Observations and analysis of risk factors for GDV in a single institution: a case-control study

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Abstract

Objective
To evaluate/ determine the risk factors for dogs presented with Gastric Dilation-Volvulus (GDV) to a referral veterinary centre and to compare the results with those currently reported in veterinary literature.

Materials and Methods
The observational case-control study comprised a population of 215 dogs that attended the referral centre between 2000 and 2018. Medical records were searched for GDV and those matching the criteria were manually reviewed. A questionnaire was completed by the owners of the dogs involved in the study (both case and control populations) in order to gain further information that could be considered relevant to GDVs. In particular, information included the dogs’ behaviour and the dogs daily activities.

Results
The study included 115 cases of GDV and 115 controls. Out of the GDV dogs 13% (15/115) were small breed dogs and the remaining 87% (100/115) either large or giant breeds.

The following risk factors for developing a GDV have been identified: Purebred dogs over 3 years old and either large or giant breeds, weighing > 30 kg. Foreign body ingestion, diarrhoea, and grass consumption were also associated to increase the likelihood in developing GDV. Behavioural temperament was not associated with developing GDV.

Clinical Significance
The findings support previously identified risk factors in the development of GDV, but characteristics related to the dogs temperament warrant further investigation. Knowledge of these results will further allow clinicians to make evidence-based recommendations to owners in attempting to prevent GDV in dogs. Furthermore this paper confirms that the risk of GDV in certain breeds and in certain conditions is always high and that GDV is still an extremely current disease.
Introduction

Gastric Dilatation - Volvulus (GDV) is an acute and potentially fatal syndrome that mainly affects large deep-chested dogs, although occasionally it has been reported in small dogs and other species, including cats\textsuperscript{1-5} guinea pigs\textsuperscript{7}, monkeys\textsuperscript{8} and humans\textsuperscript{9}. Dilatation is supposed to precede torsion, though it has been reported that gastric torsion episodes may arise without prior dilatation\textsuperscript{9}. Symptoms predominate due to rapid accumulation of gases and fluids within the gastric lumen leading to distension, increasing intraluminal pressure and stomach rotation; those in turn lead to dyspnoea, varying degrees of hypovolemic and/or septic shock, ventilation-perfusion mismatch, systemic inflammatory response syndrome (SIRS), coagulation malfunction and multiple organ dysfunction syndrome (MODS)\textsuperscript{10-13}, including ventricular arrhythmias and Disseminated Intravascular Coagulation (DIC)\textsuperscript{14}. If left untreated, GDV can lead to severe impairment of venous return to the heart, diminished stroke volume, necrosis of the gastric wall and eventual fatality\textsuperscript{15}.

Although the exact aetiology of GDV is still unknown, numerous predisposing risk factors have been described\textsuperscript{12,16}. Male, large and giant pure breed dogs\textsuperscript{17,18}, and deep chested dogs are at increased risk\textsuperscript{9}. Other reported risk factors include increased age\textsuperscript{18}, low Body Condition Score (BCS)\textsuperscript{17}, nervous or a fearful temperament\textsuperscript{17}, stressful events occurring within 8 hours prior to the GDV episode\textsuperscript{12}, and a familial history of GDV\textsuperscript{18}. Nutrition-related risk factors have also been identified, such as eating one meal per day, small food particles, rapid food ingestion\textsuperscript{17,20} and eating only one type of food\textsuperscript{14}. Some authors have suggested a relationship between GDV and weather conditions with one study reporting a higher incidence during winter months\textsuperscript{21} whereas another reported an increase in environmental temperature presented as a significant risk factor for GDV\textsuperscript{16}. The association between GDV and physical activity remains controversial\textsuperscript{15, 16}. Recently, a study on canine gut microbiome showed that microbiome in GDV patients was altered by an expansion of a minor lineage and was associated with specific alleles of both innate and adaptive immunity genes. These associations are consistent with the hypothesis that immune genes may play a role in predisposition to GDV by altering the gut microbiome\textsuperscript{22}.

The purpose of this epidemiological survey was to determine whether some of the most commonly claimed risk factors for GDV exist in northern Italy and to ascertain whether there are differences when comparing similar studies conducted, to date, in other countries.

Methods

The epidemiological case-control study was conducted at a single veterinary practice (between 2000 and 2018)

To meet the inclusion criteria dogs had to be older than 6 months of age, without previous prophylactic gastropexy. Dogs in the control group had never had a GDV episode. Owners of both GDV cases and control dogs should have completed and signed the questionnaire under direct supervision of the attending clinician.

All GDV dogs were recruited during their presentation to the centre for an acute episode of GDV. On the other hand, control dogs were selected randomly from patients brought into the centre for reasons other than GDV.
The questionnaire consisted of different sections including the owner's data, the dog's signalment (breed, age, BCS, sex, neutered/intact), the dog's temperament (shy, balanced, aggressive, or exuberant) as assigned by the owner. Two sections focused on the GDV and included treatments received, whether a previous episode had occurred, the time spent between physical activity and GDV presentation, the elapsed time between a meal and GDV, and the presence of a possible stressful situation before of the onset of the disease. The last part of the questionnaire included questions related to the dog's lifestyle and dietary habits. Both the owner and the veterinarian defined the BCS of the dog, choosing either skinny, thin, ideal weight, overweight, obese. Details of the physical activity performed by the dog during the day and correlation between physical activity and meal were documented. The owner was asked whether the dog was housed in kennels and whether it was used to long journeys. Finally the presence of vomiting/diarrhoea was investigated along with whether the dog was prone to ingesting grass or foreign bodies (TABLE 1).

Statistical Analysis

Statistical analysis, performed using statistical software R. Data was merged making non-dichotomous variables into dichotomous variables. For example, for the "food intake speed" parameter, the owner could choose between four answers: slow, normal, quick, voracious. The data was then grouped in slow/normal (Group 1) and fast/voracious (Group 2), using the Pivot tables. This procedure was carried out for all non-dichotomous variables (i.e. those variables for which the answer did not include a simple YES/NO but a scale of values). These variables were: the speed of food intake; temperament of the dog, type of feeding, position of the bowl, number of meals, type and frequency of physical activity, presence of episodes of vomiting and/or diarrhoea, tendency to eat foreign bodies, tendency to consume grass, stay in kennels, and whether it was used to long journeys.

Once all dichotomous variables were rendered, each parameter was entered in 2x2 contingency tables. For some variables, several 2x2 tables were created, for example 4 tables were created for physical activity including the possibility to carry out physical activity before the meal, the possibility to carry out physical activity after the meal, possibility to perform physical activity before and after the meal.

From the 2x2 contingency tables the following values were calculated: OR, ES, OR MIN and OR MAX. OR is a statistical value that represents the relationship between sick and exposed subjects and the healthy and exposed subjects. It is calculated as \((a/c)/(b/d)\), ie (cases/non-cases) exposed/(cases/non-cases) not exposed. (TABLE 2).

The values OR MIN and OR MAX indicate the confidence interval, that is, define how much the OR value represents the estimate of a real value. The confidence interval makes it possible to verify the statistical significance of the results: if it contains the value 1, the null hypothesis is satisfied (ie that there is no difference between exposed or non-exposed subjects to risk factors). If the confidence interval does not contain the value 1, the null hypothesis is rejected, i.e. the alternative hypothesis is accepted, which states that there is a difference between exposed and non-exposed subjects to the risk factor, so that the OR value is significant (TABLE 3).

After calculating the OR value of each variable, \(\chi^2\)-tests were performed; p values of < 0.05 were considered statistically significant.

Results

In total, 86.9% (100/115) of dogs presented with GDV were large/giant breeds while only 13.1% (15/115) were medium/small breeds. Among the control dogs, 54.84% (85/155) were large-giant breeds and 19.35% (30/155) medium/small breeds. In total, 94.7% of GDV dogs and 81.7% of control dogs were purebred dogs. Out of 115 cases, 76 GDV dogs (66%) were male and 39 (34%) female. The control group consisted of 65 (56.5 %) male and 50 (43.4 %) female dogs. Most dogs were older than three years of age, 93% (108/115) of GDV dogs and 71.3% (82/115) of control dogs. Most dogs were older than three years of age, 93% (108/115) of GDV dogs and 71.3% (82/115) of control dogs. Most dogs had a low to normal BCS, 90% of GDV dogs and 93% of control dogs respectively and 68.6% of GDV dogs (79 /115) and 65% (75/115) of control dogs were > 30 kg.
| Table No. 1: Summary of distribution of individuals variables |
|-------------------------------------------------------------|
| **Breed** | **Neutered** | **Sex (Male/Female)** | **Age (years)** | **Body height (CM)** | **Body weight (KG)** | **Comments** |
|-----------|--------------|-----------------------|----------------|----------------------|----------------------|-------------|
| Boxer     | Yes          | M                     | 5              | 60                   | balanced             | balanced    |
| German Shepherd | Yes  | M                     | 4              | 70                   | balanced             | balanced    |
| German Shepherd | Yes  | M                     | 5              | 50                   | balanced             | balanced    |
| German Shepherd | Yes  | M                     | 6              | 60                   | balanced             | balanced    |
| German Shepherd | Yes  | M                     | 7              | 30                   | balanced             | balanced    |
| German Shepherd | Yes  | M                     | 8              | 40                   | balanced             | balanced    |
| German Shepherd | Yes  | M                     | 9              | 50                   | balanced             | balanced    |
| German Shepherd | Yes  | M                     | 10             | 60                   | balanced             | balanced    |
| German Shepherd | Yes  | M                     | 11             | 70                   | balanced             | balanced    |
| German Shepherd | Yes  | M                     | 12             | 80                   | balanced             | balanced    |
| German Shepherd | Yes  | M                     | 13             | 90                   | balanced             | balanced    |
| German Shepherd | Yes  | M                     | 14             | 100                  | balanced             | balanced    |
| German Shepherd | Yes  | M                     | 15             | 110                  | balanced             | balanced    |
| German Shepherd | Yes  | M                     | 16             | 120                  | balanced             | balanced    |
| German Shepherd | Yes  | M                     | 17             | 130                  | balanced             | balanced    |
| German Shepherd | Yes  | M                     | 18             | 140                  | balanced             | balanced    |
| German Shepherd | Yes  | M                     | 19             | 150                  | balanced             | balanced    |
| German Shepherd | Yes  | M                     | 20             | 160                  | balanced             | balanced    |

**Notes:**
- **Comments:**
  - More than 4 h before, 1 h after, 12 h later
  - Occasionally
  - Sometimes
  - Never
  - Occasionally
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| No. | Yes/No | Breed     | Gender | Age | Activity | Frequency | Diet | Exercise | Behavior |
|-----|--------|-----------|--------|-----|----------|-----------|------|----------|----------|
| 21  | Yes    | Boxer     | M      | 5   | No       | Some time | No   | No       | Yes      |
| 22  | Yes    | German Shepherd | M | 34 | No, 3 h later | Never | No | No       | Yes      |
| 23  | Yes    | German Shepherd | M | 2  | No, 2 h later | Never | No | No       | Yes      |
| 24  | Yes    | German Shepherd | M | 8  | No, 25 h later | Never | No | No       | Yes      |
| 25  | Yes    | German Shepherd | M | 8  | No, 25 h later | Never | No | No       | Yes      |
| 26  | Yes    | German Shepherd | M | 13 | No, 25 h later | Never | No | No       | Yes      |
| 27  | Yes    | German Shepherd | M | 8  | No, 25 h later | Never | No | No       | Yes      |
| 28  | Yes    | German Shepherd | F | 7  | No, 1 h later | Never | No | No       | Yes      |
| 29  | Yes    | German Shepherd | M | 11 | No, 25 h later | Never | No | No       | Yes      |
| 30  | Yes    | Samoiedo   | F | 15 | No, 25 h later | Never | No | No       | Yes      |

**Notes:**
- **Activity:** Includes time spent on physical activities such as running, walking, or playing.
- **Frequency:** Indicates how often the activity is performed.
- **Diet:** Specifies the type of diet, with options for home-made or commercial food.
- **Exercise:** Specifies the level of exercise, with options for high, moderate, or low.
- **Behavior:** Specifies behaviors observed during the activity.
| No. | Age (yr) | Breed | Sex | Coat Color | Tail | Ear | Tail | Ear | Ear Infection | Head | Neck | Spine | Hips | Forelimbs | Hindlimbs | Hocks | Tail | Tail carriage | Break | Walk | Trot | Hindlimb | Reflex | Limb Stability | Abnormalities | General Observations |
|-----|----------|-------|-----|------------|------|-----|------|-----|---------------|------|------|--------|------|-----------|-----------|------|------|----------------|-------|------|------|-----------|-------|----------------|---------------------|---------------------|
| 31  | Yes      | German Shepherd | M   | Black | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D |
| 32  | Yes      | Shitzu | F   | White | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D |
| 33  | Yes      | Great Dane | M   | Black | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D |
| 34  | Yes      | Irish Setter | M   | Black | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D |
| 35  | Yes      | German Shepherd | M   | Black | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D |
| 36  | Yes      | Greyhound | M   | Black | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D |
| 37  | Yes      | Dobe | M   | Black | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D |
| 38  | Yes      | Doberman Pinscher | M   | Black | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D |
| 39  | Yes      | Siamese Cat | M   | Black | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D |

**Notes:**
- Age (yr): **6**
- Coat Color: **Black**
- Tail: **D**
- Ear: **D**
- Tail carriage: **D**
- Break: **D**
- Walk: **D**
- Trot: **D**
- Hindlimb: **D**
- Reflex: **D**
- Limb Stability: **D**
- Abnormalities: **D**
- General Observations: **D**
| ID | Breed              | Gender | Age | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | 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Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Ear | Height | Weight | Colour | Nature | Exercise | Diet | Coat | Hair | Tail | Earl…
|   | breed                         | sex | age | weight | coat | colour | size | activity | diet | water | soil | outside | excrement | voiding | defecation |
|---|-------------------------------|-----|-----|--------|------|--------|------|----------|------|-------|------|----------|-----------|---------|------------|
| 60 | boxer                         | M   | 1   | 35     | short | no     | long | occasional | rare | 2      | 2.5  | no       | occasionally | occasionally | occasionally |
| 61 | english setter               | F   | 27  | 70     | long  | yes    | small| occasional | regular | 2      | 1.5  | no       | occasionally | occasionally | occasionally |
| 62 | chihuahua                    | M   | 1   | 5      | long  | no     | very small | occasional | 2      | 1.5  | no       | occasionally | occasionally | occasionally |
| 63 | shih tzu                     | M   | 9   | 30     | long  | no     | very small | occasional | 2      | 1.5  | no       | occasionally | occasionally | occasionally |
| 64 | yorkshire terrier            | F   | 11  | 35     | long  | no     | normal | occasionally | regular | 2      | 1.5  | no       | occasionally | occasionally | occasionally |
| 65 | german shepherd              | M   | 5   | 40     | short | no     | large | occasional | regular | 2      | 2.5  | no       | occasionally | occasionally | occasionally |
| 66 | great dane                   | M   | 7   | 70     | long  | no     | very large | occasional | 2      | 2.5  | no       | occasionally | occasionally | occasionally |
| 67 | doberman                     | M   | 8   | 45     | long  | no     | large | occasional | regular | 2      | 3.5  | no       | occasionally | occasionally | occasionally |
| 68 | chow                          | F   | 2   | 30     | short | no     | very small | occasional | 2      | 1.5  | no       | occasionally | occasionally | occasionally |
| 69 | chihuahua                    | M   | 1   | 6      | short | no     | very small | occasional | 2      | 1.5  | no       | occasionally | occasionally | occasionally |
| 70 | great dane                   | M   | 7   | 70     | long  | no     | very large | occasional | 2      | 2.5  | no       | occasionally | occasionally | occasionally |
| 71 | saint bernard                | M   | 6.5 | 70     | short | no     | very small | occasional | 2      | 1.5  | no       | occasionally | occasionally | occasionally |
| 72 | german shepherd              | F   | 9   | 20     | short | no     | very small | occasional | 2      | 1.5  | no       | occasionally | occasionally | occasionally |
| 73 | great dane                   | M   | 7   | 70     | short | no     | very small | occasional | 2      | 1.5  | no       | occasionally | occasionally | occasionally |
| 74 | doberman                     | M   | 8   | 45     | long  | no     | large | occasional | regular | 2      | 3.5  | no       | occasionally | occasionally | occasionally |
| 75 | chihuahua                    | M   | 1   | 6      | short | no     | very small | occasional | 2      | 1.5  | no       | occasionally | occasionally | occasionally |
| 76 | saint bernard                | M   | 6.5 | 70     | short | no     | very small | occasional | 2      | 1.5  | no       | occasionally | occasionally | occasionally |
| 77 | great dane                   | M   | 7   | 70     | short | no     | very small | occasional | 2      | 1.5  | no       | occasionally | occasionally | occasionally |
| 78 | doberman                     | M   | 8   | 45     | long  | no     | large | occasional | regular | 2      | 3.5  | no       | occasionally | occasionally | occasionally |
| 79 | saint bernard                | M   | 6.5 | 70     | short | no     | very small | occasional | 2      | 1.5  | no       | occasionally | occasionally | occasionally |

**Notes:**
- Yes/No values indicate the frequency and type of behavior observed.
- "Occasionally" indicates behavior that is seen rarely or sometimes.
- "Regularly" indicates behavior that is typical or common.
- "Never" indicates behavior that is not observed.
- "Voracious" indicates a high consumption rate.
- "Slow" indicates a slower pace.
- "Rioned" indicates a raised condition.
- "Dry" indicates a dry texture.
- "Wet" indicates a wet texture.
- "Homemade" indicates food prepared at home.
- "Normal" indicates a typical diet.
- "Fast" indicates a rapid pace.
- "Normal" indicates a typical environment.
- "Voracious" indicates a high consumption rate.
- "Slow" indicates a slower pace.
- "Rioned" indicates a raised condition.
- "Dry" indicates a dry texture.
- "Wet" indicates a wet texture.
- "Homemade" indicates food prepared at home.
- "Normal" indicates a typical diet.
- "Voracious" indicates a high consumption rate.
- "Slow" indicates a slower pace.
- "Rioned" indicates a raised condition.
- "Dry" indicates a dry texture.
- "Wet" indicates a wet texture.
- "Homemade" indicates food prepared at home.
- "Normal" indicates a typical diet.
- "Voracious" indicates a high consumption rate.
- "Slow" indicates a slower pace.
- "Rioned" indicates a raised condition.
- "Dry" indicates a dry texture.
- "Wet" indicates a wet texture.
- "Homemade" indicates food prepared at home.
- "Normal" indicates a typical diet.
| Breed                  | Sex | Age | Month | Year | Weight | Feeding | Exercise | Grooming | Rest | Behavior | Diet | Special Needs |
|-----------------------|-----|-----|-------|------|--------|---------|----------|----------|------|-----------|------|---------------|
| Boxer                 | F   | 20  | 4     | 1    | 20      | balanced | weekly   | no        | never | aggressive | voracious | box, no surgery |
| Chow chow             | M   | 30  | 4     | 1    | 30      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| Cane Corso            | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| Doberman              | M   | 30  | 4     | 1    | 30      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| Dobermann             | F   | 11  | 2     | 1    | 20      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| German Shepherd       | M   | 26  | 2     | 1    | 26      | balanced | weekly   | no        | never | voracious | voracious | box, no surgery |
| No. | Breed                  | Gender | Age | Body Condition | Coat Type | Color | Tail Length | Ears       | Weight (kg) | Natural Diet | Exercise Needs | Urolithiasis | Personal Details |
|-----|------------------------|--------|-----|----------------|-----------|-------|-------------|------------|-------------|---------------|----------------|---------------|------------------|
| 101 | great dane             | F      | 4   | timid          | dry miostened | 1     | no fast soil | 1.5 living outside | more than 4 | 1 | 1 h before, 1 h later | never          | no occasionally | occasionally | yes  yes      |
| 102 | cane corso             | M      | 7   | balanced      | dry        | 2     | yes normal soil | 3.5 walk |              | half a h before, half a h later | never          | no occasionally | never          | yes  yes      |
| 103 | dachshund              | F      | 12  | aggressive     | homemade   | 1     | no voracious soil | 2     walk |              | never          | no occasionally | never          | no sometimes    |
| 104 | geriatric shepherd     | M      | 11  | balanced      | homemade   | 1     | yes slow soil | 2.5 walk | more than 4 | never          | no occasionally | never          | sometimes sometimes |
| 105 | german shepherd        | M      | 12  | aggressive     | dry miostened | 1     | yes voracious soil | 2.5 walk |              | never          | no occasionally | occasionally | sometimes no    |
| 106 | bavarian hound         | F      | 8   | aggressive     | dry        | 2     | no voracious soil | 2.5 living outside |              | never          | no never occasionally | sometimes no    |
| 107 | maremma sheep dog      | M      | 8   | balanced      | dry        | 2     | yes slow soil | 2.5 walk | 3 3 1 h before | never          | no never occasionally | occasionally yes  no |
| 108 | German Shepherd        | M      | 9   | balanced      | homemade   | 2     | no fast soil | 2.5 run | 1 1 2 h later | occasional- men- ly | yes never occasionally | yes yes      |
| 109 | dobermann              | M      | 8   | exuberant     | dry miostened | 1     | no fast soil | 2.5 run | 2 1 2 h before | never          | no occasionally | occasionally sometimes no |
| 110 | Italian hound          | F      | 13  | timid          | homemade   | 1     | yes voracious soil | 2     walk | 1 1 3 h later | never          | no never occasionally | never | sometimes sometimes |
| 111 | great dane             | M      | 2   | timid          | dry miostened | 2     | no normal soil | 2 nothing |              | never          | never never never no no |
| 112 | dalmatian              | M      | 5   | balanced      | dry miostened | 2     | no voracious soil | 1.5 living outside |              | never          | never no occasionally | never yes yes |
| 113 | german shepherd        | F      | 7   | timid          | dry        | 1     | no voracious soil | 2.5 living outside |              | never          | never never never no no |
| 114 | great dane             | F      | 7   | timid          | dry        | 3     | no slow side | 2.5 living outside |              | never          | never never never yes no |
| 115 | bernese mountain dog   | F      | 2   | no 75          | balanced  | dry   | 3     no normal raised | 2.5 nothing |              | occasionally | no never occasionally | sometimes no |
| 116 | bernese mountain dog   | M      | 2   | no 45          | balanced  | dry   | 3     no normal raised | 2.5 nothing |              | occasionally | no never occasionally | sometimes no |
| 117 | bernese mountain dog   | M      | 4   | exuberant     | dry        | 2     | no normal soil | 2.5 living outside |              | occasionally | no occasionally | occasionally sometimes no |
| 118 | bernese mountain dog   | M      | 3   | yes 44         | balanced  | dry   | 2     no normal soil | 3.5 walk | 1 2 1 h before | occasionally | no never never sometimes | sometimes |
| 119 | bernese mountain dog   | M      | 7   | yes 45         | balanced  | dry   | 2     no normal soil | 2.5 walk | 2 1.5 1 h before | occasionally | no never never never no no | grandmaj died for glv |
| Breed                     | Age | Gender | Diet     | Bowel Movement | Stool Color | Stool Consistency | Stool Output | Meal Time | Stool Output | Meal Time |
|---------------------------|-----|--------|----------|----------------|-------------|-------------------|--------------|-----------|--------------|-----------|
| Bernese Mountain Dog      | M   | 1.5    | balanced dry | Slightly moist | normal      | firm              | 2.5          | 0.5 h     | never        | 0.5 h     |
| Argentine Dogo           | M   | 1.5    | balanced dry | regular       | normal      | firm              | 2.5          | 0.5 h     | never        | 0.5 h     |
| German Shorthaired Pointer | F   | 2.5    | balanced dry | regular       | normal      | firm              | 2.5          | 0.5 h     | never        | 0.5 h     |
| Rottweiler                | M   | 2      | balanced dry | regular       | normal      | firm              | 2.5          | 0.5 h     | never        | 0.5 h     |
| Boxer                     | M   | 2      | balanced dry | regular       | normal      | firm              | 2.5          | 0.5 h     | never        | 0.5 h     |
| Irish Setter              | M   | 2      | balanced dry | regular       | normal      | firm              | 2.5          | 0.5 h     | never        | 0.5 h     |
| German Shepherd Dog       | F   | 3      | balanced dry | regular       | normal      | firm              | 2.5          | 0.5 h     | never        | 0.5 h     |
| German Shorthaired Pointer | F   | 4      | balanced dry | regular       | normal      | firm              | 2.5          | 0.5 h     | never        | 0.5 h     |
| Doberman                   | M   | 4      | balanced dry | regular       | normal      | firm              | 2.5          | 0.5 h     | never        | 0.5 h     |
| Australian Cattle Dog     | F   | 5      | balanced dry | regular       | normal      | firm              | 2.5          | 0.5 h     | never        | 0.5 h     |
| Australian Shepherd Dog   | M   | 6      | balanced dry | regular       | normal      | firm              | 2.5          | 0.5 h     | never        | 0.5 h     |
| Golden Retriever          | M   | 7      | balanced dry | regular       | normal      | firm              | 2.5          | 0.5 h     | never        | 0.5 h     |
| Rottweiler                | M   | 8      | balanced dry | regular       | normal      | firm              | 2.5          | 0.5 h     | never        | 0.5 h     |
| Siberian Husky             | M   | 9      | balanced dry | regular       | normal      | firm              | 2.5          | 0.5 h     | never        | 0.5 h     |
| Great Dane                | F   | 10     | balanced dry | regular       | normal      | firm              | 2.5          | 0.5 h     | never        | 0.5 h     |

**Legend:**
- **Age:** Age of the animal in years.
- **Gender:** Gender of the animal (M = Male, F = Female).
- **Diet:** Type of diet (balanced, homemade).
- **Bowel Movement:** Frequency of bowel movement (normal, more than 2).n
- **Stool Color:** Color of the stool (normal, more than 2).n
- **Stool Consistency:** Consistency of the stool (normal, more than 2).n
- **Stool Output:** Amount of stool output (normal, more than 2).n
- **Meal Time:** Time of meal consumption (before, 1 h before, 1 h later).
- **Stool Output:** Time of meal consumption (before, 1 h before, 1 h later).

**Notes:**
- Slightly moist stool is more than 2.
- Regularly consumed food is more than 2.
- Firm stool is more than 2.
- Absent stool is more than 2.
- No stool is more than 2.
| #  | Breed                  | Gender | Age (y) | Weight (kg) | Diet Type | Feeding Habits | Water Consumption | Soil Type       | Soil Quality   | Movement  | Frequency | Activity | Notes          |
|----|------------------------|--------|---------|-------------|------------|----------------|------------------|----------------|----------------|------------|-----------|----------|----------------|
| 141| French Bulldog         | M      | 7       | 12          | balanced   | homemade      | 1                | no             | normal         | living outside | 1         | 0.5      | regularly       |
| 142| Border Collie          | M      | 9       | 27          | exuberant   | dry misedtened| 2                | yes            | slow            | run         | more than 4 | never    | occasionally    |
| 143| Boxer                  | M      | 1.5     | 25          | exuberant   | dry           | 2                | no             | slow            | walk        | 2          | 3    | 2 h later     |
| 144| Alaskan Malamute       | M      | 11      | 55          | balanced   | dry           | 1                | no             | normal         | walk        | 1          | 0.5    | 5 h later     |
| 145| Greyhound              | F      | 8       | 20          | balanced   | dry           | 1                | no             | normal         | living outside | never     | never   | never          |
| 146| Cross Breed            | M      | 8       | 30          | balanced   | dry           | 1                | no             | normal         | raised      | 2.5       | living outside | never     | never | never          |
| 147| Rottweiler             | M      | 11      | 60          | balanced   | dry           | 1                | no             | normal         | walk        | 1          | 1    | 2 h later     |
| 148| Golden Retriever       | F      | 6       | 35          | exuberant   | dry           | 2                | no             | normal         | soil        | 3.5       | living outside | never     | never | occasionally   |
| 149| Alaskan Malamute       | M      | 3       | 39          | aggressive  | homemade      | 2                | no             | fast            | soil        | 2.5       | living outside | never     | never | occasionally   |
| 150| French Bulldog         | M      | 4       | 15          | balanced   | dry           | 2                | no             | fast            | soil        | 2.5       | walk     | 1          | 1    | 5 h later     |
| 151| Cross Breed            | M      | 10      | 12          | balanced   | dry           | 2                | yes            | fast            | soil        | 2.5       | walk     | 1          | 0.5  | 3 h later     |
| 152| Dwarf Dachshund        | M      | 6       | 6.5         | balanced   | dry           | 1                | yes            | normal         | soil        | 2.5       | walk     | 1          | 1    | 1 h later     |
| 153| Border Collie          | F      | 4       | 25          | exuberant   | dry           | 2                | no             | normal         | soil        | 2.5       | living outside | 1         | never | occasionally   |
| 154| Beagle                 | M      | 11      | 23          | balanced   | dry           | 2                | no             | fast            | soil        | 2.5       | walk     | 4          | 0.25 | half a h later     |
| 155| Terranova              | F      | 14      | 40          | balanced   | homemade      | 1                | no             | voracious       | soil        | 2.5       | living outside | never     | never | never          |
| 156| Doberman               | M      | 13      | 55          | balanced   | homemade      | 1                | no             | voracious       | soil        | 2.5       | living outside | occasionally | never | never          |
| 157| Maremma Sheepdog       | M      | 14      | 65          | balanced   | homemade      | 1                | no             | slow            | soil        | 2.5       | living outside | occasionally | never | never          |
| 158| Rottweiler             | M      | 13      | 40          | balanced   | homemade      | 1                | no             | fast            | soil        | 2.5       | living outside | occasionally | never | never          |
| 159| Great Dane             | F      | 7       | 65          | balanced   | dry           | 3                | no             | normal         | soil        | 2.5       | living outside | regular    | never | occasionally   |
| 160| Great Dane             | M      | 5       | 70          | balanced   | dry           | 2                | no             | normal         | soil        | 2.5       | living outside | regular    | never | occasionally   |
| No | Breed                          | Gender | Eats     | Meal       | Meets     | Poops     | Lives     |
|----|--------------------------------|--------|----------|------------|-----------|-----------|-----------|
| 161| M                               | male   | 1 fast   | soil 2.5   | 1 h before| 1 h nor   | living outside |
| 162| F                               | female | 2 no fast| soil 2.5   | 2 h before| 1 h nor   | living outside |
| 163| M                               | male   | 1 fast   | soil 2.5   | 1 h before| 1 h nor   | living outside |
| 164| F                               | female | 2 no fast| soil 2.5   | 2 h before| 1 h nor   | living outside |
| 165| M                               | male   | 1 fast   | soil 2.5   | 1 h before| 1 h nor   | living outside |
| 166| F                               | female | 2 no fast| soil 2.5   | 2 h before| 1 h nor   | living outside |
| 167| M                               | male   | 1 fast   | soil 2.5   | 1 h before| 1 h nor   | living outside |
| 168| F                               | female | 2 no fast| soil 2.5   | 2 h before| 1 h nor   | living outside |
| 169| M                               | male   | 1 fast   | soil 2.5   | 1 h before| 1 h nor   | living outside |
| 170| F                               | female | 2 no fast| soil 2.5   | 2 h before| 1 h nor   | living outside |
| 171| M                               | male   | 1 fast   | soil 2.5   | 1 h before| 1 h nor   | living outside |
| 172| F                               | female | 2 no fast| soil 2.5   | 2 h before| 1 h nor   | living outside |
| 173| M                               | male   | 1 fast   | soil 2.5   | 1 h before| 1 h nor   | living outside |
| 174| F                               | female | 2 no fast| soil 2.5   | 2 h before| 1 h nor   | living outside |
| 175| M                               | male   | 1 fast   | soil 2.5   | 1 h before| 1 h nor   | living outside |
| 176| F                               | female | 2 no fast| soil 2.5   | 2 h before| 1 h nor   | living outside |
| 177| M                               | male   | 1 fast   | soil 2.5   | 1 h before| 1 h nor   | living outside |
| 178| F                               | female | 2 no fast| soil 2.5   | 2 h before| 1 h nor   | living outside |
| 179| M                               | male   | 1 fast   | soil 2.5   | 1 h before| 1 h nor   | living outside |
| 180| F                               | female | 2 no fast| soil 2.5   | 2 h before| 1 h nor   | living outside |
| No. | Breed                          | Gender | Age (years) | Size | Feeding | Activity | Exercise | latrine | Water | Temperature | Rest | Social | Training | Other |
|-----|-------------------------------|--------|-------------|------|---------|-----------|----------|---------|-------|-------------|------|---------|----------|-------|
| 181 | german shepherd               | M      | 5           | 52   | yes     | exuberant | dry      | 1       | no    | fast        | soil 2.5 | living outside | never   | no     | never    | never |
| 182 | golden retriever              | M      | 1           | 32   | no      | balanced  | dry      | 3       | no    | normal      | soil 2.5 | run        | 4       | 4      | 2 h later | never |
| 183 | great dane                    | F      | 7           | yes  | 60      | balanced  | dry      | 2       | no    | fast        | rises 2.5 | living outside | 1       | 1      | 3 h later | never |
| 184 | czechoslovakian wolf          | M      | 5           | no   | 36      | aggressive | dry      | 1       | no    | fast        | soil 2.5 | living outside | 2       | 2      | 2 h before | occasionally |
| 185 | labrador retriever            | M      | 7           | no   | 35      | balanced  | dry      | 2       | no    | fast        | rises 3.5 | walk       | 2       | 1      | 1 h before | never |
| 186 | german shepherd               | F      | 8           | yes  | 34      | timid     | dry      | 1       | no    | fast        | soil 3.5 | living outside | occasionally | no       | never    | sometimes |
| 187 | leonberger                    | M      | 8           | no   | 60      | balanced  | dry      | 1       | yes   | slow        | soil 2.5 | living outside | occasionally | no       | occasionally | sometimes |
| 188 | cross breed                   | M      | 0.5         | no   | 17      | miscellaneous | dry      | 2       | no    | slow        | soil 2.5 | walk       | 2       | 1      | 4 h later | never |
| 189 | german shepherd               | M      | 9           | no   | 33      | balanced  | dry      | 1       | no    | normal      | soil 2.5 | living outside | 2       | 4      | 4 h later | occasionally |
| 190 | cross breed                   | M      | 2           | no   | 11      | balanced  | dry      | 2       | yes   | normal      | soil 2.5 | living outside | 3       | 2      | 3 h later | never |
| 191 | hound                         | M      | 3           | no   | 23      | timid     | dry      | 2       | yes   | slow        | soil 2.5 | living outside | 2       | 3      | 1 h before | sometimes |
| 192 | czechoslovakian wolf          | F      | 1           | no   | 23      | exuberant | dry      | 3       | no    | fast        | soil 2.5 | walk       | 3       | 3      | 1 h later | weekly |
| 193 | english setter                | M      | 1.5         | no   | 22      | exuberant | dry      | 2       | no    | voracious   | soil 2.5 | living outside | never   | never   | never    | never |
| 194 | pittbull                      | M      | 4           | no   | 30      | timid     | dry      | 2       | no    | voracious   | soil 2.5 | living outside | never   | never   | occasionally | sometimes |
| 195 | german shepherd               | M      | 0.58        | no   | 28      | balanced  | dry      | 2       | no    | normal      | soil 2.5 | living outside | never   | no     | occasionally | yes |
| 196 | german shepherd               | F      | 0.5         | yes  | 18      | exuberant | dry      | 2       | no    | fast        | soil 2.5 | living outside | never   | never   | occasionally | no |
| 197 | sharpei                       | M      | 15          | no   | 18      | aggressive | dry      | 1       | yes   | voracious   | soil 2.5 | walk       | 1       | 0.5    | 8 h before | never |
| 198 | labrador retriever            | F      | 7           | yes  | 28      | balanced  | dry      | 3       | no    | normal      | soil 2.5 | nothing    | never   | never   | never    | yes |
| 199 | husky                         | M      | 15          | no   | 23      | balanced  | wet      | 1       | yes   | slow        | soil 2.5 | walk       | 3       | 2      | 2 h before | occasionally |
| 200 | weimaraner                    | M      | 1           | no   | 26      | exuberant | wet      | 2       | no    | voracious   | soil 2.5 | walk       | 4       | 0.25   | 2 h before | occasionally |

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| No. | Breed                  | Sex | Age | Size | Coat | Diet            | Activity | Training | Energy | Toy     | Body  |
|-----|------------------------|-----|-----|------|------|-----------------|----------|----------|--------|---------|-------|
| 201 | Boxer                  | F   | 10  | yes  |14    | 17 timid        | 1 h      | 2 no     | yes    |2 no     | 1.5   |
| 202 | Bloodhound             | M   | 6   | no   |29    | 20 balanced     | 2 h      | 2 no     | never  |2 no     | 2.5   |
| 203 | Boxer                  | F   | 10  | no   |29    | 2 balanced      | 2 h      | 2 no     | sometimes |no     | 2.5   |
| 204 | Dalmatian              | M   | 9   | yes  |27    | 20 balanced     | 2 h      | 2 no     | sometimes |no     | 2.5   |
| 205 | Dalmatian              | M   | 9   | no   |29    | 21 balanced     | 2 h      | 2 no     | occasionally |no     | 2.5   |
| 206 | Dachshund              | M   | 6   | no   |30    | 32 balanced     | 2 h      | 2 no     | never  |2 no     | never |
| 207 | Dachshund              | M   | 2   | no   |27    | 27 balanced     | 2 h      | 2 no     | sometimes |no     | 2.5   |
| 208 | Dachshund              | F   | 2   | no   |21    | 25 balanced     | 2 h      | 2 no     | occasionally |no     | 2.5   |
| 209 | Dachshund              | M   | 2   | no   |25    | 25 balanced     | 2 h      | 2 no     | occasionally |no     | 2.5   |
| 210 | Dachshund              | M   | 4   | no   |30    | 40 balanced     | 2 h      | 2 no     | occasionally |no     | 2.5   |
| 211 | Dachshund              | M   | 8   | no   |30    | 30 balanced     | 2 h      | 2 no     | occasionally |no     | 2.5   |
| 212 | Dachshund              | M   | 12  | yes  |30    | 30 balanced     | 2 h      | 2 no     | occasionally |no     | 2.5   |
| 213 | Dachshund              | M   | 20  | yes  |30    | 30 balanced     | 2 h      | 2 no     | occasionally |no     | 2.5   |
| 214 | Dachshund              | M   | 2   | no   |30    | 30 balanced     | 2 h      | 2 no     | occasionally |no     | 2.5   |
| 215 | Dachshund              | F   | 2   | no   |30    | 30 balanced     | 2 h      | 2 no     | occasionally |no     | 2.5   |
| 216 | Dachshund              | M   | 12  | yes  |30    | 30 balanced     | 2 h      | 2 no     | occasionally |no     | 2.5   |
| 217 | Dachshund              | M   | 4   | yes  |30    | 30 balanced     | 2 h      | 2 no     | occasionally |no     | 2.5   |

**Table Notes:**
- **No.** is the identification number for each dog.
- **Breed** is the breed of the dog.
- **Sex** is the sex of the dog (F for female, M for male).
- **Age** is the age of the dog in years.
- **Size** is the size of the dog in pounds.
- **Coat** is the coat type (long, medium, short).
- **Diet** is the diet type (homemade, store-bought).
- **Activity** is the activity level of the dog (low, medium, high).
- **Training** is the training level of the dog (low, medium, high).
- **Energy** is the energy level of the dog (low, medium, high).
- **Toy** is the toy preference of the dog (yes, no).
- **Body** is the body type of the dog (normal, obesity).

**Legend:**
- **Yes** indicates that the trait is present.
- **No** indicates that the trait is not present.
- **Sometimes** indicates that the trait is present occasionally.
- **Occasionally** indicates that the trait is present occasionally.
| ID | Breed                  | Gender | Studied? | Age  | Temperament | Feeding | Diet | Pooping | Littering | Walking | Rinsed  | Living Outside | Other Notes |
|----|------------------------|--------|----------|------|-------------|---------|------|---------|-----------|---------|---------|---------------|-------------|
| 218| No Afghan Greyhound    | M      | yes      | 2    | timid        | home-made| dry  | 1      | no         | 0.5     | 2       | living outside | never never no|
| 219| No Afghan Greyhound    | F      | yes      | 10   | 30          | exuberant| wet  | 2      | no         | 0.5     | 2       | living outside | sometimes |
| 220| No Malinois cross      | M      | no       | 9    | 30          | balanced| dry  | 2      | no         | 0      | 2       | living outside | never   |
| 221| No Afghan Greyhound    | M      | yes      | 1    | 24          | balanced| dry  | 2      | no         | 0      | 2       | living outside | never never no|
| 222| No Labrador Retriever  | M      | no       | 5    | yes         | no      | dry  | 2      | yes        | 0.5     | 2       | living outside | never never no|
| 223| No Australian Shepherd | M      | yes      | 2    | 35          | balanced| dry  | 2      | no         | 0      | 2       | living outside | never never never |
| 224| No Labrador Retriever  | M      | yes      | 1    | 30          | no      | dry  | 2      | no         | 0.5     | 2       | living outside | never never never |
| 225| No German Shepherd     | F      | yes      | 4    | 2           | no      | dry  | 2      | yes        | 0.5     | 2       | living outside | never never never |
| 226| No Weimaraner          | F      | yes      | 4    | 30          | no      | dry  | 2      | no         | 0.5     | 2       | living outside | never never |
| 227| No German Shepherd     | F      | yes      | 10   | 35          | yes     | dry  | 2      | no         | 0      | 2       | living outside | never |
| 228| No Boxer               | M      | yes      | 5    | 30          | yes     | dry  | 2      | no         | 0.5     | 2       | living outside | never |
| 229| No Boxer               | F      | yes      | 5    | 30          | yes     | dry  | 2      | no         | 0.5     | 2       | living outside | never |
| 230| No Boxer               | F      | yes      | 5    | 30          | yes     | dry  | 2      | no         | 0.5     | 2       | living outside | never |


Table 2. Dogs, feeding and physical activity characteristics. The relationship between different characteristics and statistic values: OR, OR MIN, OR MAX, ES and P Value

| Variable                                      | GDV 115/230 | CONTROL 115/230 | TOT CASES 230 | TOT CONTROLS 115/230 | OR  | OR MIN | OR MAX | ES  | Pvalue |
|-----------------------------------------------|-------------|-----------------|---------------|----------------------|-----|--------|--------|-----|--------|
| SIZE – large+giant breed, n                   | 100         | 85              | 115           | 115                  | 2,35| 1,19   | 4,66   | 0,35| 0,0200 |
| BREAD - pure breed, n                        | 109         | 94              | 115           | 115                  | 4,06| 1,57   | 10,48  | 0,48| 0,0041 |
| SEX - male                                    | 76          | 65              | 115           | 115                  | 1,50| 0,88   | 2,56   | 0,27| 0,1758 |
| AGE - > 3 years of age                       | 103         | 75              | 115           | 115                  | 4,58| 2,25   | 9,32   | 0,36| 0,00002|
| SEX - intact                                  | 73          | 68              | 115           | 115                  | 1,20| 0,71   | 2,04   | 0,27| 0,5881 |
| WEIGHT - >30 kg                               | 79          | 61              | 115           | 115                  | 1,94| 1,13   | 3,33   | 0,27| 0,0216 |
| TEMPER – shy oraggressive nature              | 27          | 27              | 82            | 106                  | 1,44| 0,76   | 2,71   | 0,32| 0,3382 |
| FEEDING only dry or wet food                  | 93          | 84              | 115           | 115                  | 1,56| 0,84   | 2,90   | 0,31| 0,2103 |
| FEEDING with dry food                         | 41          | 22              | 115           | 115                  | 2,34| 1,28   | 4,27   | 0,30| 0,0078 |
| FEEDING moistened dry food                    | 31          | 19              | 115           | 115                  | 1,86| 0,98   | 3,54   | 0,32| 0,0374 |
| FEEDING once daily                            | 62          | 44              | 114           | 114                  | 1,90| 1,12   | 3,21   | 0,26| 0,0240 |
| FEEDING available all day long                | 32          | 27              | 112           | 113                  | 1,27| 0,70   | 2,31   | 0,30| 0,5183 |
| FEEDING Rapid+Voracious eating                | 69          | 38              | 115           | 115                  | 3,04| 1,77   | 5,21   | 0,27| 0,0731 |
| BOWL POSITION – on the ground                 | 105         | 92              | 115           | 115                  | 2,63| 1,19   | 5,80   | 0,40| 0,0240 |
| BODY CONDITION – overweight or obese          | 12          | 8               | 115           | 115                  | 1,56| 0,61   | 3,97   | 0,47| 0,4827 |
| EXERCISE-                                     | 81          | 67              | 115           | 115                  | 1,71| 0,99   | 1,96   | 0,27| 0,0735 |
| EXERCISE >once daily                          | 49          | 38              | 66            | 75                   | 2,81| 1,37   | 5,73   | 0,36| 0,0069 |
| EXERCISE before the meal                      | 26          | 34              | 43            | 67                   | 1,48| 0,68   | 3,23   | 0,27| 0,4222 |
| EXERCISE after the meal                       | 76          | 65              | 115           | 115                  | 1,50| 0,88   | 2,56   | 0,27| 0,1758 |
| EXERCISE before and after the meal            | 16          | 12              | 43            | 67                   | 2,72| 1,13   | 6,54   | 0,44| 0,0411 |
| NOT USED TO LONG TRIPS                        | 81          | 72              | 115           | 115                  | 1,42| 0,82   | 2,47   | 0,28| 0,2637 |
| USED TO KENNELS/DOGHOUSES                     | 11          | 8               | 115           | 115                  | 1,41| 0,55   | 3,66   | 0,48| 0,6319 |
| VOMITING                                      | 75          | 33              | 115           | 115                  | 4,66| 2,67   | 8,13   | 0,28| 0,0001 |
| DIARRHEA                                      | 51          | 36              | 115           | 115                  | 1,75| 1,02   | 3,00   | 0,27| 0,0570 |
| EATING FOREIGN BODIES                         | 54          | 23              | 115           | 115                  | 3,54| 1,97   | 6,36   | 0,29| 0,0277 |
| EATING GRASS                                  | 93          | 68              | 115           | 115                  | 2,92| 1,61   | 5,30   | 0,30| 0,0006 |
Table 3. The relationship between OR, for the different evaluated variables, in GDV cases and control cases

| Variable | OR (95% CI) |
|----------|-------------|
| SIZE: large/giant/medium/small | 2.55 (1.21-5.41) |
| BRED: pure/crossed | 4.06 (1.37-12.14) |
| SEX: male/female | 1.50 (0.89-2.53) |
| AGE: > 3 years/ < 3 years old | 4.58 (1.32-15.71) |
| SEX: unneutered/neutered | 1.20 (0.56-2.57) |
| WEIGHT: <30kg/30kg | 1.94 (0.83-4.53) |
| TEMPER: shy/aggressive/sane | 1.44 (0.74-2.83) |
| FEEDING mixed: No/Yes | 1.56 (0.91-2.68) |
| FEEDING with dry food: No/Yes | 2.54 (1.25-5.13) |
| FEEDING availability all day: Yes/No | 1.27 (0.73-2.22) |
| FEEDING available all day: Yes/No | 1.27 (0.73-2.22) |
| BOWL POSITION: on the ground/Elevated | 2.63 (1.11-6.18) |
| BODY CONDITION: Overweight/Obese/Thin/Normal | 1.56 (0.91-2.72) |
| EXERCISE: Yes/No | 1.71 (0.81-3.58) |
| EXERCISE once a day/once a day | 2.81 (1.31-5.98) |
| EXERCISE before the meal: Yes/No | 1.48 (0.73-2.99) |
| EXERCISE after the meal: Yes/No | 1.50 (0.77-2.86) |
| EXERCISE before and after the meal: Yes/No | 2.72 (1.06-6.90) |
| LONG TRIPS: No/Yes | 1.62 (0.71-3.66) |
| KENNELS/DOGHOUSES: Yes/No | 1.61 (0.76-3.40) |
| VOMITING: Yes/No | 4.66 (2.07-10.56) |
| DIARRHEA: Yes/No | 1.75 (0.83-3.70) |
| FOREIGN BODIES: Yes/No | 3.54 (1.63-7.63) |
| EATING GRASS: Yes/No | 2.92 (1.38-6.18) |
The majority of GDV dogs (76.6%) had a balanced temperament, whereas 23.4% were classified as being shy, aggressive or having an exuberant character.

When considering diet as a variable, 19% of GDV dogs (22/115) consumed a combination of commercial and homemade diet, while the remainder 81% (93/115) were either fed only a commercial diet or a homemade only diet. On the other hand, in the control dog group 26.9% (31/115) of dogs received a combination of commercial and homemade diet. (OR = 1.56, CL 95% = 0.84 – 2.90 and P = 0.2). A total of 230 animals consumed dry food, 64.3% (74/115) GDV dogs and 80.8% (93/115) control dogs, respectively, and 73.1% cases (84/115) and 83.5% controls (96/115) were fed dry food. Form these data results a positive statistic association between the dry food diet and the development of GDV (OR = 2.34, CL 95% = 1.28 – 4.77 and P = 0.007). Overall, 62/115 (53.91%) GDV dogs were only fed once a day versus 44/115 (38.26%) control dogs. For this epidemiological variable too results a positive statistic association (OR = 1.90, CL 95% = 1.12 – 3.21 and P = 0.02).

Out of a total of 230 animals, 13.9% (32/230) GDV dogs and 11.7% (27/230) controls had access to food throughout the day ad libitum; 69.5% (80/115) DGV dogs and 74.7% (86/115) had not access to food throughout the day and ad libitum. Statistic analysis of these data did not show a valid and true association between our results and the development of GDV (OR = 1, 27 CL 95% = 0, 70 - 2,31 P = 0,5).

The analysis of meal intake rates showed that 40% of GDV dogs (46/115) and 66% of control dogs (38/115) consumed their meal slowly, while 60% of affected cases (69/115) and 34% of controls (38/115) eat the meal quickly or voraciously. This trend would be a positive risk factor for development of GDV. However even if OR = 3.04 and CL 95% = 1.77 – 5.21 the result is not supported by a P Value that defines the statistically valid association (P = 0.07).

About the position of the bowel, the 91.4% (105/115) of GDV dogs was fed with the bowl on the ground, whereas only the 8.6% (10/115). Between controls 80% (92/115) consume the meal with bowl on the ground and 20% (23/115) with raised bowl. Final data (OR= 2.63 95%CL = 1.19 – 5.80 and P = 0.02) define de statistically valid association.

Cases and controls were compared according to two groups of BSC: obese or overweight subjects (group 1) and thin or weight-form subjects (group 2). 10% of cases (12 / 115) were assigned in group 1, while the remaining 90% (103 / 115) was assignend to group 2. In the control sample the 6.9% (115/8) was overweight-obese and 93% (107/115) was thin or weight-form. The result is OR = 3.97, but CL 95% = 0.61-3.97 and P = 0.4 for which there is no statistically valid association.

Numerous are the data obtained regarding the study as a possible risk factor for GDV. Out of 115 GDV dogs, 70.5% (81/115) performed physical activity during daytime (they are considered dogs that live in the garden and/or are taken on a walk by the owner), versus 50.5% (34/115) of control dogs considered sedentary animals, living in an apartment or at home without having access to the outside or animals that are not regularly walked by the owner. In this case, even if OR = 1.71, CL 95% = 0.99-1.96 and negative Chi square test (P = 0.07), the association is statistically significant.

Among the dogs performing physical activity, 74.2% (49/66) GDV dogs and 50.6% (38/75) control dogs performed physical activity more than once daily. For this variable, OR is calculated equal to 2.81, CL 95% = 1.37-5.73 and P = 0.006 for which the statistical test is valid and there is an evident association between this variable and the GDV.

About physical activity compared to meal timing, we report that 60% of GDV dogs (69/115) did physical activity before the meal and the 40% (46/115) did not before and that 58% (67/115) of control group did activity before meals compared to the 28.6% (33/115) that did not. Our statistical analysis with OR = 1,48 CL 95% = 0,68 – 3,23 and P = 0,04% show that our results are not statistically valid. Regarding potential stress factors, 29.5% of GDV dogs (34/115) and 37.3% (43/115) of control dogs were used to join the owner on long journeys and trips by car. In total, 9.57% of GDV (11/115) dogs and 6.96% of control dogs (8/115) were used to staying in pensions or kennels. With values of
OR=1.41, CL 95%=0.55-3.66 e P=0.6 not event this statistical analysis is significant for developing of GDV. In 65.2% of GDV dogs (72/115) there was a history of frequent vomiting, while only 28.6% of control dogs (33/115) had regular episodes of vomiting (OR= 2.63 95%CL = 1.19 – 5.80 and P = 0.02). Episodes of diarrhea were reported in 44.3% (51/115) of GDV dogs and 31.3% of control dogs (36/115) , respectively (OR=1.75, CL 95%==1.02-3 e P=0.057). Ingestion of foreign was present in 38.2% of GDV dogs (44/115) and in 20% of control dogs (23/115). Finally, 80.8% of GDV dogs (93/115) and 59.1% of control dogs (68/115) were reported to ingest grass or foreign bodies (OR=3.54, CL 95%=1.97-6,36 e P=0.02). Due to these 3 last results listed above as predisposing factors (vomiting, dhiarrea and foreign bodies) and considering the results we can conclude that all three have a statistical positive significance.

In table1 and 2 statistical analyses of risk factors are summarized. Several predisposing risk factors were identified. There was a significant difference between large/giant dogs and medium/small dogs, with large and giant dogs having 2.35 odds to develop a GDV (OR = 2.35, 95% CL = 1.19-4.66 and P = 0.02).

Purebred dogs are also statistically significantly more likely to develop GDV, with an OR of 4.06. Dogs older than three years of age and dogs over 30 kg are also at increased risk, with OR of 4.58 and 1.94, respectively. Regarding food, a positive statistical association was found between dogs receiving dry food and the development of GDV (OR = 2.34). Dogs that only receive one meal a day, and dogs that consume the meal from a bowl on the floor are at increased risk (OR= 1.90 and 2.63, respectively). There was a trend of fast eating being a risk factors, however this revealed to not be statistically significant. Dogs performing daily activity, dogs that have physical activity several times daily, and dogs that perform physical activity around the meal are at increased risk of developing GDV (OR = 1.71, 2.81, and 2.72, respectively). A strong association was found between dogs having regular episodes of vomiting and GDV and also between dogs having regularly diarrhea and the development of GDV (OR = 4.66 and OR = 1.75, respectively). Ingestion of foreign bodies and ingestion of grass were likewise risk factors for the development of GDV (OR = 3.54 and OR = 2.92, respectively).

**Discussion**

This case-control study revealed several predisposing risk factors for the development of GDV in this population of dogs which are similar to risk factors previously described. The results support the data from existing literature that there is a significant difference between large/giant breed dogs and medium-small dogs\textsuperscript{7,12,23} and that the subjects in the first group are more likely to develop GDV (OR = 2.35, 95% CI 1.19 - 4.66 and P = 0.02).

In this study there was little difference between the occurrence of GDV in large or giant breeds. This correlates with other studies which have previously found no significant difference between the incidence of GDV between large and giant breeds. In this study German Shepherd (51dogs/115), Great Dane (14 dogs/115) and Dobermann (8 dogs/115) were the most represented breeds. Other breeds exhibiting disease include: Akita Inu, Bobtail, Boxer, Bernese Mountain Dog, Cane Corso, Chow Chow, Dalmatian, Dogue de Bordeaux, Drahthaar, Greyhound, Leonberger, Neapolitan Mastiff, Shepherd of Brie, Shepherd of Maremma, Rhodesian Ridgeback, Rottweiler, Samoyed, Giant Schnauzer, Bavarian Hound, Italian Hound, Setter Gordon, Irish Setter and Newfoundland.

Purebred dogs are reported to present a significant risk factor for GDV\textsuperscript{10,12,23,25}. Compatible with existing literature\textsuperscript{21,23}, this research also demonstrates purebred dogs have an increased likelihood of developing GDV. A case-control study done by Glickman et al. in 1997\textsuperscript{(17)} calculated that among a group of 1114 cases, 1089 dogs were purebred dogs (13% German shepherd, 12% Hay, 6% Standard Poodle, 4% Doberman, 63% other breeds) and that only 25 the dogs were mixed breed\textsuperscript{17}.There is variation in individual studies between the breed most predisposed to GDV and this has been thought to depend on the breed most widespread within a particular region.

Weight is also reported to represent a significant risk factor\textsuperscript{10,17}. Dogs weighing 30 kg or more have 1.94 times more likely to others of developing GDV and large mixed breed dogs are more at risk than small breeds\textsuperscript{24}. 

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Schellenberg et al. found female dogs present a higher risk for GDV than male dogs. Pipan et al. in a published case control study of 2012 found that the OR of intact females showed them to be more predisposed to the development of GDV. This finding was not supported in this study; male dogs appeared more predisposed to GDV, although males and females showed no significant difference (OR = 1.50, 95% CL 0.88-2.57 and P = 0.17). The sex of a dog has not yet been identified as a significant risk factor for GDV and previous studies have not found a significant difference between intact and neutered dogs. This study found neither sex nor status of dogs were risk factors for the development of GDV.

Although GDV syndrome can affect young dogs, the risk increases significantly with increasing age. The presented data supports that previously described in the literature, that an increase in age, corresponds with an increase in the risk of developing the disease. Dogs older than three years have a 4.58 fold higher risk of developing GDV with the median age for GDV at 7.8 years. It has been suggested that there is an association between an increase in age and stretching of the ligaments that support the stomach which would facilitate gastric torsion when the stomach is weighed down by food.

The occurrence of stress to the dog in the 8 hour time period before the gastric torsion-dilatation episode thus supports the theory that the dog's temperament poses a risk factor for disease. In a comparison between large and giant breeds, large dogs with an aggressive temperament were associated with increased risk compared to dogs of a docile character. When dogs are amongst other people or animals the risk of disease is lower. Despite the appearance that shy and aggressive, or exuberant dogs, seemed to be more predisposed to GDV development when comparing them to those with a balanced temperament, the finding was not statistically significant. However, the classification as to whether the dogs were aggressive or fearful was reliant on the owner's assessment. Since this is subjective, a more objective method for evaluating the dog temperament would have been useful and may have produced different results. In addition to the questionnaire, it would have been useful to widen the choice of selection criteria when determining character and add other items to better define the true temperament of the subject. Finally, by increasing the sample number, it is not excluded that the association between the dog's character and the risk of illness could give positive results. The role diet plays in developing GDV has not yet been determined. For several years it has been suggested that there is an association between the consumption of commercial dry food and acute gastric dilation. It has not been defined whether this risk is associated with; the tendency of dry biscuits to expand into the stomach, the amount of food given per meal, whether there is some other characteristic of this type of food that influences the emptying of the stomach, or a combination of all of the above.

However, others propose that the administration of dry versus wet commercial food does not increase the risk of GDV. This study found that dogs that were fed a diet based on commercial dry food were more likely to development of GDV in contrast to dogs that did not eat dry diets. Moreover, it has been noted that some owners moisten dry food before giving it to their dog, thinking of making the foods more palatable or softening them, thus facilitating chewing. This action was not associated with a lower risk of developing GDV in the population. Our results are in agreement with another author who states that the consumption of dry food not previously humidified before administration is a protective factor against the disease. However, moistening dry food increases the risk of GDV in large breeds but not in giant breeds. Regarding other dietary habits, subjects who do not consume a mixed diet, in both commercial (dry food and / or canned wet food) and home-made (food leftovers, snacks or prizes like biscuits, bread, fruit, or food specially cooked for the dog as meat, soup, rice) are more predisposed to GDV (OR = 1.56, 95% CL = 0.84 to 2.90). Although in this study this association is not statistically valid (P = 0.2), according to some authors consuming only one type of diet represents a risk factor for GDV. According to most of the literature data, statistically evident risk factors result in the administration of dry commercial food and the administration of wet dry food.

One study found that having food available throughout the day increased the incidence of 13% in large sizes and 55% in giant breeds. This was not
found in this population. This study demonstrates a correlation between diet and risk of GDV. Although the combination of wet and dry food appears to protect dogs from developing GDV, this variable should be further investigated because it can be an important predisposing factor easy amendable by owners. It may be useful not only to increase the sample size, but also to record in detail the foods administered to each dog, in order to make more specific evaluations.

When environmental factors are considered, the administration of food in a bowl raised from the ground significantly increases the risk of developing GDV. Eating from a raised bowl increases the risk of gastric torsion in large and giant dogs; 20.4% of large breed and 51.9% of giant breeds GDVs could be attributed to the use of raised bowl. In contrast the results of this study show that more dogs developed GDVs that had been feed from a bowl on the ground compared to dogs fed with the raised bowl. However since almost all dogs were fed with the bowl on the ground, the association between the variable and the increase in risk is subject to confounding and therefore feeding from a bowl placed on the ground may not represent a real risk factor.

The study data agrees with the finding reported in most of the literature that dogs fed only once a day are more predisposed to develop the disease compared to dogs that consume more meals in a day. Dogs that eat quickly or voraciously had a tendency to have a greater risk of developing GDV compared to dogs that eat the meal normally or slowly, however this finding was not statistically significant.

Regarding vomiting, Elwood et al. reported that, in particular Irish Setter, it has been seen that individuals affected by GDV do not report more frequent episodes of vomiting in anamnesis compared to control animals of the same sex and age. The authors concludes that, due to these data there is no significant association between vomiting and increased risk of GDV. Other authors, consider vomiting an indirect predisposing factor for the development of GDV due to the fact that it can cause aerophagia (bridal – caywood). In our study dogs that report vomiting episodes (daily, weekly or monthly) are more prone to develop GDV than dogs that do not exhibit vomiting. In fact, there is a very significant statistical association (OR = 4.66 – CL 95% = 2.67 – 8.13 and P = 0.0001). In any case, this variable should be further investigated especially as regards the causes of vomiting, the frequency of these episodes and the possible correlation with the meals. According to some authors, an increased risk of developing GDV is mainly attributed to dogs that have had gastrointestinal problem in their clinical previous history. In our we did not investigated about multiple gastrointestinal problems but we studied only the relationship between previous episodes of diarrhea and GDV. From our data, dogs that report diarrhea episodes (daily, weekly or monthly) would be more predisposed to developing the disease (OR = 1.75, CL 95% = 1.02-3 and P = 0.05), even if the association is not statistically significant. The P Value, however, is at the limit to be considered statistically valid, so the study of this variable should be deepened. By increasing the sample, it is not excluded that the association between the disease and this variable could be positive. In our research we considered also the factor foreign body. Owners were asked if their dogs were used to ingest accidentally or spontaneously things other than food (grass or foreign body). It has been seen that dogs that tend to ingest grass were more predisposed to develop GDV than dogs that do not have this feeding behaviour. The calculated values (OR = 2.92, CL95% = 1.61-5.30 and P = 0.0006) testify that the ingestion of grass represents a risk factor for the GDV. Foreign bodies a recent paper shows that there is a correlation between foreign body and development of GDV. Our data from this research confirmed this positive association and showed a significant statistical relationship between the ingestion of foreign bodies and an increase in the risk of GDV (OR = 3.54, CL 95% = 1.97-6.36 and P = 0.02). According to the owners, the most ingested foreign bodies are: stones, cat litter, pieces of wood, pieces of plastic and linen (underwear, socks). Our data agree well with a recent study that states that in large and giant breed dogs, the ingestion of foreign bodies increases the risk of developing GDV by 5 times. The theories of why the ingestion of foreign bodies could increase the risk of GDV are different. Gastric foreign bodies can cause acute or chronic mechanical obstruction, partial or total. Obstructed outflow delays
gastric emptying and can cause gastric distension. Furthermore, the presence of CE can cause gastritis. Therefore, given the serious damage that the ingestion of foreign bodies can cause, owners of dogs of predisposed breeds should restrict access to foreign material as much as possible to minimize the risk of GDV\textsuperscript{24}.

Despite the complexity of the risk factors, it is possible to reduce the incidence of GDV in high-risk breeds by observing some precautions\textsuperscript{25}. It is not recommended to feed the dog only once a day\textsuperscript{25}. They should be fed with small amounts of food per meal and have more meals per day (at least 2)\textsuperscript{18}. It would also be useful to reduce the speed of recruitment\textsuperscript{14, 25}, as slowing the speed of intake has a preventative effect\textsuperscript{7}.

Feeding with dry commercial food alone may not be a well suited choice for dogs at risk\textsuperscript{20} adding home food to the commercial diet may be useful for preventing the syndrome\textsuperscript{14}. It is advisable to avoid administering only a commercial crunchy diet to those at risk\textsuperscript{14}.

There are still doubts about the role of physical activity; according to some authors, the intense physical activity should be reduced in the two hours after the meal\textsuperscript{14}. According to others, moderate daily physical activity and moderate post-prandial exercise appears to be beneficial for the reduction of risk\textsuperscript{20}.

Owners of dogs of the breeds more predisposed to the disease should also be advised to restrict access to foreign material as much as possible, as the presence of a FB at the gastric level increases the possibility of developing GDV.

Regarding other aspects, it would certainly be useful for purebred clubs to work closely with researchers and veterinary surgeons to better identify specific morphometric and genetic factors that predispose certain dogs to the development of GDV\textsuperscript{14}.

This Study Contains Several Limitations

In a case-control study, the case group and the control group are selected on the basis of the outcome (ie, having the disease of interest compared to not having the disease) and comparing the two groups with respect to their previous exposure frequencies to possible risk factors. Recruitment of subjects is specifically chosen by groups of subjects with or without the disease of interest\textsuperscript{26}.

Conversely there are also advantages of this type of study. It is inexpensive, useful and effective for investigating a infrequently occurring disease. The clinician was also able to access a lot data from a single subject. Interviews with one owner granted information on signalling, eating habits and lifestyle.

Nonetheless, the case-control study is very sensitive to BIAS (or distortion). This term means the difference between the estimate obtained from the sample and the true characteristic of the population. To avoid a distortion in the identification and quantification of risk factors, it would be useful to match the cases with controls that are as similar as possible (for example the same age, sex and breed) using a procedure called "matching"\textsuperscript{26}. However, in this study this type of procedure was not used and the controls were chosen on the basis of other criteria, as explained below. Furthermore it is the opinion of the authors that increasing the sample size might change final results.

Conclusion

In this study several risk factors have been identified for GDV development. These include; large and giant dogs, purebred dogs, dogs over 3 years old, a weight>30 kg, a diet which consists of commercial dry food, the ingestion of foreign bodies and grass, a history of episodes of diarrhoea and/or vomiting, exercise more than once a day and both before and after the meal, the consumption of a single daily meal and the speed of food intake.

On the contrary, neither sex nor the status of the subject (integer/neutered), temperament, BCS and the habit of long journeys or to stay in pensions or kennels are to be considered risk factors.

This study concludes that the risk of GDV in certain breeds and in certain conditions remains high. Since GDV continues to be an extremely current disease it is important that risk factors are understood. Although consideration should be given to both the complexity of the risk factors and the etiopathogenesis of GDV, the author suggests it is not possible to prevent this syndrome by acting solely on the risk factors. The only
safe method to prevent the disease is preventive gastropexy 27-32.

**Competing Interests**

The authors declare that they have no competing interests.

**Availability of Data and Materials**

All data generated or analysed during this study are included in this article.

**Consent for Publication**

Not applicable

**Ethics Approval and Consent to Participate:**

Not applicable

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**Abbreviations**

- GDV - Gastric Dilatation Volvulus
- SIRS - Systemic Inflammatory Response Syndrome
- MODS - Multiple Organ Dysfunction Syndrome
- DIC - Disseminated Intravascular oagulation
- BCS - Body condition score
- FB - Foreign Body
- OR – Odds Ratio
- ES – Effect Size
- OR MIN – Odds Ratio Minimal
- OR MAX – Odds Ratio Maxima
- TOT – Total

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