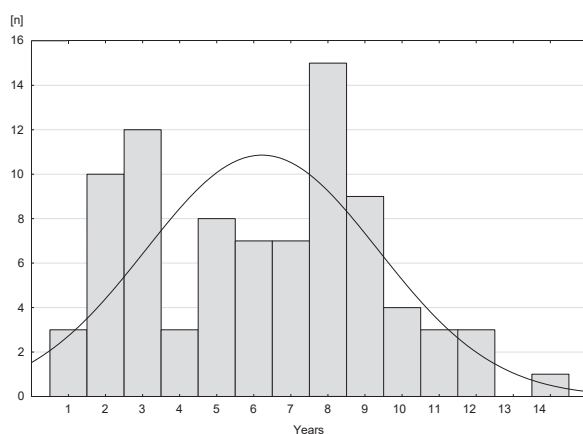


Figure 1: Life expectancy histogram for male dogs

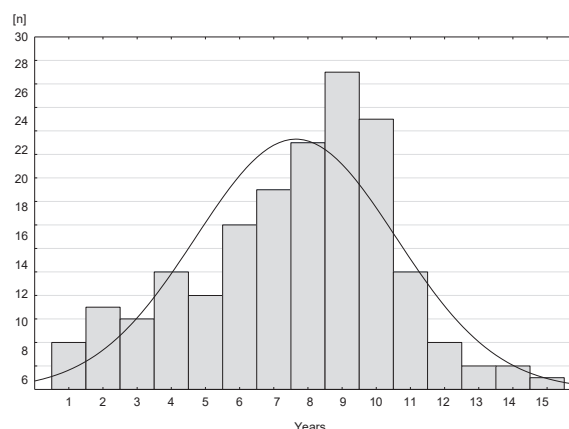


Figure 2: Life expectancy histogram for female dogs

Table 2. Statistical evaluation of the diseases prevalence

Dog breed	Disease->	1	2	5-7	17	18	21	23	26	29
	p-value->	0.0871	0.2863	0.0871	0.0830	0.0664	0.0913	0.2116	0.1369	0.1245
English Mastiff	*	0.3846	0.3846	0.3846	0.3846	0.3846	0.3846	0.3846	0.3846	0.3846
	**	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
Irish Wolfhound	*	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625
	**	0.7796	0.7796	0.7796	0.7796	0.7796	0.7796	0.7796	0.7796	0.7796
Leonberger	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	**	0.3239	0.3239	0.3239	0.3239	0.3239	0.3239	0.3239	0.3239	0.3239
Great Dane	*	0.0467	0.0467	0.0467	0.0467	0.0467	0.0467	0.0467	0.0467	0.0467
	**	0.1762	0.1762	0.1762	0.1762	0.1762	0.1762	0.1762	0.1762	0.1762
Newfoundland Dog	*	0.3077	0.3077	0.3077	0.3077	0.3077	0.3077	0.3077	0.3077	0.3077
	**	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071
St. Bernard Dog	*	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625
	**	0.8230	0.8230	0.8230	0.8230	0.8230	0.8230	0.8230	0.8230	0.8230

*P-value for the degree of disease representation, **P-value for the level of significance

Explanatory key for the table: 1 - Osteoarthritis; 2- Gastric dilatation and torsion; 5-7 - Hip dysplasia, level C to level E; 17 - Dilated cardiomyopathy, negative finding; 18 - Dilated cardiomyopathy, positive finding; 21 - Other; 23 - Cancer (osteosarcoma; 26 - Inflammation of the uterus (pyometra); 29 - Ear infection

A significant difference ($P < 0.05$) for an increased rate of disease representation was demonstrated in the following breeds:

- English Mastiff; specifically for osteoarthritis and hip dysplasia (level C to level E),
- Leonberger; specifically for osteosarcoma,
- Great Dane; specifically for gastric dilatation and torsion,
- Newfoundland Dog; specifically for osteoarthritis, hip dysplasia (level C to level E), and inflammation of the uterus (pyometra),
- St. Bernard Dog; specifically for osteosarcoma and ear infection.

A significant difference ($P < 0.05$) for a reduced level of disease representation was demonstrated in the breeds listed below:

- Irish Wolfhound; specifically for hip dysplasia (level C to level E),
- Great Dane; specifically for hip dysplasia (level C to level E), cancer (osteosarcoma) and inflammation of the uterus (pyometra).

Percentage of disease per breed during the lifetime

Osteoarthritis was most often diagnosed for English Mastiff (38.46%) and Newfoundland Dog (30.77%). Gastric dilatation and torsion was most often noted for Great Dane (39.25%). Hip dysplasia (level C to level E) was most frequently diagnosed in English Mastiff (38.46%) and Newfoundland Dog (38.46%). Dilated cardiomyopathy was diagnosed to the extent of 10% in the selected 10 breeds, only for Irish Wolfhound, the prevalence was 10.42%. Osteosarcoma was diagnosed to the increased extent in St. Bernard Dog (50.00%) and Leonberger (40.00%). Inflammation

of the uterus was diagnosed mainly in Newfoundland Dog, where the disease affected 55.56% of the nine female dogs. Otitis externa infection became predominant for St. Bernard Dog where 43.75% suffered from the illness.

DISCUSSION

The study of dog diseases and the length of their life expectancy has recently become increasingly important. Just as the dog offers a natural model for human conditions and diseases, a simple observation leads to the conclusion that the canine aging phenotype also mimics that of the human. Genotype information, biochemical information pertaining to the GH/IGF-1 pathway, and some limited longitudinal investigations is the reason why the domestic dog was first considered an animal model on aging (Berrymann et al., 2008).

In the world (mainly USA and Great Britain), studies on the lifespan and disease of dogs have been published (e.g., Mitchell, 1999; Glickman, 2000; Gagnon et al., 2009; Evans, Adams, 2010). However, there was no scientific study on the subject in the Czech Republic, a country with a high concentration of the dog population.

A recent study indicated the median lifespan in dogs to be 12 years (O'Neill et al., 2013). The lower threshold of the same in giant breeds as provided herein (7.60 years) fully corresponds to the opinion that the prolonged lifespan is associated with a small body size in several species of mice, in dogs and in humans (Patronek et al., 1997). Stourac, Labrousse (2007) reported that giant breeds age relatively faster

than smaller breeds, their average lifespan being about 7 years; they provided a similar average lifespan as we did in the present paper. Most of the data in the studied sample came from Great Danes (107 animals) and Irish Wolfhounds (48 animals). Both of the breeds gain much attraction among breeders in the Czech Republic and their numbers considerably exceed those of other giant dog breeds.

Out of the evaluated giant breeds, Great Danes had the shortest lifespan (7.1 years). *Michell* (1999) reports an estimate of life expectancy for Great Danes to be 8.4 years, while *Adams et al.* (2010) give 8.5 years and *O'Neill et al.* (2013) provide the average lifespan of Great Danes to be a mere 6.0 years. The value found in the present study is placed within the range above.

The average lifespan of Irish Wolfhounds from the studied sample was 7.52. This corresponds with data of *Urfer et al.* (2007) where the estimated life expectancy was between 4.95 - 8.75 years in Irish Wolfhounds. However, previous research has demonstrated that all Irish Wolfhounds alive worldwide during the study time can be traced back to one recent bottleneck in the 1950's. As recently as the 1990's, the gene pool was further limited by the use of several popular sires, each of whom sires 30 to 40 litters (*Janis*, 2007).

Statistically, females were demonstrated to achieve a significantly higher life expectancy than male dogs. This fully corresponds with the results reported by *Miller, Austad* (2005) as well as *O'Neill et al.* (2013). Likewise, *Kengeri et al.* (2013) report a longer exposure of the ovary in the body of Rottweiler females as a prerequisite for successful longevity. A higher life expectancy is provided in female mammals, which applies even to humans (*Gagnon et al.*, 2009).

As regards mortality, gastric torsion or dilatation formed the most common cause of death (natural death and euthanasia) in giant breed dogs regardless of gender (22%, i.e. 52 animals), followed by osteosarcoma (20%; 47 animals). The number of dogs that died naturally (62%) exceeded that of the dogs that died by means of assisted euthanasia (38%) nearly two times. According to available data, owners and veterinarians in various countries make use of assisted euthanasia in dogs to the varying degrees. According to the study of *O'Neill* (2013) from England, the rate of assisted euthanasia was 86.4%; for the UK, 52% was reported by *Michell* (1999). A study from the USA (*Gobar*, 1998) reported 71%, *Patronek et al.* (1997) showed 70.2% for purebred dogs and 68.5% for hybrids. Opting for euthanasia may also pose a moral dilemma for the veterinarian (*Yeates, Main*, 2011) and emotional turmoil for the dog owner (*McCutcheon, Fleming*, 2001). Instances of reasons behind the lower rate of employing assisted euthanasia in giant breeds that was found in the present study may include the fact the gastric dilatation and torsion forms the most common cause of death. This

disease arises in healthy animals suddenly, progressing very fast. It usually occurs after the evening feeding with the owner finding a dead dog outside the house in the morning. The most common cause for assisted euthanasia found in the present study was osteosarcoma. In this diagnosis, dog owners were opting for euthanasia in 74.4% of cases (35 events of assisted euthanasia out of 47 diagnosed cases of osteosarcoma). Such a high number reflects holder opinions preferring the quality of life to longevity.

CONCLUSION

In general, among the investigated giant breeds of dogs, the most common cause of spontaneous death was gastric dilatation and torsion, followed by osteosarcoma with applied euthanasia. The females had a longer lifespan than males; however, the average lifespan was 7.6 years. Among the investigated breeds, the most frequently repeated health problem was hip dysplasia. This initial analysis may be useful for a subsequent breed selective recovery program.

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REFERENCES

- Adams JV, Evans KM, Sampson J, Wood JLN* (2010): Methods and mortality results of health survey of purebred dogs in the UK. *Journal of Small Animal Practice*, 51, 512–524. doi: 10.1111/j.1748-5827.2010.00974.x.
- Baranyiova E, Holub A, Tyrlik M* (2009): Body size and behaviour traits of dogs in Czech households. *Acta Veterinaria Brno*, 78, 107–114. doi: 10.2754/avb200978010107.
- Bartke A* (2017): Somatic growth, aging, and longevity. *Npj Aging and Mechanisms of Disease*, 3: 14. doi: 10.1038/s41514-017-0014-y.
- Beck JJ, Staatz AJ, Pelsue DH, Kudnig ST, MacPhail CM, Seim HB, Monnet E* (2006): Risk factors associated with short-term outcome and development of perioperative complications in dogs undergoing surgery because of gastric dilatation-volvulus: 166 cases (1992–2003). *Journal of American Veterinary Medical Association*, 229, 1934–1939. doi: 10.2460/javma.229.12.1934.
- Berryman DE, Christiansen JS, Johannsson G, Thorner MO, Kopchick JJ* (2008): Role of the GH/IGF-1 axis in lifespan and healthspan: Lesson from animal models. *Growth Hormone and IGF Research*, 18, 455–471. doi: 10.1016/j.ghir.2008.05.005.
- Broschek C, Distl O* (2005): Dilated cardiomyopathy (DCM) in dogs – pathological, clinical, diagnostic and genetic aspects.

- Deutsche Wochenschrift Tierärztliche, 112, 380–385. (in German)
- Egenvall A, Nodtvedt A, Euler H (2007): Bone tumors in a population of 400 000 insured Swedish dogs up to 10 y of age: incidence and survival. *Canadian Journal of Veterinary Research*, 71, 292–299.
- Evans KM, Adams VJ (2010): Mortality and morbidity due to gastric dilatation-volvulus syndrome in pedigree dogs in the UK. *Journal of Small Animal Practice*, 51, 376–381. doi: 10.1111/j.1748-5827.2010.00949.x.
- Favier RP, Mol JA, Kooistra HS, Rijnberk A (2001): Large body size in the dog is associated with transient GH excess at a young age. *Journal of Endocrinology*, 170, 479–484. doi: 10.1677/joe.0.1700479.
- Gagnon A, Smith KR, Tremblay M, Vezina H, Pare PP, Desjardins B (2009): Is there a trade-off between fertility and longevity? A comparative study of women from three large historical databases accounting for mortality selection. *American Journal of Human Biology*, 21, 533–540. doi: 10.1002/ajhb.20893.
- Glickman LT (2000): Incidence of and breed-related risk factors for gastric dilatation-volvulus in dogs. *Journal of American Veterinary Medical Association*, 216, 40–45. doi: 10.2460/javma.2000.216.40.
- Gobar GM, Case JT, Kass PH (1998): Program for surveillance of causes of death of dogs, using the Internet to survey small animal veterinarians. *Journal of American Veterinary Medical Association*, 213, 251–256.
- Janis A (2007): Dive at your own risk! The Irish Wolfhound Foundation, 1,3. Lititz, Pennsylvania, USA.
- Kengeri SS, Maras AH, Suckow CL, Chiang EC, Waters DJ (2013): Exceptional longevity in female Rottweiler dogs is not encumbered by investment in reproduction. *Geriatrics and Gerontology*, 35, 2503–2513. doi: 10.1007/s11357-013-9529-8.
- Lindblad-Toh K, Wade CM, Mikkelsen TS, Karlsson EF, Jaffe DB, Kamal M, Clamp M, Chang JL, Kulbokas EJ, Zody MC et al. (2005): Genome sequence, comparative analysis and haplotype structure of domestic dog. *Nature*, 438, 803–819. doi: 10.1038/nature04338.
- McCutcheon KA, Fleming SJ (2001): Grief resulting from euthanasia and natural death of companion animals. *Omega – Journal of Death and Dying*, 44, 169–188.
- Meurs KM, Lahmers S, Keene BW, White SN, Oyama MA, Mauceli E, Lindblad-Toh K (2012): A splice site mutation in a gene encoding for PDK4, a mitochondrial protein, is associated with the development of dilated cardiomyopathy in the Doberman pinscher. *Human Genetics*, 131, 1319–1325. doi: 10.1007/s00439-012-1158-2.
- Michell AR (1999): Longevity of British breeds of dog and its relationships with sex, size, cardiovascular variables and disease. *Veterinary Record*, 145, 625–629.
- Miller RA, Austad SN (2005): Growth and aging: Why do big dogs die young? In: Masoro EJ, Austad SN (eds): *Handbook of the biology of aging*. Academic Press, 512–533. doi: 10.1016/B978-012088387-5/50022-4.
- O'Neill DG, Church DB, McGreevy PD, Thomson PC, Brodbelt DC (2013): Longevity and mortality of owned dogs in England. *The Veterinary Journal*, 198, 638–643. doi: 10.1016/j.tvjl.2013.09.020.
- Patronek GJ, Waters DJ, Glickman LT (1997): Comparative longevity of pet dogs and human: Implication for gerontology research. *Journal of Gerontology: Biological Sciences*, 52, 171–178.
- Philipp U, Vollmar A, Haggstrom J, Thomas A, Distl O (2012): Multiple loci are associated with dilated cardiomyopathy in Irish Wolfhounds. *PLoS ONE*, 10: 1371. doi: 10.1371/journal.pone.0036691.
- Rosenberger JA, Pablo NV, Crawford PC (2007): Prevalence of and intrinsic risk factors for appendicular osteosarcoma in dogs: 179 cases (1996–2005). *Journal of the American Veterinary Medical Association*, 231, 1076–1080. doi: 10.2460/javma.231.7.1076.
- Stourac M, Labrousse MJ (2007): Great Dane. Released own expense. Published by the author, Brno. (in Czech)
- Thomas RE (1982): Gastric dilatation and torsion in small or miniature breeds of dogs – three case reports. *Journal of Small Animal Practice*, 23, 271–277. doi: 10.1111/j.1748-5827.1982.tb01665.x.
- Uhrikova I, Rehakova K, Rauserova-Lexmaulova L, Lojek A, Doubek J (2012): Total antioxidant capacity in dogs with gastric dilatation and volvulus. *Veterinarni Medicina*, 57, 207–211.
- Urfer SR, Gaillard C, Steiger A (2007): Lifespan and disease predispositions in the Irish Wolfhound: A review. *Veterinary Quarterly*, 29, 102–111.
- Wess G (2012): Update on dilated cardiomyopathy in dogs. *Kleintierpraxis*, 57: 76.
- Yeates JW, Main DCJ (2011): Veterinary surgeons' opinions on dog welfare issues. *Journal of Small Animal Practice*, 52, 464–468. doi: 10.1111/j.1748-5827.2011.01095.x.

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