# Prevalence and Risk Factors for Obesity in Adult Dogs from Private US Veterinary Practices

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## ABSTRACT

Using a cross-sectional study design, the prevalence of overweight and obesity in dogs over 1 year of age seen by US veterinarians during 1995 was determined. Risk factors for overweight and obesity were also determined from the following variables: age, breed, gender, body condition score, food type, reported concurrent disease, and geographic region. Thirty-four percent of adult dogs (n = 21,754) were overweight or obese. From multivariate analyses, overweight dogs were more likely to be older, of certain breeds (Cocker Spaniel, Labrador Retriever, Dalmatian, Dachshund, Rottweiler, Golden Retriever, Shetland Sheepdog, Mixed-breed), neutered, and to consume a semi-moist food as their major diet source. In addition, overweight adult dogs were most likely to reside in the Pacific, South Central, East North Central, or Northeast regions of the United States and be diagnosed with hyperadrenocorticism, ruptured cruciate ligament, hypothyroidism, lower urinary tract disease, or oral disease. Obese dogs were more likely to be older, of certain breeds (Shetland Sheepdog, Dachshund, and Golden Retriever), neutered, and to consume "other" foods (meat or other food products, commercial treats, or table scraps), homemade, or canned foods as their major diet source. Also, obese adult dogs were more likely to live in the Pacific or Northeast region of the United States and be diagnosed with hypothyroidism, diabetes mellitus, pancreatitis, ruptured cruciate ligament, or neoplasia. Practitioners can use these data to counsel dog owners on obesity prevention, especially owners of dogs with ≥1 risk factors for overweight/obesity, and to strongly advocate for the maintenance of canine patients at an ideal body condition.

## INTRODUCTION

The prevalence of combined overweight and obesity in domestic canine populations has been reported to range from 23%[1] to 41%.[2] Other studies in canine pet populations have found relationships between canine obesity and musculoskeletal disorders,[3-5] cardiovascular problems,[5] glucose intolerance and

diabetes mellitus,[6,7] and bladder[8] and mammary cancer.[9] Experimentally, relationships have also been shown between canine obesity and hypertension[10] and immune dysfunction.[11] Because of the known relationship of human obesity to certain diseases (eg, hypertension, cardiovascular disease, diabetes mellitus, stroke, osteoarthritis, and some cancers) and premature mortality, similar relationships may hold true for dogs.[12,13] Knowledge of obesity/overweight as a risk factor for disease can heighten awareness and target health screening of dogs. With evidence from canine research studies as a tool, practitioners may be able to advocate more strongly for obesity prevention and weight reduction plans for their clients' pets.

The major objectives of this study were to determine the prevalence of overweight and obesity in adult canine populations seen by private veterinary practitioners in the United States and to elucidate basic risk factors for overweight and obesity, that is, age, breed, gender, and neuter status, food type, concurrent disease, and geographic region of residence. Such associations or risk factors are very important for identifying dogs at risk for obesity and for identifying which diseases are more likely to afflict overweight and obese dogs.

## MATERIALS AND METHODS

The general study methods and population from the National Companion Animal Study (NCAS) have been previously described in detail.[14] A proprietary practice management system (Advanced Veterinary Systems [AVS], VetConnect Systems, Eau Claire, WI) was used for data collection, including: date of birth, diagnoses (new and existing), breed, gender, neuter status, body condition score (BCS), major and minor food type and form, and geographic region.

### Body Condition Score

Body condition scores were assigned as a whole number value from 1 to 5 by the veterinarian examining the dog. A BCS of 1 indicated the animal was excessively thin, 3 was ideal, and 5 was obese. The amount of fat cover over the dogs' ribs and tail base and the abdominal contour were used in assessing body condition.

All participating clinics were provided with a training videotape on the use of the BCS scale. Multiple body condition scores over the year of data collection were averaged to obtain a single BCS per animal. Average BCS was used to place dogs in either the overweight or obese category for this analysis. Obese animals were defined as having an average BCS greater than 4.5. Overweight animals were defined as having an average BCS greater than 3.5 and less than or equal to 4.5.

### Food Type and Form

Food categories were Popular Dry, Premium Dry, Therapeutic Dry, Popular Canned, Premium Canned, Therapeutic Canned, Homemade, Semi-moist, and Other. "Popular" described brands typically purchased in a grocery store, farm store, or large-format pet retailer. "Premium" was used to define brands typically purchased in a veterinary practice, pet store, or large-format pet retailer. "Therapeutic" referred to brands prescribed and sold by veterinarians for the treatment or prevention of disease. "Homemade" referred to a complete diet prepared at home from individual food ingredients. "Other" included meat or other food products, commercial treats, or table scraps.

The dog owner chose 1 major food component (≥60% of food by volume) and a minor food component (remainder of food, if applicable). Additional food codes were added at subsequent patient visits only if changes in feeding had occurred. Only major diet (≥60% of food fed by volume) was included in this analysis.

### Geographic Region

West and East South Central were combined to form South Central; New England and Middle Atlantic were combined to Northeast; Pacific included Alaska and Hawaii.[15]

**Diagnoses**

New and existing diagnoses for a specific dog at each clinic visit were recorded using a system for standardized nomenclature.[16] Subjects were counted only once in a category for ≥1 diagnoses reported during the study that fell into that category.

**Statistical Methods**

The adult dog population was defined as animals over 1 year of age; analyses were conducted on adult dogs that had ≥1 diagnosis (including "Healthy") of any kind recorded over the study period and had ≥1 recorded BCS (ie, these dogs constituted the population denominator for the study). The SAS statistical program, 9th edition (Copyright© 2005 SAS Institute Inc., SAS Campus Drive, Cary, NC, USA.), was used to generate frequencies, prevalence estimates, univariate distributions, and multivariate analyses.

Disease and disease category prevalence were estimated for obese and overweight dogs by BCS for all diseases included in the multivariate analysis. Overall adult population prevalence estimates for obesity and overweight were generated using 2 methods: average BCS and reported diagnoses for obesity and overweight (that is, when either "obesity" or "overweight" was entered as a diagnosis for that visit by the veterinarian).

Univariate distributions were generated to describe the prevalence of overweight and obesity by age, breed, gender, and neuter status of the population. To control for confounding of the relationship between risk factors and overweight or obesity, a multivariate analysis was conducted using full logistic regression models.[17] Confounders are factors—for example, age or breed—that are related to both the exposure being examined and the outcome (overweight or obesity). Confounders can distort assessment of the relationship between the exposure of interest and the outcome. For example, when comparing state-specific cancer rates between people living in Colorado versus Florida, lower cancer rates might be observed in Colorado. Since age is a predictor of cancer risk, the differences in rates may reflect the older state population of Florida compared to a younger Colorado population. Age, therefore, is confounding the potential difference between rates. Because the multivariate model controls for confounding by age, breed, and so on, the risk factors generated are therefore independent predictors of obesity.

Variables in the multivariate models for this study included age in years; 25 most prevalent breeds; gender; neuter status; major food type consumed; concurrent disease; and geographic region of United States. The referent category for food type was popular/dry; the West North Central region was the referent category for geographic region.

Individual diseases and disease categories were included in the analysis based on hypotheses informed by literature review. Individual diseases included in the canine model included arthritis/osteoarthritis, diabetes mellitus, dystocia, hypertension, hyperadrenocorticism, hypothyroidism, intervertebral disc disease, lameness, neoplasia, oral disease, pancreatitis, paresis/ataxia, ruptured cruciate ligament, and tracheal collapse. Disease categories included in the model were dermatopathy, gastrointestinal disease, heart disease, musculoskeletal disease, oral disease, renal disease, reproductive disease, respiratory disease, and lower urinary tract disease (see Appendix). For all statistical tests, $\alpha = 0.05$. An interaction term for gender and neuter status was included in both multivariate models.

In the multivariate analysis, the prevalence odds ratio (OR) was used as an approximation of relative risk. Relative risk is a measure of the strength of the association between a disease and potential risk factors like age and breed. When the OR is >1, the factor is found to be associated with an increased risk of that disease. For example, the OR for obesity and a concurrent

diagnosis of diabetes mellitus was found to be 2.6; that is, an obese dog is 2.6 times more likely to be diagnosed with diabetes compared with an adult dog of normal/underweight body condition (all other factors being equal) A relative risk estimate does not necessarily reflect a causal relationship (for example, that obesity causes diabetes mellitus), but rather an association between the disease and the predictive factor.

A Hosmer-Lemeshow goodness-of-fit test[17] was estimated for each disease model to determine how well the model explained the variability in the observed data. The higher the *P* value, the better the "fit" of the model to explain the relationship of the independent variables (risk factors) to the dependent variable (overweight or obesity). The null hypothesis for this statistic is that the model fits; a $P$ value > 0.05 leads one to fail to reject the null hypothesis.

## RESULTS

A total of 21,754 adult dogs with a reported BCS were included in this analysis from a National Companion Animal Study population of 24,975 adult dogs. Prevalence of obesity in this private practice population based on body condition assigned by veterinarians was 5.1% for adult dogs; prevalence of overweight was 29.0%. A total of 34.1% of dogs older than 1 year of age, therefore, were either overweight or obese.

Prevalence of obesity for adult dogs based on reported diagnoses (that is, when obesity was entered as a diagnostic code) was 2.5%; the prevalence of overweight based on reported diagnosis was 1.4%. Only 3.8% of the adult dogs identified as overweight based on BCS were also coded by the veterinarian as "overweight." Among dogs identified as obese by BCS, 31.0% also had a diagnostic code of "obesity" entered by the veterinarian.

Prevalence of individual diseases and disease categories included by hypothesis in the analysis are detailed in Table 1. Oral disease, dermatopathy, and neoplasia were the most common diseases included in this analysis. Thirty-four percent of obese and overweight adult dogs were diagnosed with ≥1 disease in the oral disease category.

The prevalence of obesity and overweight (Figure 1) is greatest for dogs in their middle-aged years, roughly between 6 and 10 years. Neutered males and spayed females (Figure 2) had the highest prevalence of overweight (32.0% and 32.6%) and obesity (5.5% and 5.6%); intact males had the lowest prevalence of overweight (20.0%) and obesity (3.6%). Overweight prevalence of 30% or more (Figure 3) was found for Cocker Spaniels, Beagles, Labrador Retrievers, Golden Retrievers, Shetland Sheepdogs, Rottweilers, and Mixed-breed dogs. Among the 10 most common breeds, obesity prevalence ranged from 2.6% (Poodle [all sizes]) to 10.0% (Shetland Sheepdog).

In the multivariate analysis (Table 2), overweight dogs were more likely to be to be older (OR = 1.1), of certain breeds (Cocker Spaniel [OR = 1.9], Dachshund [OR = 1.6], Dalmatian [OR = 1.6], Labrador Retriever [OR = 1.6], Rottweiler [OR = 1.6], Golden Retriever [OR = 1.5], Shetland Sheepdog [OR = 1.4], and Mixed-breed dogs [OR = 1.1]) neutered (OR = 1.5), and to consume semi-moist foods as their major diet (OR = 1.5). In addition, overweight adult dogs were most likely to reside in the Pacific (OR = 1.4), South Central (OR = 1.3), East North Central or Northeast (both OR = 1.2) regions and be diagnosed with hyperadrenocorticism (OR = 2.4), ruptured cruciate ligament (OR = 1.7), hypothyroidism (OR = 1.4), lower urinary tract disease (OR = 1.3), or oral disease (OR = 1.1). Obese dogs were more likely to be older (OR = 1.1), of certain breeds (Shetland Sheepdog [OR = 1.9], Dachshund [OR = 1.7], Golden Retriever [OR = 1.6], neutered [OR = 1.3] and to consume "other" (meat or other food products, commercial treats, or table scraps) foods (OR = 2.3), homemade (OR = 1.9), or canned (OR = 1.4) foods as their major diet source. Also, obese adult

dogs were more likely to live in the Pacific (OR = 1.7) or Northeast (OR = 1.3) region of the United States and be diagnosed with hypothyroidism (OR = 2.8), diabetes mellitus (OR = 2.6), pancreatitis (OR = 2.2), ruptured cruciate ligament (OR = 2.1), or neoplasia (OR = 1.4).

more than 40% of all dogs were overweight or obese. Intact dogs were underrepresented in the overweight and obese categories. The overweight/obesity risk for neutered dogs reported here is also consistent with other study results.[2,18] Multiple studies have documented a link between spaying or neutering and decreased energy requirements.[19-23]

**Table 1.** Disease and Disease Category* Prevalence by Body Condition Category for Adult Dogs.

| Disease/Disease Category | Obese (4.5 < BCS ≤ 5.0) n = 1099 | Overweight (3.5 < BCS ≤ 4.5) n = 6302 | Normal and Underweight (1.0 < BCS < 3.5) n = 14,353 |
|---|---|---|---|
| Arthritis/Osteoarthritis | 4.2% | 4.0% | 2.4% |
| Dermatopathy | 18.9% | 18.6% | 17.2% |
| Diabetes mellitus | 0.7% | 0.4% | 0.3% |
| Dystocia | 0.0% | 0.1% | 0.2% |
| Gastrointestinal disease | 6.6% | 7.3% | 7.3% |
| Heart disease | 3.8% | 3.4% | 3.9% |
| Hypertension | 0.0% | .08% | .03% |
| Hyperadrenocortism | 0.6% | 0.5% | 0.2% |
| Hypothyroidism | 3.3% | 1.5% | 0.8% |
| Intervertebral disc disease | 1.7% | 2.0% | 1.8% |
| Lameness | 4.3% | 3.7% | 2.9% |
| Lower urinary tract disease | 3.6% | 3.6% | 3.0% |
| Musculoskeletal disease | 8.6% | 8.3% | 6.1% |
| Neoplasia | 10.3% | 7.6% | 5.3% |
| Oral disease | 34.1% | 30.5% | 25.7% |
| Pancreatitis | 0.9% | 0.5% | 0.4% |
| Paresis/Ataxia | 0.3% | 0.2% | 0.3% |
| Renal disease | 1.1% | 0.8% | 0.9% |
| Reproductive disease | 0.5% | 1.0% | 1.4% |
| Respiratory disease | 3.5% | 3.2% | 3.6% |
| Ruptured cruciate ligament | 1.6% | 1.1% | 0.5% |
| Tracheal collapse | 0.4% | 0.2% | 0.1% |

BCS = body condition score.
*Dog was reported to have at least 1 disease in category.

## DISCUSSION

This study documents a combined overall prevalence of overweight and obesity of 34.1% in the adult dog population seen in private practices across the United States. Obesity alone had a prevalence of 5.1%. This is the first large-scale, nationally based study to provide these important percentages. Of particular note is that roughly 38% of all castrated male and spayed female adult dogs in this study were overweight or obese. Between the ages of 6 and 10 years,

The data suggest that the primary target of overweight and obesity prevention should be young and middle-aged, spayed and neutered dogs. Since weight gain generally occurs slowly and insidiously, targeting obesity prevention counseling at the time of the spay or neuter surgery may be prudent, especially for dogs of breeds prone to overweight or obesity. As reported in a recent study, the ideal body condition range for health maintenance in dogs may be lower than previously thought; euthanasia (end-of-

life decisions) due to incapacitating osteoarthritis occurred earlier in dogs when body condition was not maintained within an ideal range.[24]

**Figure 1.** Prevalence of Obesity and Overweight by Year of Age for Adult Dogs.

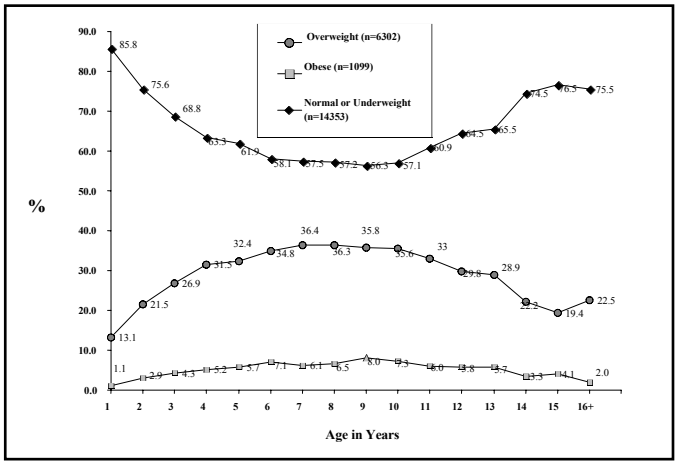
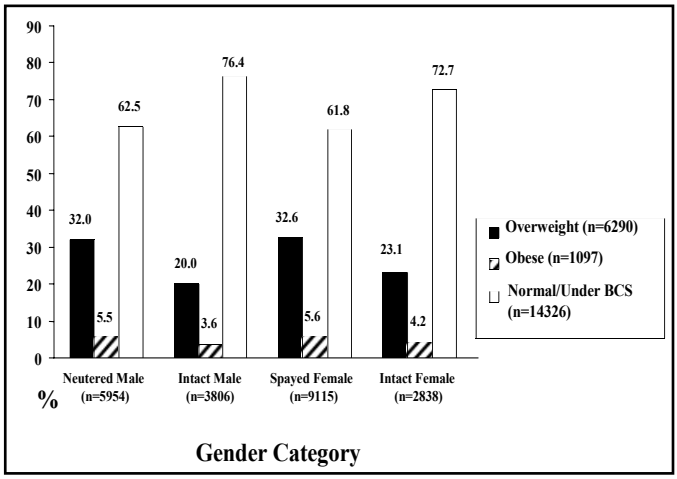



**Figure 2.** Prevalence of Obesity and Overweight by Gender for Adult Dogs.




Breed risk for overweight/obesity was found in our study as has been reported in other canine populations.[2,5,25] Dog breeds in this study found to be more at risk for both overweight and obesity were the Shetland Sheepdog, Dachshunds, and Golden Retriever; these breeds may require extra vigilance on the part of owners to keep pets at normal body condition. The disease associations documented here provide additional evidence of the links between overweight/obesity and specific diseases in dogs. Overweight dogs are at greater risk of oral disease than the remainder of the adult dog population. Overweight dogs are also at increased risk for lower urinary tract disease; however, a relationship between obesity and urinary tract disease as a category was not found, possibly due to a lack of statistical power because there were fewer obese dogs and/or the effects of grouping many diseases into one category. Obese dogs were found to be at increased risk for hypothyroidism, diabetes mellitus, pancreatitis, ruptured cruciate ligament, and neoplasia, corroborating previous canine studies suggesting these associations.[3-7] The relationship between overweight or obesity and skin disease suggested by 1 earlier small study[25] was not supported by our finding. That study failed to separately consider endocrine diseases such as hypothyroidism and hyperadrenocorticism, which are frequently associated with skin disease. These 2 endocrine disorders did show associations with overweight and obesity in this study and were not included in the dermatopathy category. An association of obesity with neoplasia is interesting; however, risk for specific types of cancer would require study designs more suited for the study of rare disease.

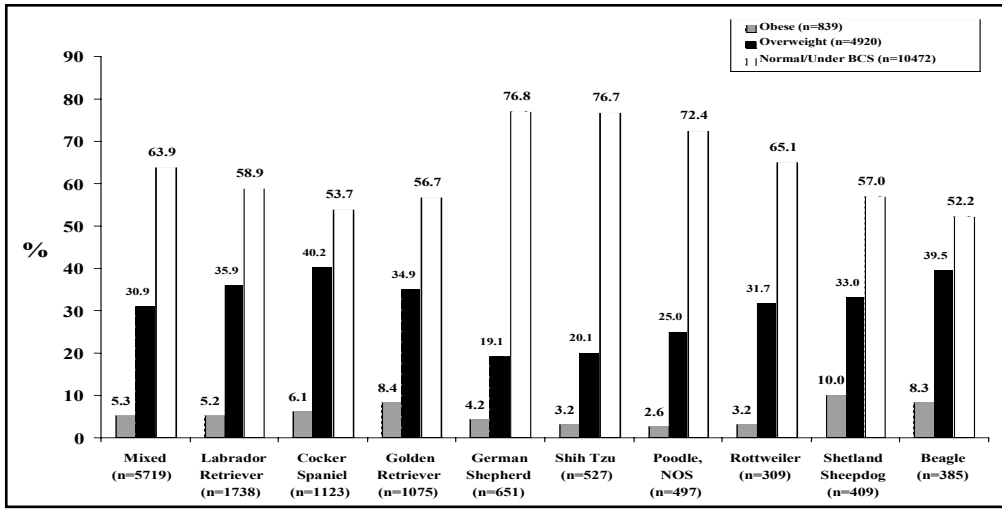
Feeding semi-moist foods was associated with increased risk of overweight in our study. Feeding canned, homemade, or, particularly, "other" foods was associated with obesity. Possible explanations include the higher caloric density[26] of these diets com-

pared to other commercial formulations, feeding frequency,[18] and different feeding practices of owners who chose to feed these types of food compared to the more common practice of feeding primarily dry food.

with which overweight or obesity was recorded as a diagnosis.

Results from the feline population of the NCAS[27] revealed similar, although not identical, results for overweight/obesity preva-

**Figure 3.** Prevalence of Obesity and Overweight by Breed for Adult Dogs.




Region did emerge as a risk factor for adult obesity/overweight and may reflect differing lifestyles of dogs (and owners) across the geographic areas of the United. Some lifestyle factors not measured in our study, such as exercise and urban/rural status,[2,18] have been shown to increase risk for obesity.

We observed dramatic underreporting of overweight and obesity when comparing prevalence from BCS results to reported diagnoses, especially for overweight dogs. For example, the prevalence of obesity defined by BCS for dogs was 5.1% compared with 2.5% when defined by reported diagnostic code. The difference between overweight prevalence in dogs defined by BCS (29.0%) and reported diagnosis (1.4%) was even greater. Underreporting of the diagnosis of obesity and overweight may reflect the perception of practitioners that obesity/overweight does not constitute a disease state, especially for animals in the overweight category. Alternatively, the knowledge that BCS was being collected for this study may have reduced the frequency

lence and risk for disease. The overall prevalence of overweight/obesity was 35% for cats versus 34% for dogs; obesity was slightly more prevalent in the feline as compared to the canine population (6.4% vs 5.1%, respectively). Neutering was a strong risk factor for feline as well as canine obesity. Differential overweight/obesity risk was also observed by breed. Obese cats and dogs are both at risk for diabetes mellitus and neoplasia. Overweight cats and dogs are both at risk for oral and lower urinary tract disease. However, obese dogs were not found to be at risk for oral disease or dermatopathy as were obese cats. In contrast to the canine population, no risk for feline overweight/obesity was found by geographic region of residence, possibly reflecting greater homogeneity of feline lifestyles across the United States.

Probabilities calculated for the goodness-of-fit statistics were: $P = 0.003$ (overweight model) and $P = 0.2$ (obesity model). Based on the Hosmer-Lemeshow goodness-of-fit statistic, the variables in the multivariate model for obesity were able to

**Table 2.** Multivariate Disease Models: Risk Factors for Overweight and Obese Adult Dogs (N = 17,963).

| | Risk Factors (*P* value) | Odds Ratio (CI*) | β† |
|---|---|---|---|
| Overweight Dogs (n = 5188) | Age (<.0001) | 1.1 (1.0,1.1) | 0.05 |
| | Mixed Breed (.008) | 1.1 (1.0,1.2) | 0.1 |
| | Labrador Retriever (<.0001) | 1.6 (1.4,1.8) | 0.5 |
| | Cocker Spaniel (<.0001) | 1.9 (1.6,2.2) | 0.6 |
| | Golden Retriever (<.0001) | 1.5 (1.3,1.7) | 0.4 |
| | Rottweiler (.002) | 1.6 (1.2,2.0) | 0.4 |
| | Shetland Sheepdog (.01) | 1.4 (1.1,1.8) | 0.3 |
| | Dalmatian (.01) | 1.6 (1.1,2.2) | 0.5 |
| | Dachshund (.0005) | 1.6 (1.2,2.2) | 0.5 |
| | Neuter (<.0001) | 1.5 (1.3,1.7) | 0.4 |
| | Semi-moist foods (.02) | 1.5 (1.1,2.0) | 0.4 |
| | East North Central region (.01) | 1.2 (1.0, 1.3) | 0.2 |
| | Northeast region (.003) | 1.2 (1.1,1.3) | 0.2 |
| | Pacific region (<.0001) | 1.4 (1.2,1.5) | 0.3 |
| | South Central region (.002) | 1.3 (1.1,1.5) | 0.2 |
| | Hyperadrenocorticism (.003) | 2.4 (1.4,4.3) | 0.9 |
| | Hypothyroidism (.03) | 1.4 (1.0,1.9) | 0.3 |
| | Lower urinary tract disease(.03) | 1.3 (1.0, 1.6) | 0.2 |
| | Oral disease (.001) | 1.1 (1.1,1.2) | 0.1 |
| | Ruptured cruciate ligament (.01) | 1.7 (1.1,2.6) | 0.5 |
| Obese Dogs (n = 885) | Age (<.0001) | 1.1 (1.0,1.1) | 0.05 |
| | Golden Retriever (.0008) | 1.6 (1.2,2.2) | 0.5 |
| | Shetland Sheepdog (.003) | 1.9 (1.2,2.8) | 0.6 |
| | Dachshund (.03) | 1.7 (1.0,2.7) | 0.5 |
| | Neuter (.05) | 1.3 (1.0,1.6) | 0.2 |
| | Homemade foods (.007) | 1.9 (1.2,2.9) | 0.6 |
| | Other foods (.0003) | 2.3 (1.5,3.6) | 0.5 |
| | Canned Food (.005) | 1.4 (1.1,1.8) | 0.3 |
| | Northeast region (.03) | 1.3 (1.0,1.6) | 0.3 |
| | Pacific region (<.0001) | 1.7 (1.3,2.2) | 0.5 |
| | Neoplasm (.02) | 1.4 (1.1,1.7) | 0.3 |
| | Diabetes mellitus (.02) | 2.6 (1.2,5.6) | 1.0 |
| | Ruptured cruciate ligament (.04) | 2.1 (1.0,4.1) | 0.7 |
| | Hypothyroidism (<.0001) | 2.8 (1.9,4.2) | 1.0 |
| | Pancreatitis (.05) | 2.2 (1.0,4.7) | 0.8 |

*95% confidence interval (CI).
†Parameter estimate/coefficient from logistic model.

adequately predict the outcome of obesity. However, the *P* value for the overweight model statistic was <.05 (null hypothesis rejected, ie, model does not fit) and so cannot completely explain the variability in the data analyzed. There may be essential variables not collected in this study that would help more fully predict the outcome, for example, exercise patterns, single or multiple dog household status, urban/rural residence, and feeding frequency.

Major strengths of the study reported here include the size and geographic distribution of the population studied as well as the ability to generalize the results to private practice populations in the United States.

Although the data for this study were collected during 1995, the scope and the results of the study remain relevant to the contemporary description and assessment of the obesity problem of dogs seen in private companion animal practice and provide a benchmark for subsequent measurements of obesity and overweight prevalence in the pet canine population. Surveillance and monitoring of the health of US dogs is especially relevant in light of the current epidemic of human obesity.

Limitations of the study include the use of a cross-sectional study design, a lack of standardized case definitions, and the potential for underreporting of cases.[14] A cross-sectional study is of limited use for discerning disease causality.[28] This is important to keep in mind when examining associations such as between obesity and hypothyroidism. Uncommon or rare diseases, even if of great interest, are not efficiently examined in this type of study.[28] For the results reported in this study, the lack of case definitions and the potential for disease misclassification must be considered. Grouping of individual diagnoses into system categories was necessary to increase the efficiency of the statistical analysis and to minimize error from disease misclassification. The failure of this study to document a risk relationship between overweight or obesity and an uncommon disease, such as transitional cell carcinoma of the urinary bladder, does not prove or disprove such a relationship. Misclassification of the outcome (overweight or obesity) by BCS must also be considered as a source of differences between our study results and others as the assessment of body condition has not been standardized across research studies.

In addition to providing important descriptive data on the problem of obesity in dogs seen by practitioners in the United States, this study provides evidence that the promotion of weight reduction approaches for overweight/obese dogs may reduce morbidity. Feeding practices of neutered pets may need to be more closely guided by veterinarians, especially in regard to feeding calorie-dense non-commercial foods. Future studies should ideally include additional lifestyle factors such as exercise patterns, single or multiple dog household status, urban/rural residence, and feeding frequency to help fully model and predict overweight/obesity. A cohort design would allow dogs to be followed over their lifetime, enabling determination of the temporal association of disease incidence to the development of overweight/obesity. Finally, with these study results, the ability of practitioners to communicate the importance of maintaining canine patients at ideal body condition will be strengthened.

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**APPENDIX.** DISEASES (WITHIN CATEGORY) IN STUDY DOGS DIAGNOSED BY VETERINARIANS

*Dermatopathy (prevalent diagnoses > .05%)*: Acral lick granuloma, alopecia (endocrine and general), angioneurotic edema, dandruff, dermatitis (allergic contact, atopic, flea allergy, flea bite, fly bite, food allergy, foxtail, hormonal, intertrigenous/fold, moist, paronychial, perivulvar, prutitic, seborrheic), dermatophytosis, folliculitis, paronychia, pyoderma.

*Gastrointestinal Disease (prevalent diagnoses > .05%)*: Ascites, anal sac disease, chronic diarrhea, colitis, constipation, enteritis, gastritis (acute, general), gastroenteritis, umbilical hernia.

Heart Disease (prevalent diagnoses > .05%): cardiac arrhythmia, congestive heart failure, cardiomegaly, heart disease, heart murmur (acquired, general), mitral insufficiency.

*Lower urinary Tract Disease (prevalent diagnoses > .05%)*: cystitis (acute, bacterial), bladder stone(s), urinary tract infection, urolithiasis (calcium oxalate, cystine, silica, struvite, unspecified, urate, xanthine).

*Musculoskeletal Disease (prevalent diagnoses > .05%)*: arthritis, cruciate ligament rupture, eosinophilic panosteitis, intervertebral disc disease, lameness, muscle atrophy, osteoarthritis, osteochondritis dessicans, patellar luxation, soft tissue injury, spondylitis, spondylosis.

*Neoplasia (prevalent diagnoses > .05%)*: adenocarcinoma, adenoma, eyelid margin tumor, hemangiosarcoma, histiocytoma, lipoma, lymphosarcoma, mast cell tumor, mammary tumor, meibomian gland ademona, melanocarcinoma, osteosarcoma, perianal gland tumor, sebaceous adenoma, tumor-unspecified.

*Oral Disease (prevalent diagnoses > .05%)*: dental calculus, dental caries, fractured tooth, gingivitis, malocclusion, periodontal disease, retained deciduous teeth.

*Renal Disease (prevalent diagnoses > .05%)*: azotemia, renal disease (acute and chronic), renal failure (acute and chronic), uremia.

*Reproductive Disease (prevalent diagnoses > .05%)*: balanoposthitis, dystocia, mastitis, metritis, prostatic disease, prostatic hypertrophy, prostatitis, pyometra, vaginitis.

*Respiratory Disease (prevalent diagnoses > .05%)*: bronchial asthma, bronchitis, dyspnea, epistaxis, nasal discharge, pharyngitis, rhinitis, sinusitis, tracheal collapse, tracheitis, tracheobronchitis, pneumonia, pulmonary edema, upper respiratory infection.