

Diet, Exercise, and Weight as Risk Factors in Hip Dysplasia and Elbow Arthritis in Labrador Retrievers^{1,2}

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EXPANDED ABSTRACT

KEY WORDS: • *hip dysplasia* • *elbow arthrosis* • *diet* • *exercise* • *weight* • *dog*

Hip dysplasia (HD) and elbow arthrosis (EA) are, despite extensive breeding programs, still causing problems in many dog breeds such as the Labrador Retriever. Among the environmental factors involved in developmental bone diseases, experimental studies show that overfeeding has proven to be detrimental in both hip (1–3) and elbow dysplasia (3). Over-supplementation of calcium has been shown to be a risk factor for osteochondrosis, one of the main constituents of EA, in both experimental (1) and epidemiological studies (4). In an epidemiological study published in 1992, Slater et al. (4) found that playing with other dogs might also be a risk factor for osteochondrosis disseccans in dogs.

To register data on demographics, diet, exercise, and weight in the Swedish dog population, a mail and telephone questionnaire was developed and validated (5). This tool was used in this study to evaluate the effects of risk factors for HD and EA in a defined population of Labradors.

Our research group is primarily investigating multifactorial diseases in dogs that are of comparative value to humans. The methods used for comparison are epidemiological and molecular genetic studies, making use of insurance data and population-based cases and controls matched by breed, sex, and age (6).

To identify environmental risk factors concerning demographics, diet, exercise, and weight for both HD and EA, 2 parallel epidemiological studies were performed.

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MATERIAL AND METHODS

Dogs

From the registries at the Swedish Kennel Club and out of a birth cohort (born in 2000) of Swedish Labradors with known status on both HD and EA at the age of 12–24 mo, 325 dogs were allocated as cases or controls. A majority of the dogs were born from both sires and dams unaffected by either HD or EA (82 and 81%, respectively) (6). The dogs were matched by sex and age. Each case of HD was matched with a control dog of the same sex, born at maximum 15 d apart from that individual. If possible, the dog was also matched with a littermate (39% of the cases). If more than 1 littermate was possible, the selection was made by lot. The same procedure was followed with the EA cases.

The distribution of males (48%) and females (52%) were even. Only 2% of the dogs were neutered. Most (83%) had been purchased at the age of 2 mo from a breeder. Dogs from 113 breeders were included in the study, and 9% of the dog owners were breeders themselves.

Design and questionnaire

We performed 2 parallel retrospective case-control studies. The owners of the cases and controls were sent a previously validated questionnaire with a total of 39 questions regarding the specific dog (5). After ~2 wk, the owner was contacted by phone and interviewed by one of the authors (Mari Trogen).

The dietary section of the questionnaire included questions about feeding patterns and appetite. Type, frequency, and amount consumed of commercial food, table food, and homemade diets were recorded. Owners were also questioned about treats and the use of vitamin and mineral supplements. Another section of the questionnaire, concerning exercise and the way the dogs perform and lead their lives, recorded time spent on, and seasonal variations of, different training activities. The final section identified the weight and size of the dog compared with the average for the breed, as well as owner-perceived body condition score.

Most questions were multiple choice or formulated to record continuous data. In addition, some questions were open, to allow the possibility of adding specific information. All questions, except the ones concerning previous diets, pertained to dietary intake during the last month.

Calculation of nutrient intake

To calculate the daily energy and nutrient intake from commercial feeds and other ingredients, the Animal Nutritionist (version 2.5,

N-squared) software was used (7). The database was updated and modified to suit Swedish conditions and included data on both table foods (8) and commercial products used.

Statistical analyses

A McNemar Chi-square analysis was used to determine differences in categorical variables between cases and controls (9). If there were significant differences, the odds ratio (OR) was calculated. For continuous variables, Student's *t* test and Wilcoxon Signed Rank test were used (10). A value of $P < 0.05$ was considered significant.

RESULTS

The overall response was 90% (292/325) and was equal for cases and controls. Reasons for no response were that the owner was unreachable during the time of the study ($n = 14$), the dog was dead ($n = 1$), a lack of time or unwillingness to participate ($n = 12$), the dog was sold ($n = 5$), or that the owner recently bought the dog and did not know the dog's background ($n = 1$).

For HD, 160 dogs could be matched (80 males and 80 bitches), and 32% of these were matched within litter. For EA, 124 dogs could be matched (58 males and 66 bitches), and 47% of these could be matched within the same litter. Eight dogs could not be matched with any dog but remained in the material.

Most (median 93%) use of dry matter (DM) originated from commercial dry feeds (78–100, 10th and 90th percentiles, respectively). The median energy intake was 542 kJ/kg BW^{0.66} (362–750).

Most dogs (98%) were taken for walks an average of 4 times/d (min-max 0.4–7), with an average time of 100 min/d (10–360). Fewer Labradors (19%) ran along side a bike, but the Labradors performed this type of exercise an average of twice/wk (0.25–7). Also, quite a few owners said that they were jogging with their dog (15%) an average of twice/wk (0.25–7).

Most (85%) Labradors were allowed to play with other dogs, most commonly 5 times/wk (median; min-max 0.3–100), most commonly for 15 min on each occasion (2–60). Approximately 4 of 10 dogs were exercised by running after balls and sticks an average of 4 times/wk (0.25–40) for 10 min on each occasion (1–60).

The median weight of the males was 34 kg (min-max 22–43), whereas the median weight of bitches was less (27 kg, min-max 18–43 kg). When asked, only 4% of owners considered their Labrador to be overweight. However, in a study previously validated by Laflamme (11), when the owner pointed out their dog's size on a picture scale, 24% of the owners thought their dog to be a 7 on a 1–9 grade scale. This means that the dogs are overweight according to the body condition score system. Three percent of the dogs were being fed to lose weight at the time of the interview.

Risk factors for HD and EA

The results showed no significant difference between cases and controls for either HD or EA in the proportion fed homemade diets, table foods, commercial diets, or treats.

All individuals fed ad libitum were found in the case groups for both HD ($n = 4$) and EA ($n = 6$). Identified risk factors for both HD and EA were being exercised by running after balls and sticks thrown by the owner ($P < 0.016$, OR = 2.4, 95% CI 2.2–2.6 for HD; $P < 0.014$, OR = 3.2, CI 3.0–3.5 for EA). For HD, 54 and 35% of cases and controls performed the activity, and, for EA, 52 and 34% of cases and controls performed the activity, respectively.

A high body weight (medians 32 and 30 kg for cases and controls, respectively; SD 4.4 and 3.7, respectively; $P < 0.05$), as well as a high intake of fat (medians 3.3 and 2.6 g/MJ, respectively; SD 1.3 and 1.2, respectively; $P < 0.05$) and proportion of energy from fat (medians 34 and 30% of the energy for cases and controls, respectively; SD 7.3 and 6.8, respectively; $P < 0.02$) was shown to be significant risk factors for elbow arthrosis. A high body condition score was a parameter that was indicative/nearly significant as risk factor for elbow arthrosis (3.29 and 3.11 on a 5-grade body composition scale for cases and controls, and a SD of 0.90 and 0.93, respectively; $P < 0.08$).

DISCUSSION

This study has indicated feeding patterns and some types of exercise as well as weight as significant risk factors in HD and/or EA. As these factors may vary when studying multifactorial diseases in populations, it has been shown that matching breed, sex, and age among individuals is of value when performing similar studies in the future (12).

This survey was based on a sample of the Swedish Labrador population from the registry of the Swedish Kennel Club that registers 85% of the pure-bred dogs in Sweden. Our sample consists of a larger proportion of cases of HD and EA than the entire source population that has ~23% HD and 10% EA (6). Therefore, this sample may not be totally representative for the entire population of Swedish Labradors. However, compared with other studies in which cases and controls are taken from veterinary clinics (4,12), we possibly have a better chance to get a representative subsample of the population.

Although this study included few individuals with ad libitum feeding, it should be noted that all of those were in the case groups for HD and EA. This supports earlier studies (1–3) that ad libitum feeding is a risk factor in developmental bone diseases such as hip dysplasia and elbow arthrosis.

Many Labradors are living quite an active life even though the main purpose of ownership might be companionship. Other studies have indicated that prolonged or jarring activity, such as running after a ball or a stick in a high speed, might lead to the development of osteochondrosis (4). This study supports that study and has shown that there might be an increased risk to perform this type of activity for both HD and EA.

The conclusion is that in Swedish Labradors bred for hip and elbow conformity, feeding patterns, diet, weight, and exercise are risk factors that have to be taken into account in developing preventive measures as well as in the design of research to elucidate the multifactorial background of skeletal diseases.

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