

Digestive System

Obesity

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Overview

The 2022 Pet Obesity Prevalence Survey reported nearly 60% of the US dog population is overweight or obese (1), and this number rises yearly. Canine obesity was officially classified as a disease at the 2023 World Small Animal Veterinary Association One Health meeting. There are a plethora of adverse clinical consequences associated with the overweight and obese states. (Shepherd, 2021; Weeth et al, 2007) These make it imperative for us to identify the factors that initiate and promote this disease condition so it can be managed appropriately. Obesity can be defined in numerous ways, but simply put, obesity is an abnormal or excessive accumulation of fat that is a risk to health. It increases the risk of several debilitating diseases through a variety of pathways, some as straightforward as the mechanical stress of carrying extra pounds and some involving complex changes in hormones and metabolism. The risk of health problems starts when your pet is slightly overweight; the likelihood of these health problems worsens as overweight turns into a state of obesity. The longer this excess fat mass (obesity) persists the result is a decline in both quality of life and longevity. Fortunately, this disease can be treated as well as prevented. For simplicity's sake, the terms obese or obesity will be used in this chapter. Adipose (fat) tissue is classified as an endocrine organ as

these cells secrete hormones and cell-mediating substances that promote inflammation (Poulos et al, 2009; Hildebrandt et al, 2023; German et al, 2010). The inflammatory process, when chronic or prolonged, triggers numerous metabolic dysfunctions including unmanaged oxidative stress; which damages cells and tissues increasing the risk of deleterious co-morbidities (Backus et al, 2016). Excess fat mass can accumulate at any age, even as early as the puppy life-stage (Zorena et al, 2020). Therefore, identifying early trends in excess weight gain will allow for quicker initiation of management strategies. This chapter reviews the diagnosis and treatment of obesity; management of the obese-prone pet; and prevention of this disease state.

The American College of Veterinary Nutritionists established an iterative process to develop appropriate nutritional support plans for healthy pets and those diagnosed with one or more disease conditions. The components of this process (animal-, diet- and feeding management specific factors) allow for a comprehensive look at the pets' current feeding management and provide vital information to determine if any alterations would benefit the pet/patient. This chapter will walk you through this process as it relates to an uncomplicated overweight/obese pet.

Common health concerns associated with the overweight-obese canine

Osteoarthritis	Degenerative joint disease	Chronic pain
Diabetes mellitus	Heart disease	Hypertension
Hypothyroidism	Increased risk of hyperthermia	Some cancers
Respiratory distress	Difficulty breathing	Anesthetic complications
Urinary bladder stones	Difficulty grooming	Decreased life span

It Starts with a Diagnosis

A diagnosis of obesity can be associated with an underlying medical condition, be a consequence of misguided feeding management, or some combination thereof. An examination by your pet's primary care veterinarian will help determine the cause(s) of the condition and devise a plan for any underlying medical factors. Assuming the obese condition is not medically-induced and/or the underlying causes can be adequately addressed, affected dogs should be placed on a comprehensive weight loss treatment plan.

The degree of excess body fat, in relation to lean muscle mass, categorizes the pet's state of obesity. The ideal proportion of lean-to-fat is approximately 80:20, which is reflective of a Body Condition Score of 5/9 based on the scoring system depicted in **Figure 6.1**. An increase in fat mass greater than 20% of body mass reflects an increase in Body Condition Score ranging from 6/9 up to 9/9, reflecting a 10% increase in fat mass with each unit increase in Body Condition Score. Utilizing the 9-point Body Condition Score system, 8/9 and 9/9 are described as obese, while 7/9 is overweight (Laflamme, 1997). Once the score has been determined, an ideal body weight is determined to calculate the daily calorie needs of the pet to address safe, healthy weight loss (German et al, 2009). Alternatively, breed specific guidelines for average adult body weight and/or historical healthier reported body weight for the pet

can be used to help determine a target body weight. Daily calorie-needs (maintenance energy requirement) for the target body weight is determined by calculating a resting energy requirement for the pet, then multiplying this value by a factor that reflects age, gender, reproductive status, activity, illness, weight gain or weight loss (Cline et al, 2021). You should work with your pet's veterinarian to ensure these calculations are accurate.

Diet and Feeding Management Factors

The goal of successful weight loss is to "lose fat, keep the lean". In that light, nutrients in the pet's diet can influence the degree of excess body fat, as well as the changes in fat and lean muscle mass, and the pets' inflammatory picture during weight loss (Laflamme, 1997; Blees et al, 2020). Therefore, special focus on dietary levels of fat, protein, carbohydrates (the calorie-providing nutrients), as well as antioxidant-enriched and anti-inflammatory dietary contributors is recommended. Keeping these dietary factors in mind, an evaluation of your pet's current diet will determine whether a diet change would promote healthy, safe weight loss.

Controlled calorie deficit is key in safely decreasing fat mass. Fat contributes twice the calorie content as protein or carbohydrate. A numerical appreciation of this concept

Body Condition Score for Dogs

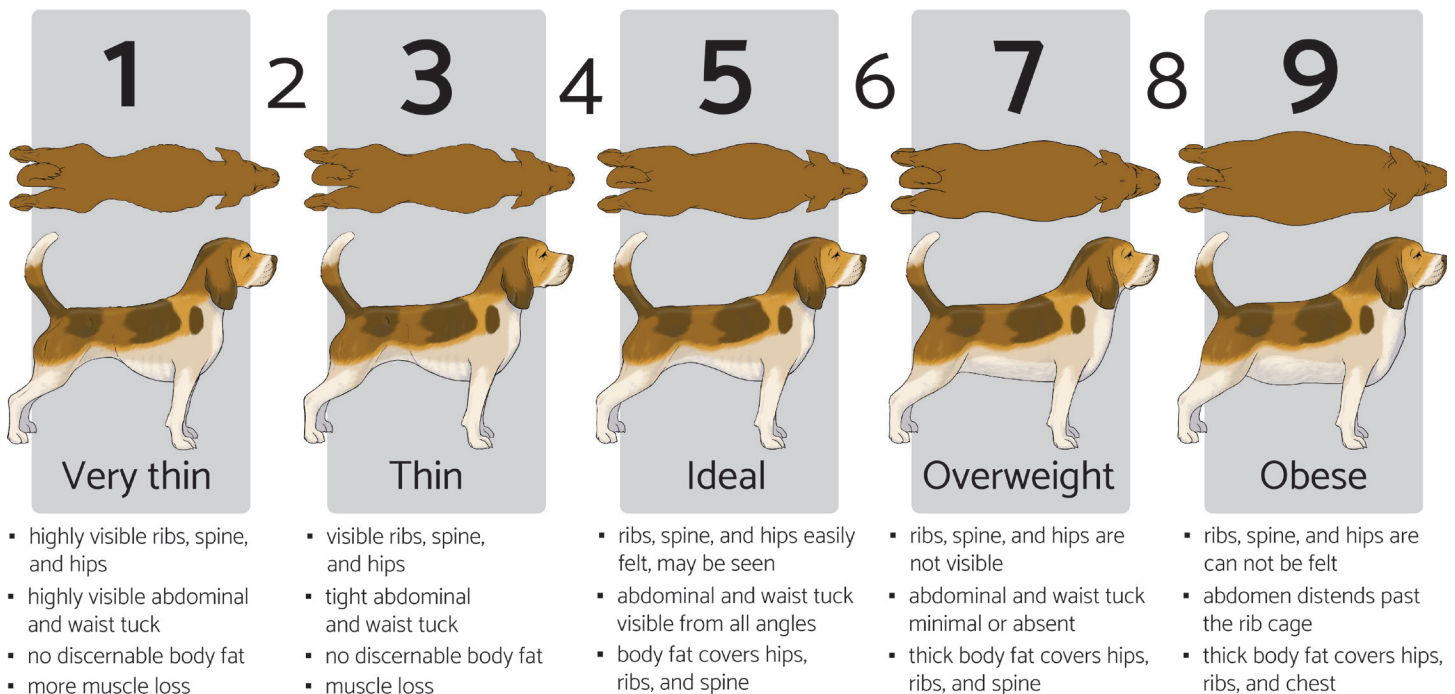


Figure 6.1 - Body condition scores for dogs

is fat provides 8 kcal per gram unit, while protein and carbohydrates each contribute 4 kcal. Translating that into dietary decisions, restricted fat calorie content of the diet is an effective way to promote calorie deficit. To off-set the decrease in dietary fat, increasing the calorie contribution from protein sources is recommended (Weber, 2007). Maintaining a higher level of protein in weight loss diets supports the maintenance of lean muscle mass. Additionally, the body is provided with adequate amino acids to support daily protein needs such as immunocompetence, enzyme and hormone production, and daily protein turnover. Micronutrients (i.e., minerals and vitamins) are likewise important during weight loss as they contribute to ensuring a nutritionally complete and balanced diet. It is recommended that a prescription diet formulated for safe weight loss be used in the obese patient rather than a non-prescription, over-the-counter weight management, adult- or growth-life stage diet. Prescription weight loss diets provide restricted fat, while adjusting all remaining nutrients based on the energy density of the diet. This helps to prevent protein, carbohydrate, vitamin, and mineral deficiencies commonly observed when over-the-counter diets are utilized in a weight loss feeding program (Shepherd, 2021; Flanagan et al, 2017).

Fiber, although not a true nutrient but a component of dietary carbohydrates, should be a component of diets used for weight loss. Insoluble fibers provide satiety without adding to the calorie content. Soluble fibers help support the gastrointestinal microorganisms (Barko, 2018) to help ensure a healthy gastrointestinal environment during the weight loss process. An increase in daily water intake, via diet and/or drinking, promotes a feeling of fullness without adding calories. The biologically active metabolites of omega-3 fatty acids, eicosapentaenoic acid and docosahexaenoic acid, help to mitigate the chronic inflammatory state associated with obesity. Fish and fish oil products are excellent dietary sources of these anti-inflammatory fatty acids. Oxidative damage driven by obesity-associated inflammatory mediators can be

managed with vitamins A, C, and E along with selenium, copper, manganese, and zinc which all provide antioxidant functions. Chromium is a trace element suggested to contribute to weight loss. Although evidence does not support significant weight loss, it can help suppress appetite, break down fat and stimulate thermogenesis resulting in some calorie usage (Tian et al, 2013). Seeking advice from your veterinarian regarding the potential benefits of supplementing your dog’s diet for weight loss is recommended.

Pet food companies that provide a prescription diet line include weight loss-focused prescription diet options. Your pet’s veterinarian can work with you to recommend which weight loss diet would be most efficacious for your dog based on the degree of obesity, eating behaviors, exercise potential, diet ingredients, preferred food texture, diet affordability and availability.

The feeding approach used during a weight loss program can influence calorie burn, your pet’s behaviors, and ultimately the success of the weight loss program. A key point for successful weight loss is to avoid ad libitum or free feeding (Shepherd, 2021). It is imperative that you accurately manage daily calorie intake by measuring the meal allotment in grams. Gram measurement is more accurate than standard cup measures and thus decreases the risk for over-feeding calories (German et al, 2011; Coe et al, 2019). The calories from food are utilized in several ways once ingested. Ten percent of calories eaten at each meal are used to digest and absorb the nutrients from that meal. This is referred to as the thermic effect of food, while the remaining calories are burned through movement. Thus, feeding smaller more frequent meals throughout the day will help with the desired calorie burn. It is important to adhere to the appropriate diet and calculated daily calorie intake. During the calorie-reduction period, it is not uncommon for pets to develop undesirable behaviors including begging, obsessive food seeking, vocalizing, and in some cases food aggression (Shepherd, 2021). Spacing their daily calorie intake into smaller, frequent meals can help to prevent these behavioral changes. You might want to consider an automated feeder to help with the increased feeding frequency as well as, divert the pet’s persistent food focus away from you. Interactive feeding is another strategy to abate undesired food-related behaviors. There are a multitude of innovative, interactive devices (i.e., toys) that require your dog to manipulate the device to access food in a controlled manner. These devices are also often used for enrichment purposes that have other benefits along with calorie control. Transition into the weight loss plan over approximately 1-2 weeks can serve as another strategy to mitigate adverse behavioral changes with

Common Clinical Findings

Vomiting

Diarrhea

Weight Loss

Reduced Serum Cobalamin

calorie restriction. Likewise, consider identifying a quiet, safe space to feed the pet and re-locate the pet to another room while you are eating meals to abate begging and minimize any tendency on your part to provide table food offerings.

Developing the Healthy Weight Loss Treatment Plan

The goal is safe, controlled, healthy weight loss to a pre-determined body condition and body weight. A methodical approach (see below) includes determination of a target

Body Condition Score that translates into the target body weight. To achieve this goal, daily calorie intake is calculated based on the target body weight, an appropriate diet is identified, and a daily feeding plan is implemented. A specific monitoring plan including timing for sequential weight checks; a log for daily feeding, behavior and health concerns; and a timeline for progress can help with plan compliance. Once the targeted body condition and body weight is reached, you will need to work with your pet's veterinarian to adjust daily calorie intake, and possibly diet, for long-term healthy weight management.

Example of a Simple Weight Loss Plan for an Obese Dog:

A 5-year-old female, spayed West Highland White Terrier. Presenting with no underlying health concerns. Diagnosed with primary obesity.

Current Diet

Adult Maintenance Life-stage Small Breed dry diet, free-fed along with 1 tablespoon of beef or chicken flavor canned diet fed twice daily. Unknown amount of table food daily and 2 Dog Dental Treats daily.

Current BCS: 8/9 Current BW: 11.5 kg (25.3 lb)

^aTarget BCS: 5/9 ^bTarget BW: 8.0 kg (17.6 lb)

Calculated daily calorie need for weight loss:

MER = 333 kcal/day with 8% as treat allowance, thus 306 kcal/day from the prescription weight loss diet and 27 kcals as treat. Utilize a commercial prescription weight loss diet formulated as: fat calorie-restricted, protein-calorie and insoluble fiber-enhanced, enriched in EPA and DHA. Feed calories as 90% dry and 10% can food.

Using an example Rx diet

Dry kibble: 2.9 kcal/gram diet (245 kcal/8 oz cup)

Canned: 0.625 kcal/gram diet (220 kcal/12 oz can)

Per day feed:

94 grams dry kibble with 49 grams canned diet, divided between 3-4 meals across the day. Include 27 kcal/day of low fat, higher fiber treats.

Suggested common options include:

fresh, frozen, raw, or steamed non-starchy vegetables (green beans, broccoli, cauliflower, zucchini, baby carrots), fruits (apples, blueberries, raspberries, strawberries, watermelon); low fat dairy (cheese, cooked/pasteurized egg whites). Commercial low fat dog biscuit-type treats are available to complement Rx weight loss/management diets with a listed per biscuit calorie count.

Monitoring guidelines:

Record BW every 3 weeks, observe your pet eating meals and report any changes in appetite; diet tolerance; activity level; and overall attitude to your pet's veterinarian immediately.

^a Each increase in BCS above 5/9 reflects at 10% increase in fat mass. In this example $8/9 - 5/9 = 3$ or 30% excess fat.

^b Subtract 30% from the current BW to obtain the target BW. In this example $11.5 \text{ kg} - (11.5 \text{ kg} \times 30\%) = 8.0 \text{ kg target BW}$.

^c MER is calculated based on target BW. In this example $(8 \text{ kg}^{0.75} \times 70) \times 1$ (canine weight loss factor) = 333 kcal per day.

Roadblocks to successful weight loss

The success of the initial weight loss and subsequent weight management plan hinges on communication and compliance (Blees et al, 2020; Churchill, 2016). The client needs to be on board 100% and this starts with the understanding their pet is obese, the detrimental effects of this condition, and that weight loss is beneficial (Eastland-Jones et al, 2014; Webb et al, 2020). It is important that the client and the pet's veterinarian have a shared set of goals for the pet as an obesity treatment plan is developed. Client commitment to and compliance with all aspects of the plan are vital to its success; therefore, the plan should be devised in a user-friendly manner to help ensure the intended outcomes. Common stumbling blocks are diet accessibility, cost, and palatability; client constraints regarding pet exercise; more than one pet in the household; dietary substitutions; extreme adverse pet behaviors in response to calorie restriction; multiple individuals feeding the pet; and changes in the pet's health (German et al, 2012; German et al, 2017; Coy et al, 2021; Porsani et al, 2020). Communicating concerns to your veterinarian as they occur will enable the weight loss plan to be revised as needed to maximize the chances for success.

Managing the Obese-Prone Pet

The growth life-stage can be a notorious time for accumulation of excess fat mass in puppies. Although the number of adipose cells is naturally set for life during the growth period, over-feeding the growing puppy easily leads to excess adipose cell development. This is referred to as hyperplastic obesity. As the dog matures, these additional adipocytes store excess fat/lipids not needed for daily needs, thus predisposing the dog to being obese-prone for life. In this scenario, weight management often becomes a long-term, constant focus for the pet caregiver to minimize the risk of obesity-related health consequences down the road. Several strategies can be considered that would prevent hyperplastic obesity based on growth diet choices; daily calorie calculations; environmental constraints; and breed predilection. By all means, be sure to seek advice about managing an obese-prone pet from your pet's veterinarian or a Board-Certified Veterinary Nutritionist™.

Overweight-Obesity Prevention: The Silver Bullet

The day you bring your puppy home is when obesity prevention should be at the forefront of your puppy care list. A puppy growth chart (Salt et al, 2017), provided by

your veterinarian, is a helpful way to track the puppy's growth and identify concerns early. An effectual growth chart provides: placemarks for actual compared to predicted monthly body weight; target daily calorie intake for predicted monthly body weight; amount of puppy diet to feed each day; recommended daily treat allowance; feeding frequency recommendations; a predicted growth curve; and complete diet information.

Training is generally a pivotal aspect of raising a puppy and food type treats are a common incentive/reward during training. It's wise to determine the calorie content of the different types of treats and include that calorie contribution into the daily total calorie intake. Choosing low fat, high protein treats is recommended. The rule of thumb to prevent a nutritionally unbalanced feeding program is limit treat calories to a maximum of 10% total daily calories. Consider monitoring the puppy's growth monthly using changes in body weight, Body Condition Score, and muscling as markers. Your veterinarian can demonstrate and provide web-links on how to assess the Body Condition Score and muscle mass during a puppy visit.

Exercise is another valuable aid in weight management (Vitger et al, 2016). Along with strengthening bones and promoting lean muscle mass, movement burns calories. The type of exercise that works best for both you and your dog will be the easiest to maintain on a consistent schedule. Choose weight-bearing or non-weight-bearing exercise based on your pet's mobility, pain, age, and any health concerns. Canine rehabilitation services can assist with specialized exercise programs as needed.

In Summary

Obesity is a prevalent disease state in our canine companions that reduces their quality of life and shortens their life-span (Salt et al, 2018; German et al, 2012). Once diagnosed, it can be treated through teaming up with your pet's veterinarian to develop a successful, comprehensive weight loss plan. Safe weight loss from the obese condition takes time. Therefore, patience, compliance and commitment are necessary for success. Early focus on feeding management during growth can help prevent the onset of obesity and optimize your dog's overall health. As the saying goes, **An ounce of prevention is worth a pound of cure.**

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Relevant References

Association for Pet Obesity Prevention. <https://www.petobesityprevention.org>

Shepherd, M. Canine and Feline Obesity Management 2021 Vet Clin North Am Small Anim Pract. May 2021; 51:3 653-66

Weeth, LP, et al. Prevalence of obese dogs in dogs with cancer. AJVR, 2007;68(4), 389-398. 4.

Poulos SP, et al. The development and endocrine functions of adipose tissue. Mol Cell Endocrinol. 2010 Jul 8;323(1):20-34. doi: 10.1016/j.mce.2009.12.011.

Hildebrandt X, et al. Cell death and inflammation during obesity: “Know my methods, WAT(son)” Natur., (2023) 30:279-292; <https://doi.org/10.1038/s41418-022-01062-4>.

German, AJ, et al. Obesity, its associated disorders and the role of inflammatory adipokines in companion animals. The Vet J, 2010; 185(1), 4-9.

Zorena, K, et al. Adipokines and obesity. Potential link to metabolic disorders and chronic complications. Int J Mol Sci. 2020 May 18;21(10):3570. doi: 10.3390/ijms21103570.

Backus, R. et al Development of obesity: Mechanisms and physiology. Vet Clin North Am: Small Anim Pract. 2016; 46, 773-784

Laflamme D. Development and validation of a body condition score system for dogs. Canine Pract. 1997;22:10-15. 15.

Canine Body Condition Score. <https://wsava.org/wpcontent/uploads/2020/01/Body-Condition-Score-Dog.pdf>.

German AJ, et al. Use of Starting Condition Score to Estimate Changes in Body Weight and Composition During Weight Loss in Obese Dogs. Res Vet Sci. 2009;87:249-254.

Cline, et al. 2021 AAHA Nutrition and Weight Management Guidelines for Dogs and Cats. J Am Anim Hosp Assoc. 2021; 57:153-174.

WSAVA Global Nutrition Guidelines. www.wsava.org/WSAVA/media/Documents/Guidelines.

Blees, NR, et al. Influence of macronutrient composition of diets on leptin and adiponectin concentrations in overweight dogs. J Anim Physiol Anim Nutr. 2020 Mar;104(2):698-706.

Weber M, et al. A high-protein, high-fiber diet designed for weight loss improves satiety in dogs. J Vet Intern Med. 2007;21:1203-8.

Flanagan J, et al. Success of a weight loss plan for overweight dogs: the results of an international weight loss study. PLoS One 2017;12:e0184199.

Barko PC, et al. The gastrointestinal microbiome: a review. J Vet Intern Med. 2018;32(1):9-25.

Tian H, et al. Chromium picolinate supplementation for overweight or obese adults. Cochrane Database Syst Rev. 2013 Nov; 2013(11): CD010063

German AJ, et al. Imprecision when using measuring cups to weigh out extruded dry kibbled food. J Anim Physiol Anim Nutr. 2011;95:368-73.

Coe JB, et al. Dog owner's accuracy measuring different volumes of dry dog food using three different measuring devices. Vet Rec. 2019;185:599.

Churchill, J., & Ward, E. Communicating with pet owners about obesity: Roles of the veterinary health care team. Vet Clin North Am Small Anim Pract, 2016; 46, 899-911.

Eastland-Jones, RC, et al. Owner misperception of canine body condition persists despite use of a body condition score chart. J Nutr Sci. 2014; 3, e45.

Webb, TL, et al. Understanding obesity among companion dogs: New measures of owner's beliefs and behaviour and associations with body condition scores. Prev Vet Med. 2020; 180, 105029.

German AJ, et al. Overweight dogs exercise less frequently and for shorter periods: results of a large online survey of dog owners from the UK. J Nutr Sci. 2017;6:e11.

German AJ, et al. Long-term follow-up after weight management in obese dogs: the role of diet in preventing regain. Vet J. 2012;192:65-70

Coy, AE, et al. Why can't I resist those “puppy dog” (or “kitty cat”) eyes? A study of owner attachment and factors associated with pet obesity. Animals. 2021; 11, 539.

Porsani MYH, Teixeira FA, Amaral AR, et al. Factors associated with failure of dog's weight loss programmes. Vet Med Sci. 2020;6:299-305

WALTHAM Petcare Science Institute. Puppy Growth Charts. Available at: <https://www.waltham.com/resources/puppy-growth-charts>

Salt C, et al. Growth standard charts for monitoring bodyweight in dogs of different sizes. PLoS One. 2017;12(9):e0182064.

Vitger AD, et al. Integration of a physical training program in a weight loss plan for overweight pet dogs. J Am Vet Med Assoc. 2016;248:174-82.

Salt, C, et al. Association between life span and body condition in neutered client-owned dogs. J Vet Intern Med. 2018; 33(1), 89-99.

German AJ, et al. Quality of life is reduced in obese dogs but improves after successful weight loss. Vet J. 2012;192:428-34.