

The Demographics of Hip Dysplasia in the Maine Coon Cat

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Abstract

Objectives: To study the demographics of feline hip dysplasia (FHD) in the Maine Coon Cat.

Methods: The complete hip dysplasia registry (public and private) collected by the Orthopaedic Foundation for Animals through April 2015 was accessed. There were 2,732 unique felines; 2,708 (99.1%) were Maine Coon cats; only the Maine Coon cats were studied. Variables analyzed were sex, month/season of birth, and hip dysplasia score. Two groups were created: those with and without FHD. A $P < 0.05$ was considered statistically significant.

Results: The youngest cat with FHD was 4 months of age. The majority of the radiographs (2,604/2,708 - 96.2%) were performed between 4 and 60 months of age. Non-borderline scores for these 2,604 cats were available in 2,548, and are the data for this study. The overall prevalence of FHD was 24.9% (635/2,548), and was slightly higher in males (279/1,023 - 27.3%) than females (356/1,525 - 23.3%) ($P = 0.025$). Those with more severe dysplasia were older. The percentage of bilateral FHD was 56%, and bilateral cases had more severe dysplasia than unilateral cases but with no age difference. Month/ season of birth nor geographic region of origin did not influence the prevalence of FHD.

Conclusions and Relevance: This is the largest demographic study of FHD in the Maine Coon cat. The overall prevalence in the Orthopaedic Foundation for Animals registry was 24.9%, and slightly higher in males (27.3%) than females (23.3%). Dysplasia was more severe in bilateral than unilateral cases and with increasing age. Caution should be used when extrapolating these findings to other feline breeds or other groups of Maine Coon cats. Further studies need to be performed amongst other breeds and geographic locations to better understand the demographics of feline hip dysplasia.

Key words: feline, hip dysplasia, Maine Coon cat, demographics, laterality

Introduction

Hip dysplasia is a very well known condition in canines¹⁻⁴, especially amongst certain breeds. There are only a few studies of feline hip dysplasia (FHD)⁵⁻¹⁰ and there has been no study of the demographics of FHD using a large data set. We wished to pursue this question using the Orthopaedic Foundation for Animals (OFA) registry. Upon reviewing the felines from this data set, the vast majority were Maine Coon cats; we are reporting our findings for this breed

Materials and methods

The data for this study was the complete hip dysplasia registry (both public and private) collected by the Orthopaedic Foundation for Animals (OFA) through April 2015. There were a total of 1,430,979 records. Duplicate records and canine cases were deleted, resulting in 2,732 unique felines; 2,708 were Maine Coon cats and the remaining 24 various other breeds. Only the 2,708 Maine Coon cats were analyzed in this study.

The variables analyzed were sex, month/season of birth, and hip dysplasia score. The OFA hip score uses the American Veterinary Medical Association grading system: 1 = excellent, 2 = good, 3 = fair, 4 = borderline dysplasia, 5 = mild dysplasia, 6 = moderate dysplasia and 7 = severe dysplasia. The borderline score of 4 was excluded creating two groups: those with FHD (scores 5-7) and those without FHD (scores 1-3). Season of birth was arbitrarily defined as winter – December through February, spring - March through May, summer - June through August, and autumn - September through November. For those cats with FHD, laterality was also studied.

Statistical Analyses

Categorical variables are expressed as frequencies and percentages, and continuous variables as the average \pm 1 standard deviation. Differences between categorical variables were assessed using the Fishers's exact test for 2 x 2 tables and the Pearson's χ^2 for tables larger than 2 x 2. Differences for continuous variables were assessed with non parametric tests due to non-normal distributions (Mann-Whitney U test for 2 variables, Kruskal Wallis test for > 2 variables). While the American Veterinary Medical Association grading system is a numerical grade, it is not a continuous variable such as the Norberg angle, but rather a categorical ordinal variable determined by

subjective criteria (www.offa-org – Hip Dysplasia – OFA X-ray Procedures). For this reason, the hip score was analyzed as a categorical variable. All statistical analyses were performed with Systat 10 software (Chicago, IL, 2000), and a $P < 0.05$ was considered statistically significant.

Results

The vast majority (2,604/2,732 - 96.2%) of the radiographs were performed between 4 and 60 months of age (Figure 1); the youngest cat with FHD was 4 months of age. The hip score in these 2,604 cats was 1 in 114, 2 in 1,240, 3 in 559, 4 in 56, 5 in 426, 6 in 168, and 7 in 41. Thus, 2,548 cats had non-borderline scores (< 4 or > 4) and comprise the data for this study. The geographic residence for these 2,548 cats was known in 2,450, and was North America in 1,281 (52.3%), Europe in 1,114 (45.5%), and Asia, Australia or New Zealand in 55 (2.2%). The five countries submitting the most number of radiographs were the USA (1,159 – 47.3%), Finland (249 – 10.2%), Sweden (181 – 7.4%), Germany (174 – 7.1%), and Austria (154 – 6.3%), accounting for 78.3% of all cases.

There were 1,525 female and 1,023 male cats (Table 1). The prevalence of FHD was 24.9% (635/2,548), and was slightly higher in males (279/1,023 - 27.3%) than females (356/1,525 - 23.3%) ($P = 0.025$). Those without FHD were statistically younger (19.4 ± 11.9 months) than those with FHD (20.4 ± 11.6 months) ($P = 0.003$). Cats with more severe dysplasia were older (Figure 2). The percentage of cats with FHD by age groups is shown in Figure 3. There were no differences in FHD prevalence by month or season of birth.

Bilateral FHD was present in 55.3% (225/407) of females and 57.5% (131/228) of males ($P = 0.62$). The dysplasia was more severe with bilateral involvement (Figure 4). There was no age difference between those with unilateral (18.9 ± 11.0 months) or bilateral (20.5 ± 11.7 months) FHD ($P = 0.07$). In unilateral cases, the right hip was involved in 126 (60.9%) and the left in 81 (39.1%). There was no difference in the proportion of right and left hips by gender ($P = 0.77$) or hip score ($P = 0.13$). There were no differences in the prevalence of FHD between the three geographic regions (North America, Europe, and Asia/Australia/New Zealand), or the USA and Finland, the two countries submitting the largest number of radiographs to the OFA (Table 2).

Discussion

The presentation of FHD is gradual with subtle behavioral changes such as inactivity or aggression, lack of response to human attention, reluctance to go up or down stairs, and resistance to handling^{7, 11}. The onset typically occurs between three months and 3.5 years of age⁷. Physical examination may demonstrate muscle atrophy and restricted hip motion; crepitus or pain on manipulation may occur in the more advanced case¹¹. An Ortolani sign may be present in some cases¹². The ventrodorsal radiograph is obtained and the Norberg angle measured, with a lower angle reflecting increasing subluxation. The distraction index can also be measured; a higher distraction index indicates more laxity. It should be remembered that cats have shallower acetabulae and more hip laxity than canines^{7, 13, 14}. The diagnosis of FHD is confirmed by noting the shallow acetabulum, subluxation of the femoral head, and often early degenerative changes at the cranial border of the acetabulum^{11, 13}.

The diagnosis of FHD in the OFA data base was determined using the standard method of a consensus score amongst three different radiologists. The overall accuracy of this distinction between animals with and without hip dysplasia using the OFA scoring schemes was 94.9% in 1.8 million radiographs (http://www.ofa.org/hd_grades.html). Although the system is primarily used in canines, the OFA hip score has been used in a previous study of FHD⁵, and a similar OFA like system was used by the Pennsylvania group¹⁴. We believe that the consensus amongst three different radiologists gives assurance as to the correctness of the diagnosis. Those cats designated as having FHD likely did have it; and those designated as not having FHD likely did not have FHD. There is a possibility of a false negative diagnosis, if FHD later appeared in a cat as it aged after the radiograph had been submitted. This would only result in a higher prevalence of FHD.

The first mention of FHD appears to be by Peiffer¹⁵ in 1974 and Holt⁸ in 1978. Peiffer et al described pectineus tenotomy as a treatment but gave no details regarding cases of FHD. Holt described FHD in a three year six month old castrated male Persian cat. Since then there have been three studies discussing FHD aside from case reports or a

single litter. Köppel⁹ in 1989 at the University of Vienna described 293 cats, of which 285 were Domestic Shorthairs. The prevalence of FHD was 43.4% in the males (23/159) and 56.6% in the females (30/134); this difference by sex is not statistically significant. Langenbach¹⁴ in 1998 at the University of Pennsylvania studied 78 cats (gender not mentioned) with a 32% prevalence of FHD. These 78 cats were from 9 different breeds and at least 6 months old when the radiographs were performed; there were no excellent scores even in those without FHD. Keller⁵ in 1999 at the University of Missouri studied 684 cats with, 603 being Domestic Shorthair cats. The overall prevalence of FHD was 6.6% and did not differ by gender.

This is the largest series to date describing the demographics with FHD. Due to the preponderance of the Maine Coon cat breed in the OFA registry we could only study the demographics of FHD in one breed. Of the 2,732 cats in the registry 2,708 were Maine Coon (99.1%). The remaining 24 cats were comprised of 10 British Shorthair, six Persian, three Siamese, two Domestic Shorthair, and one Somali, Ragamuffin, and Bengal Tiger. In this study of the Maine Coon cat in the OFA data base the overall prevalence of FHD was 24.9%. There are certain limitations to the findings in this study. First, it only describes the Maine Coon cat population within the OFA data base, which likely has a selection bias, since the OFA registry only consists of those cats whose radiographs were voluntarily submitted for analysis. It is very possible that owners or breeders with obviously dysplastic cats never submitted radiographs. Such a bias in the OFA data set has been previously discussed in canines¹⁶. Thus the prevalence of 24.9% is likely a low estimate. A more accurate number would require obtaining radiographs of a large number of Maine Coon cats without any pre-selection by the owners/breeders. Finally, if the cats whose radiographs were performed under 1 year of age underwent repeat radiographic examination after 1 year of age, it is possible that some of the normal cats would have developed FHD, again resulting in a higher prevalence. We chose 4 months of age as the cutoff as that was the age of the youngest cat in the registry having a score of 5-7.

The reason why the OFA data base is comprised of nearly all Maine Coon cats is due to previous reports of hip dysplasia as a specific problem in that breed⁵. The goal of

our study was to describe the demographics of feline hip dysplasia using presently available data. In the USA, the submission of images to either the OFA registry or others is voluntary as there is no compulsory registry for feline hip dysplasia in North America. Besides the OFA registry, there is another voluntary and public one for the Maine Coon cat. This registry is administered by PawPeds (<https://www.pawpeds.com/healthprogrammes/hd.html>) and a single radiologist reviews all the radiographs. Other breed clubs are encouraged to join. The most recent data from that registry gives an overall prevalence of FHD in Maine Coon cats of 32.4% (969/2,988) ¹⁷.

The 24.9% prevalence of FHD in this study is similar to that of Langenbach ¹⁴, higher than that of Keller ⁵, and lower than that of Köppel ⁹. There are several possible explanations for these differences. One possible explanation is that this study involved only Maine Coon cats, while two of the three studies mentioned above are predominantly Domestic Shorthair cats ^{5, 9} with the third a mixture of breeds ¹⁴. This may be due to genetic differences for FHD by breed. Another explanation is that the gene pool for FHD may vary by geographic residence location of the cat. However, we noted no difference in the prevalence of FHD by geographic region. A final explanation may involve the effect of neutering. None of the studies investigated this potential factor, and the status of neutering is not known in the OFA data base. Finally, the 29.4% prevalence of FDH in the OFA Maine Coon cat database is very similar to the 32.4% prevalence in the Swedish PawPeds registry ¹⁷. The PawPeds registry uses a four level grading protocol: normal, grade 1 (mild dysplasia), grade 2 (moderate dysplasia), and grade 3 (bad dysplasia). The exact criteria for the dysplastic grades are not given on their web site ¹⁷ and are likely different than the OFA American Veterinary Medical Association grading system; however both demonstrate a similar prevalence of FHD.

Conclusion

This study gives the clinician new, detailed background data regarding the demographics of FHD in the Maine Coon cat. The overall prevalence of FHD in the OFA data base was 24.9% and slightly higher in males (27.3%) than females (23.3%). The percentage of bilateral FHD was 56% (of the 24.9%) with no difference by gender.

The dysplasia was more severe in bilateral cases. Caution should be used when extrapolating these findings to other feline breeds, as well as to other groups of Maine Coon cats. Further studies need to be performed amongst other breeds and geographic locations to better understand the demographics of feline hip dysplasia.

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Conflict of Interest

The authors declare no conflict of interest.

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Figure Legends

Figure 1: Histogram of all 2,708 Maine Coon cats. The vast majority (96.16%) had the radiographs performed between 4 and 60 months of age.

Figure 2: Average age for each hip score severity. The age difference between the three groups with hip dysplasia (scores 5, 6 or 7) was statistically significant ($P = 0.00004$). There were significant differences between the mild and moderate group ($P = 0.0003$) and the mild and severe group ($P = 0.017$), but not between the moderate and severe group ($P = 0.99$).

Figure 3: The number of cats and percentages with and without FHD by different age groups at the time of the radiograph. The actual number of the cats are the values within each section of the bars.

Figure 4: Differences in feline hip dysplasia by severity and unilateral/bilateral nature. The numbers within each box denote the number of cats. The age difference between all three groups was statistically significant ($P < 10^{-6}$). There were significant differences between the mild and moderate group ($P < 10^{-6}$) and the mild and severe group ($P = 0.0002$), but not between the moderate and severe group ($P = 0.63$).

Table 1: The demographics of hip dysplasia in the Maine Coon cat

	Without FHD*	With FHD	% without FHD	% with FHD	P value
All	1913	635	75.08	24.92	-
Age (months)†	19.4 ± 11.9	20.4 ± 11.6	-	-	0.003
Sex					
F	1169	356	76.66	23.34	0.025
M	744	279	72.73	27.27	
Month of Birth					
Jan	154	55	73.68	26.32	0.83
Feb	141	41	77.47	22.53	
Mar	169	56	75.11	24.89	
Apr	192	65	74.71	25.29	
May	190	61	75.70	24.30	
Jun	155	51	75.24	24.76	
Jul	175	48	78.48	21.52	
Aug	145	56	72.14	27.86	
Sep	147	39	79.03	20.97	
Oct	162	54	75.00	25.00	
Nov	148	59	71.50	28.50	
Dec	135	50	72.97	27.03	
Season of Birth					
Autumn	457	152	75.04	24.96	0.99
Spring	551	182	75.17	24.83	
Summer	475	155	75.40	24.60	
Winter	430	146	74.65	25.35	

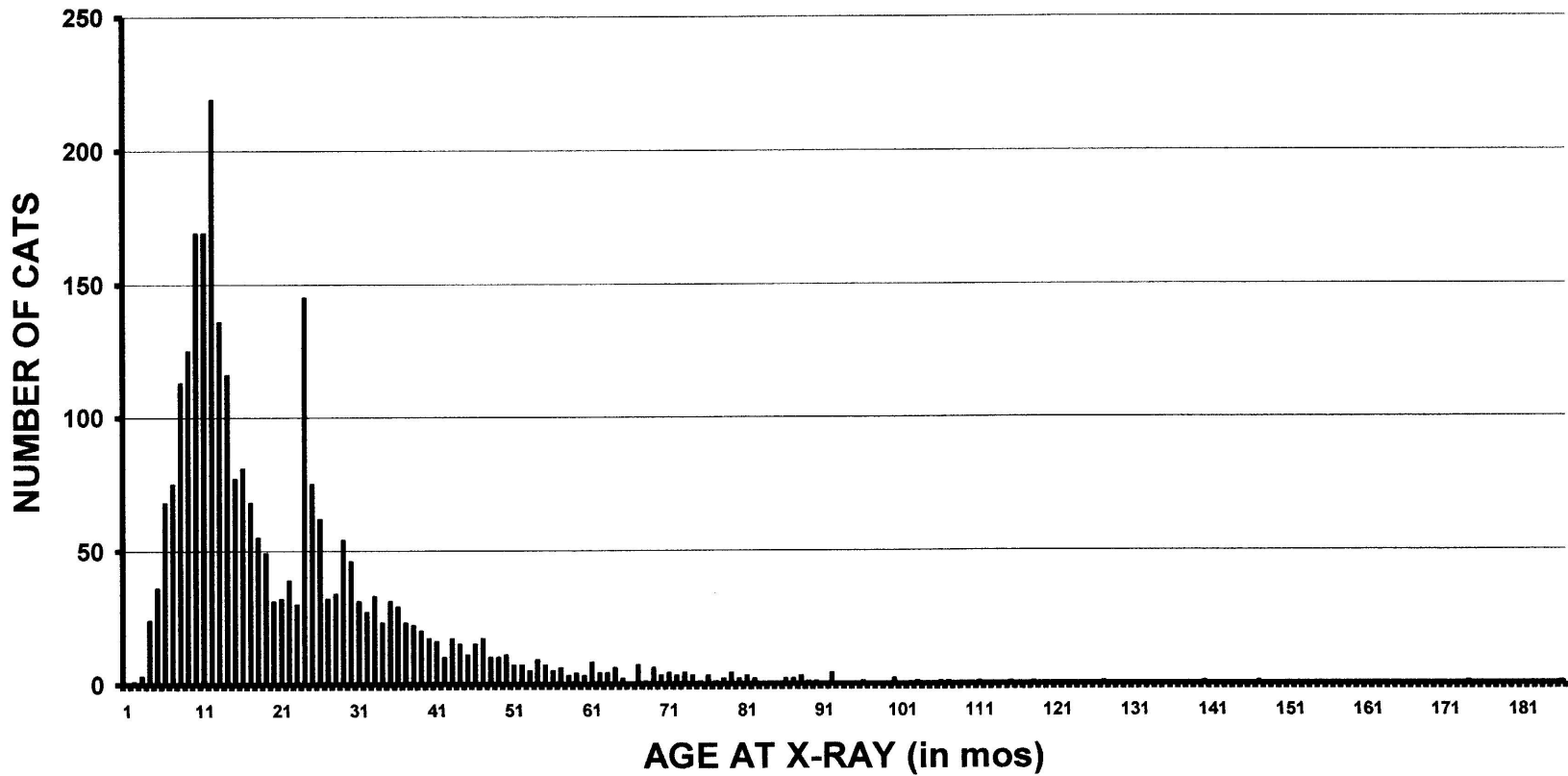
* FHD = feline hip dysplasia

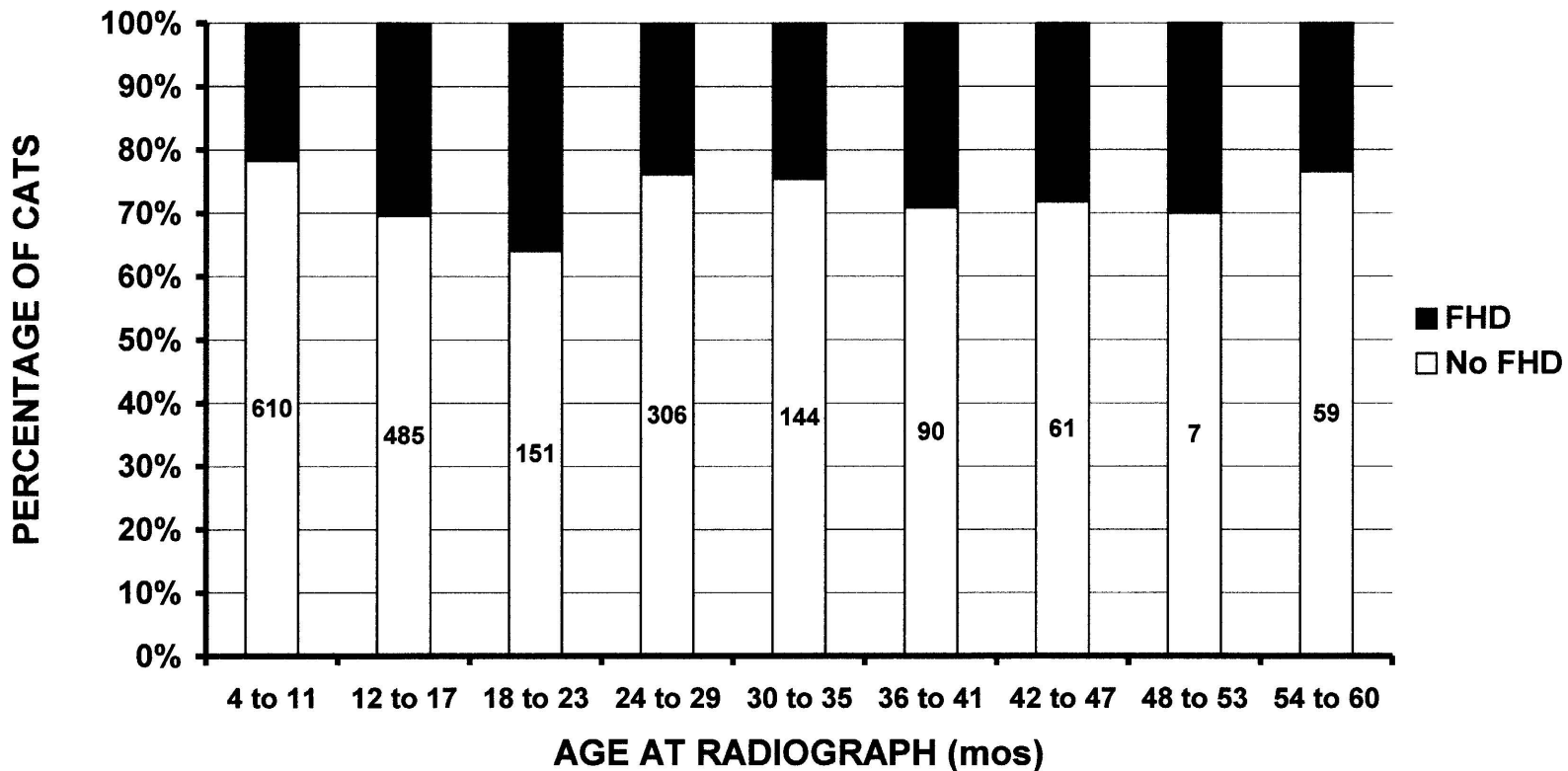
† average ± 1 standard deviation

Table 2: Prevalence of hip dysplasia in the Maine Coon cat by geographic region

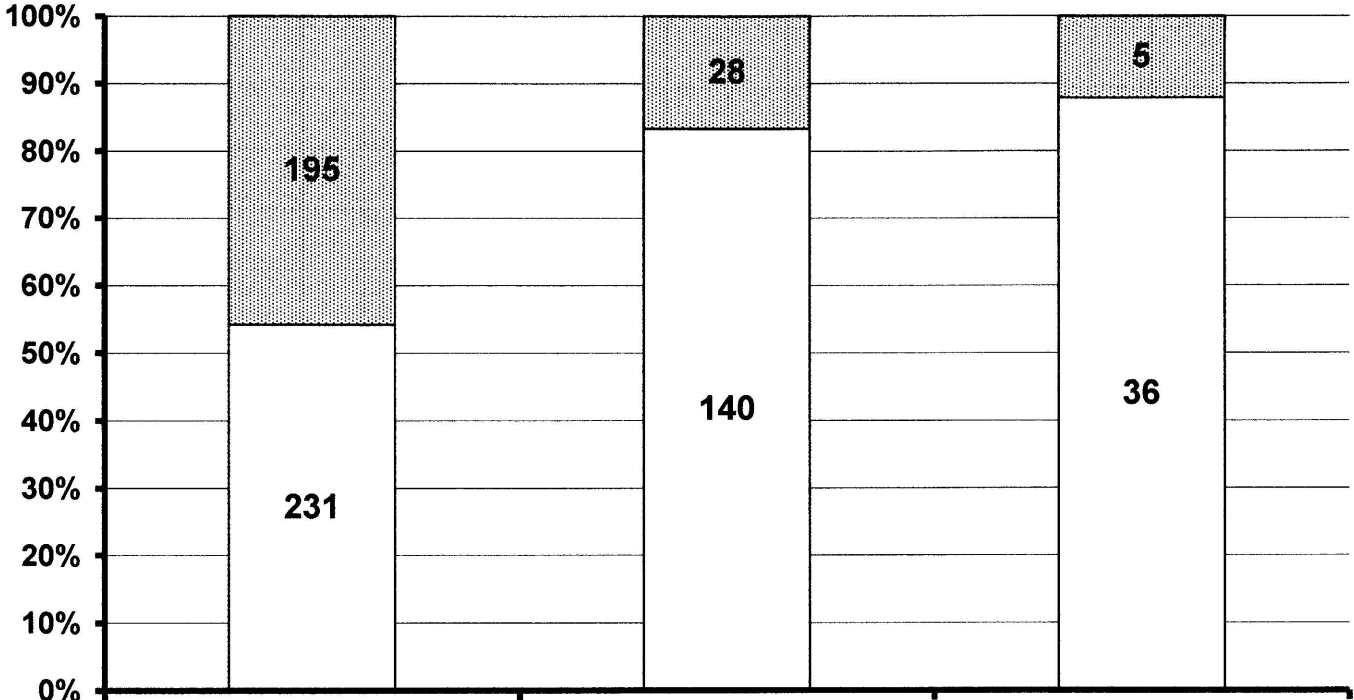
	Without FHD*	With FHD	% without FHD	% with FHD	P value
North America	930	313	74.8	25.2	0.96
Europe	827	271	75.3	24.7	
All others	41	13	75.9	24.1	
Finland	175	69	71.7	28.3	0.58
USA	825	298	73.5	26.5	

* FHD = feline hip dysplasia





PERCENTAGE OF CATS



5 (Mild)

6 (Moderate)

7 (Severe)

HIP DYSPLASIA SCORE

■ Unilateral
□ Bilateral