

The Skinny on Fat: Obesity

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Obesity is the most important malnutrition of companion animals. It can be a disabling medical condition when moderate to severe in scope. At prevalence rate estimates of 10-40%, obesity must be considered a significant hazard to dogs and cats. Increased emphasis on pet health and preventative health programs makes obesity prevention an important aspect of health maintenance programs in dogs and cats. Treatment for obesity varies from frustrating to rewarding and evaluating and prescribing for successful, long term weight loss and maintenance usually requires management of multiple, inter-related patient and client factors. Diagnosis of disease secondary to obesity and the major task of client education and motivation is the provenance of the veterinarian.

The American Animal Hospital Association released the Guidelines for Nutritional Assessment (July/August JAAHA 2010). Utilizing the two-step iterative process, a screening assessment is made and if concerns are found, then a more detailed assessment is made. Following assessment, data are analyzed, a plan formulated and initiated, and repeated evaluation and modification of the plan is made. The importance of nutrition is emphasized by it being considered one of the “SVA’s” (5 vital assessments): temperature, cardiac function, respiratory health, pain, and nutrition (<http://www.everypeteverytime.com/index.html>).

The American College of Veterinary Nutrition recommends a two-step process in making nutritional recommendations. The process is iterative in that it should be re-evaluated periodically and changes made as deemed necessary.

The first step is ASSESSMENT. During this step, assess the ANIMAL, the DIET, and the FEEDING factors.

ANIMAL FACTORS assessed include gathering historical information, performing physical examination, body condition scoring, and evaluating laboratory and imaging results if indicated. Gather information on any health or disease-related conditions, medications (including over-the-counter and nutraceuticals/supplements), reason for visit, and other household members. A thorough physical examination is performed and a body condition score assigned. There are 5- and 9- point body condition scoring systems; either can be used. In either scale, the middle number of the scale (3 out of 5 or 5 out of 9) represents ideal body condition and a body fat content of 15-25%; numbers lower than this correspond to lower body condition and less body fat (0-15%) while numbers higher than this correspond to higher body condition and greater body fat ($\geq 35\%$). Assigning a body condition score provides more information than body weight alone and can be used with a muscle condition scoring system where 3 = adequate muscle mass, 2 = decreased muscle mass, and 1 = severe muscle wasting (sarcopenia).

Descriptor	Description	5 point	9 point
CACHECTIC	Ribs are easily palpated with no fat cover; bony structures are prominent and easy to identify; muscle tone and mass often decreased; little to no subcutaneous fat; hair coat often poor; pronounced abdominal tuck	1	1
UNDERWEIGHT	Ribs are easily palpated with little fat cover; abdominal tuck present; bony structures are palpable but not prominent; hair coat may be poor; muscle tone and mass may be good or slightly decreased	2	3
IDEAL	Ribs are easily palpated, but fat cover is present; hourglass shape present and abdominal tuck is present, but not pronounced; bony prominences are palpable but not visible some subcutaneous fat, but no large accumulations; muscle tone and mass good; hair coat quality is good	3	5
OVERWEIGHT	Ribs are difficult to palpate due to overlying fat accumulation; hourglass shape is not prominent and abdominal tuck is absent; subcutaneous fat obvious with some areas of accumulation; muscle tone and mass good; hair coat quality may be decreased; cannot identify bony prominences	4	7

OBESE	Ribs are impossible to palpate due to overlying fat; hourglass shape is absent and animal may have a round appearance; subcutaneous fat is obvious and accumulations are present in the neck, tail-base, and abdominal regions; muscle tone and mass may be decreased; hair coat quality may be decreased	5	9
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DIETARY FACTORS include gathering information on dietary intake and inspection of the food, if needed. Take the dietary history from the person that actually feeds the pet(s) asking for type of food, amount fed, frequency of feeding, table food or treats, access to other food (garbage, outside, etc), supplements, and medications (including over-the-counter). If necessary, inspect a sample of the food or send a sample for analysis (i.e. Cornell Animal Health Diagnostic Center, Woodson Tenent Laboratories, EMSL Food and Consumer Products Testing Lab, etc). Pet foods can be purchased in a variety of forms – dry, canned, semi-moist, semi-dry, liquid, and frozen.

Reading the food label is also beneficial. The food label can be roughly divided into a principal display panel and an information panel. The PRINCIPAL DISPLAY PANEL contains information directed towards the consumer including the product name, species for which the food is intended, net weight of product, and descriptive words and/or pictures (e.g. “new and improved”, picture of a famous cat, etc). The INFORMATION PANEL contains the important information including ingredient list, guaranteed analysis, feeding guidelines, contact information, and the nutritional adequacy statement. Although often maligned and not as complete as labels for human foods, there is useful information to be found. Ingredients are listed in descending order according to pre-processing weight and names are set by AAFCO (e.g. by-product, etc); this means that ingredients containing moisture that weigh more will be listed first. Unfortunately, this does not give information as to the quality or exact amount of each ingredient; also, different forms of the same type of ingredient are listed separately. Chemical sounding ingredients are typically vitamins, minerals, and preservatives. Feeding guidelines are provided that are suitable for most, but not all, dogs or cats that consume the diet. The manufacturer’s or distributor’s name and address is required and questions regarding the food should be directed to them; they should be able and willing to provide answers.

When contacting them, several questions should be asked:

1. Do you have a Veterinary Nutritionist or some equivalent on staff in your company? Are they available for consultation or questions?
2. Who formulates your diets and what are their credentials?
3. Which of your diet(s) is AAFCO Feed Trial tested? Which of your diets have been AAFCO Nutritional analyzed?
4. What specific quality control measures do you use to assure the consistency and quality of your product line?
5. Where are your diets produced and manufactured? Can this plant be visited?
6. Can you provide a complete product nutrient analysis of your bestselling canine and feline pet food including digestibility values?
7. Can you give me the caloric value per can or cup of your diets?

The **guaranteed analysis** provides information regarding the 4 major components of a pet food as percentages of the diet as fed including minimum amount of crude protein, minimum amount of crude fat, maximum amount of crude fiber, and maximum amount of moisture. “Crude” refers to the analytical procedure and does not refer to the quality of the ingredient.

The **nutritional adequacy** statement must be included and is designed to ensure that the product, when fed as the sole source of nutrition, is complete and balanced for one or more life stages, including how this adequacy was verified. The four recognized life stages by AAFCO are pregnancy, lactation, growth, and adult maintenance, and nutritional adequacy can be determined by feeding trials or by calculation. The calculation method involves determining the amount of nutrients in the diet and comparing to AAFCO nutrient profiles for that/those life stage(s). Feeding trials are performed by feeding the diet to the animals in that/those life stage(s) following AAFCO protocol. Feeding trials, while not perfect, provide indirectly information on bioavailability of nutrients and is preferred method for validation of nutritional adequacy. Therapeutic diets, supplements, and treats often do not carry a nutritional adequacy statement. Therapeutic diets are formulated for specific non-healthy conditions, which are not recognized by AAFCO and for which no nutrient profiles exist (e.g. renal failure, liver failure, etc); they usually carry a statement such as “intended for intermittent use” or “use only under the supervision or direction of a veterinarian”. Snacks and treats are not formulated or intended to be the sole source of nutrition; therefore, they are not required to carry a nutritional adequacy statement.

The label often contains other information, much of which do not have official definitions. According to AAFCO, “natural” is “...only acceptable in reference to the product as a whole when all of the ingredients and components of ingredients meet the definition....the use of ‘natural’ is false and misleading if any chemically synthesized ingredients are present in the product; however, AAFCO recommends that exceptions be made in the cases when chemically synthesized vitamins, minerals, or other trace nutrients are present as ingredients in the product, provided that the product is not a dietary supplement and that a disclaimer is used to inform the consumer that the vitamins, minerals, or other trace minerals are not natural. For example, ‘Natural with added vitamins, minerals, and other trace minerals.’” AAFCO defines “natural” as “a feed or ingredient derived solely from plant, animal, or mixed sources,

either in its unprocessed state or having been subject to physical processing, heat processing, rendering, purification, extraction, hydrolysis, enzymolysis, or fermentation, but not having been produced by or subject to a chemically synthetic process and not containing any additives or processing aids that are chemically synthetic except in amounts as might occur unavoidably in good manufacturing processes.” “Organic” does not have a specific AAFCO definition other than in reference to processing, “organic (process): a formula or a specific ingredient within a formula feed that has been produced and handled in compliance with the requirements of the USDA national Organic Program (7 CFR Part 205).” The USDA National Organic Program (NOP) “develops, implements, and administers national production, handling, and labeling standards for organic agricultural products. The NOP also accredits the certifying agents (foreign and domestic) who inspect organic production and handling operations to certify that they meet USDA standards.” There is no definition of “human grade” food and many ingredients used in pet foods are suitable for human consumption. “The U.S. Food and Drug Administration (FDA) Center for Veterinary Medicine has taken the position that if every ingredient in a product is edible, meaning that it was processed according to rules of sanitation required of food sold to people, then the product may be labeled “human grade”. However, an edible ingredient becomes inedible when you add it to other inedible ingredients.” - Dr. William Burkholder, veterinary medical officer for the FDA CVM (January 2009). Other designators such as “premium” and “gourmet” also have no official definitions. Such designators are arbitrary and subject to interpretation.

FEEDING FACTORS to be assessed include how the nutrition is provided and must take into account owner and animal factors. Simply filling a bowl within reach of the animal is not enough; the appropriate diet must be provided in the appropriate amount. Obesity is the most common nutritional disorder of dogs and cats and, in part, is due to overfeeding. “One cup” of food refers to the amount of food contained in one 8-ounce measuring cup. Ask specifically for the size of the cup used and the size of the bowl that is filled up. Many owners feed free choice – “drive-by feeders” - without regard to amount. The amount of energy required by the pet can be determined using one of two formulae:

Linear: $[(30 \times BW_{kg}) + 70]$ Exponential: $70 \times (BW_{kg}^{0.75})$

This provides the **RESTING ENERGY REQUIREMENT** and this result is multiplied by a life stage or activity factor depending on the individual.

<u>Life Stage</u>	<u>Canine Factor</u>	<u>Feline Factor</u>
Gestation	1.0 – 3.0	1.6 – 2.0
Dogs – first 1/2 - 2/3	1.0 – 2.0	
Dogs – last 1/3	2.0 - 3.0	
Lactation	2.0 – 8.0	1.0 – 2.0
Growth	2.0 – 3.0	2.0 – 5.0
Adult intact	1.8	1.4
Adult neutered	1.6	1.2
Senior	1.4	1.1
Work – light	2.0	
Work – moderate	3.0	
Work – heavy	4.0 – 8.0	
Obese prone	1.4	1.0
Weight loss	1.0	0.8
Weight gain	1.2-1.4 ideal	0.8-1.0 ideal
Critical care (usually)	1.0	1.0

The second step is **FORMULATION AND INITIATION OF A FEEDING PLAN**. The nutritional plan is formulated based on the assessment phase and initiated. It is important that this plan is re-evaluated periodically (iterative process) and adjustments made based on what is found during assessment. Recommendations for the feeding plan are made based on life stage and physiological or pathological condition of the pet as well as the life style of the owner. Working within the constraints placed by the owner helps to ensure compliance; otherwise, recommendations will not be followed. There is no “one best” diet available for healthy pets or for pets that suffer from a disease. Oftentimes, many options exist including homemade diets.

Today’s health care providers, veterinarians and technicians, need to be able to assess a pet, evaluate diets, and make recommendations on diets and feeding. Knowledge of assessment and formulation of a nutritional plan should be part of a patient’s health care. Use body condition scoring in addition to weight to assess nutritional status.

Types of diets

There are basically 3 types of diets available for pets: (1) commercial, over-the-counter diets, (2) therapeutic diets, and (3) homemade including raw food diets. These arbitrary designations are becoming somewhat blurred as there are commercial raw food diets and commercially available feed mixes that provide all nutrients except for the protein source, which the pet owner adds a protein source whether cooked or raw. Over-the-counter (OTC) diets are regulated through several different agencies. The Association of American Feed Control Officials (AAFCO) is not a regulatory agency but sets nutritional standards for life stages (of which there are basically two: adults and reproduction (pregnancy, lactation, and growth) and defines ingredients. The FDA specifies and regulates health

claims in addition to ensuring safety. The USDA regulates ingredients and inspects facilities. The State Department of Agriculture enforces animal food regulations. AAFCO sets nutritional standards so that if the food is fed as a sole source of nutrition it meets or exceeds known nutritional requirements.

OTC foods are convenient and can be cost effective and they are easy to feed especially dry foods. There are potential disadvantages, though, including the minimal regulatory requirements, lack of additional AAFCO lifestages (e.g. is a 15 year old Chihuahua the same as a 3 year old Great Dane?), pet food labels provide a minimal amount of information and give no indication of food quality, and there is a wide range of diets available that vary in composition and ingredients.

Therapeutic diets have more defined formulations and are primarily produced by larger companies who maintain better control over formulation, production, and distribution. Therapeutic diets are formulated primarily for non-healthy states (e.g. chronic kidney failure and obesity); however, some can be fed to healthy pets. Larger companies actively pursue and support research. These companies maintain control of the process and so have better quality control and formulations are more defined. Therapeutic diets are available for food elimination, but OTC diets may claim to contain “novel” ingredients. There is one study of 4 OTC venison dry dog food diets that showed that none of the diets would be suitable for an elimination food trial because they contained common pet food proteins some of which were identified on the label while others were not but were detected in the diet. If these diets represent a majority of OTC products then OTC diets should not be used for a diagnostic elimination trial. In another study of “soy free” diets, 4 of 4 OTC diets contained soy while 1 of 7 therapeutic diets contained soy. There are some disadvantages of therapeutic diets including public perception of large pet food companies, some of the therapeutic diets have been recalled (especially the melamine/cyanuric acid recall in 2007 due to specialized formulated diets containing wheat gluten), often pets are transitioned onto therapeutic diets when they are sick and so do not eat, and many therapeutic diets are formulated for specific disease states and so may not be suitable for all pets in the household (e.g. a weight reduction diet for an obese pet would not be advisable for a lean healthy pet and an alkalinizing renal diet would not be suitable for a pet during growth). Some joint diets, dermatology diets, and GI diets are suitable for healthy pets including large breed growth (e.g. some joint diets).

Some owners prefer to prepare homemade foods – feel less guilty and have impression of preparing a “real meal” that is “more natural” and “more traditional”. Nearly all dogs and cats in the US consume table foods at some time in their lives. Majority of dogs and cats in US receive >90% of calories from commercial foods. When a client wants to prepare pet foods at home, it is important for veterinarians to understand the client’s reasons and motivation. In many cases it is possible to address their concerns and to recommend an appropriate commercial food. If they still wish to cook, then proper guidance can be provided.

Some owners wish to cook homemade diets in order to provide a natural or organic food. Remember, there is no legal definition for the terms “natural” and “organic”. Pet owners may also want to prepare vegetarian food for their dog or cat because they are vegetarian or vegan. Because cats are true carnivores, vegetarian cooking should be discouraged. Other owners wish to prepare homemade diets including cooked and raw diets in order to avoid additives, preservatives, and contaminants. Pet food labels may be difficult to read and understand and they do not contain as much information as human food labels; therefore, some choose to home cook because they are more comfortable with being in control. Some pets will only eat table foods because it has become a habit. Lastly, homemade diets may be used for dietary elimination trials and for medical situations where a commercial diet is not available (e.g. a dog with chronic kidney disease and pancreatitis). Homemade diets are often very palatable and so may be useful with sick patients.

It is possible to achieve the same nutrient balance with a homemade food as with a commercially prepared food. However, this largely depends on the accuracy and competence of the person formulating the food, and on the compliance and discipline of the owner. Unfortunately, some homemade recipes are flawed even when followed exactly and consistently. IN one survey, 90% of homemade elimination diets prescribed by 116 veterinarians in North America were not nutritionally adequate for adult dog or cat maintenance. Few of the recipes available in books, magazines, and on-line have been tested to document the nutritional adequacy of the diet. Preparing homemade diets take time and some owners cannot afford the time.

There are common nutrient problems in many homemade foods. Many formulations contain excessive protein, but are deficient in calories, calcium, vitamins, and micro-minerals. Commonly used meat and carbohydrate sources contain more phosphorous than calcium resulting in inverse calcium: phosphorous ratio. Foods designed by clients are commonly deficient in fat and energy density or contain an unpalatable fat source (vegetable oil). Homemade foods are rarely balanced for micro-minerals and vitamins because veterinary vitamin-mineral supplements are not complete nor are the nutrients well balanced within the product.

People are taught that eating a variety of foods is nutritionally sound. Clients often extend this principle to their pet’s nutrition. Pet owners perceive that feeding a variety of foods is their best defense against malnutrition. Likewise, many owners feed a homemade diet because they can use a variety of ingredients. Some owners choose meat and carbohydrate sources for their pet’s food based on their own preferences, product availability, or affordability. Other pets are fed “leftovers” such as fat trimmings, bones, vegetable skins, crusts, and condiments. Some owners feed their pets according to guidelines for humans not realizing that dogs and cats have different requirements. A common problem with homemade diets is that the vitamin-mineral supplement is left out because

of inconvenience, expense, or failure to understand its importance – after all, many humans do not take vitamins. Lastly, some homemade diets use raw ingredients – we will talk more about these in a little bit

Veterinarians encounter a wide variety of pet food recipes from breeders and the popular press. Some owners want an opinion as to whether the recipe is good and others want to alter the recipe. Homemade formulations can be checked for nutritional adequacy and adjusted using the “quick check” guidelines:

1. Do five food groups appear in the recipe?
 - a. Carbohydrate/fiber source from a cooked cereal grain
 - b. A protein source, preferably of animal origin, or if more than one protein source is used, one source should be of animal origin
 - c. Fat source
 - d. Source of minerals, particularly calcium
 - e. Multivitamin and trace mineral source
2. Is the carbohydrate source a cooked cereal and present in a higher or equal quantity than the meat source?
 - a. Carbohydrate to protein ratio should be at least 1:1 to 2:1 for cat foods and 2:1 to 3:1 for dog foods
 - b. Sources are cereal such as cooked corn, rice, wheat, potato, or barley
 - c. These sources have similar caloric contributions, but some carbohydrates contribute a substantial amount of protein, fiber, and fat
3. What is the type and quantity of the primary protein source?
 - a. Overall protein quality of the diet can be improved by substituting an animal-derived protein source for a vegetable protein
 - b. Skeletal muscle protein from different species have similar amino acid profiles
 - c. Final food should contain 25-30% cooked meat for dogs (1 part meat to 2-3 parts carbohydrate) and 35-50% cooked meat for cats (1 part meat to 1-2 parts carbohydrate)
 - d. Providing some liver in the meat portion is recommended once a week or no more than ½ of the meat portion on a regular basis – corrects most potential amino acid deficiencies and contributes fatty acids, cholesterol, energy, vitamins, and microminerals
 - e. If owner requests an ovo-lacto-vegetarian food, eggs are best
 - f. If vegan food is requested, soybeans are the next best, but incomplete, amino acid profile
4. Is the primary protein source lean or fatty?
 - a. Lean protein sources require addition of an animal, vegetable, or fish fat source at 2% of the formula weight for dogs and 5% of the formula weight for cats
 - b. If a homemade food lacks sufficient caloric density, addition of cooked beef or chicken fat, poultry skins, vegetable or fish oils can markedly increase caloric density without adding other nutrients
5. Is a source of calcium and other minerals provided?
 - a. An absolute calcium deficiency is common
 - b. Many owners erroneously assume cottage cheese, cheese or milk added in small quantities provides adequate calcium
 - c. Most foods require a specific calcium supplement
 - i. When the protein fraction equals or is greater than the carbohydrate fraction, usually only calcium carbonate is added (0.5 g/4.5 kg cat/d and at least 2.0 g/15 kg/dog/d).
 - ii. Calcium and phosphorous supplementation may be necessary when the protein fraction is less than the carbohydrate fraction. Steamed bone meal, dicalcium phosphate, and certain proprietary mineral supplements contain @ 27% calcium and 16% phosphorous (about 2:1) and micro-minerals
6. Is a source of vitamins and other nutrients provided?
 - a. A human adult over-the-counter vitamin-mineral tablet that contains no more than 20% of the recommended daily allowances for people works well for both dogs and cats at ½ to 1 tablet per day (@ 1 gm/tablet).
 - b. One tablet per day of a human adult product will not over-supplement pets with calcium, phosphorous, magnesium, vitamins A, D, and E, iron, copper, zinc, iodine, and selenium according to AAFCO maximum allowances for canine and feline foods.
 - c. In general, veterinary supplements provide between 0-300% of vitamin-mineral requirements of dogs and cats

Substitution of ingredients can be done, but should be researched as to the equivalent amounts. One protein source is not the same as another. Other instructions that should be given owners include those for preparation, storage, and feeding. Emphasis should be

made to not eliminate an ingredient or indiscriminately substitute ingredients. Owners that wish to use raw eggs and meats should be informed that there is a risk for infectious diseases. Animal ingredients should be cooked for at least 10 minutes at 180F. Vegetable ingredients should be washed or rinsed and cooked if increased digestibility is desired. Since antioxidants are not usually added to homemade diets, storage in airtight containers at refrigeration temperature can be done for 7 day stretches. Large quantities can be frozen. Owners should check appearance and odor daily to make sure rancidity or contamination has not occurred. Starches should be cooked to increase digestibility; however, they should be cooked separately from the protein source. Carbohydrate sources require a longer cooking time; meat and liver should not be overcooked or protein denaturation will occur

Pets should be evaluated routinely whether they are being fed commercial food or homemade food. Stools should be formed although they may contain more water. Body condition and weight should be maintained. If problems are encountered, then either the homemade diet should be re-evaluated and modified or use of a commercially available diet should be encouraged.

Definition

Obesity is a condition of positive energy balance and excess adipose tissue accumulation with adverse effects on quality and quantity of life. Obesity literally means increased body fatness, but measurement of fat fractions of body composition is difficult in practice. Therefore, obesity can be defined as body weight in excess of 15 to 20 % of ideal, due to the accumulation of body fat. Negative health manifestations often begin at this level of weight excess and are a virtual certainty at a 30% excess over ideal weight.

Pathogenesis of body fat composition

Pathogenesis of obesity is not as simple and direct as uncontrolled gluttony. The idea of human obesity as a syndrome caused by being “weak in will” has yielded to observations and reasoning that obesity is a complex disorder of metabolism and satiety control with significant genetic components. Multiple genetic and environmental factors control regulation of food intake, resting metabolic rate, thermic effect of food, and energy expenditure and efficiency during work. Three causes of initial obesity in pets are overeating, decreased exercise, and lower metabolic rate; however, genetic influence cannot be overlooked.

Risk factors for obesity

Gender is important in the development of adult obesity; females or neutered animals are more frequently affected with obesity than males or intact animals. In addition to gender, certain breeds are predisposed to developing obesity while other breeds appear to be resistant. Pet owner lifestyle is important, as overweight human beings are more likely to own an overweight pet. Apparently overweight owners provide opportunities that override normal internal and external satiety control signals for both themselves and their pets. Ad libitum feeding, improper meal feeding, inappropriate diet selection, supplementation, provision of home cooking, and the conditioning of abnormal feeding behavior all cause excess calorie consumption. Begging, competitive eating with other pets and specific food addictions are problems in some homes and are identifiable risk factors. In addition to these factors, there are metabolic diseases such as hypothyroidism and hyperadrenocorticism that are associated with obesity.

Body fat deposition

Body composition of 1-2% fat at birth increases rapidly to 10-15% by weaning at 4-6 weeks, and is 15-20% in normal dogs during the first year of maturity. Females have increased levels when compared with males. Twenty-five to 30% fat is normal in dogs 8-10 years of age as there is lower lean body mass and increased adiposity with ageing. The initial phase of obesity occurs during chronic, positive energy balance. A phase of static obesity follows when caloric expenditure equilibrates with intake and the animal maintains a stable, but altered body composition of increased adipose tissue. These phases may repeat many times during an animal's life leading to a gradual step-wise increase in body weight and body composition. Because fat-free mass appears to be an important determinant of resting energy, as more fat mass is acquired and as lean mass is lost, less energy intake is required to maintain the increased body weight (increasing fat mass). This explains why many obese animals do not appear to be eating “too much” or why owners often say “but my dog only eats a half of a cup of food a day”.

Detrimental effects of obesity

Obesity is associated with many diseases and has been shown to decrease life span in dogs and cats. In many respects, obesity-associated conditions could be considered metabolic syndrome. In human medicine, metabolic syndrome is often defined as “a cluster of conditions — increased blood pressure, a high blood sugar level, excess body fat around the waist and abnormal cholesterol levels — that occur together, increasing risk of heart disease, stroke and diabetes.” While these are not necessarily the manifestations observed in human beings, the etiopathogenesis of metabolic syndrome is similar.

Obese pets generally appear less healthy and have a less pleasing appearance. Furthermore, obese animals have less tolerance to heat and environmental changes. With added weight in obesity, physical activity is often decreased. This may not only make for an acceptable pet, but inactivity may also potentiate the weight gain because of decreasing the resting energy requirement. Obesity is associated with increased risk for musculoskeletal disease such as degenerative osteoarthritis, intervertebral disc disease, and anterior

cruciate rupture, and in growing large breed dogs, excessive energy intake and obesity may lead to developmental musculoskeletal disease such as hip dysplasia, osteochondrosis desiccans, and joint laxity and deformity. In dogs, obesity has been shown to be associated with increased blood pressure. Excess thoracic fat and increased liver size may impair ventilation, decrease respiratory efficiency, and result in alveolar hypoventilation. Treatment of collapsing trachea is improved with weight reduction. With increasing adiposity, lipid infiltrates the liver and in cats may result in liver failure due to hepatic lipidosis if a stressful event resulting in anorexia occurs. In breeding animals, obesity causes decreased sperm viability due to decreased testosterone production, and in females, it predisposes them to dystocia. Bacterial infections were also more severe in obese dogs than in dogs of normal weight. Obesity has been associated with increased skin and gastrointestinal disease in dogs and cats. It may represent overall decrease in body condition, decrease in general health, decrease in immunocompetence, and intake of an unbalanced diet. When surgery is necessary in obese animals, a compromised surgical approach, general difficulty in dissection, and increased incidence of intraoperative and postoperative complications can be expected. Obesity predisposes to local infection and some surgeons consider using antibiotic prophylaxis even in clean surgical procedures performed on obese animals. Obese animals are more difficult to achieve an adequate anesthetic state because of decreased hepatic metabolism, compromised respiratory and cardiovascular function, and because of redistribution of drugs into adipose tissue. Obesity not only interferes with surgical procedures, but diagnostic procedures as well such as thoracic auscultation and abdominal palpation. Obesity is associated with an increased risk of certain types of cancer. Obesity is associated with insulin receptor defect(s) and decreasing sensitivity to insulin fat, muscle, and liver. Insulin resistance and hyperglycemia occur concurrently as fatty acids displace glucose as the preferential fuel source. While the obese, type II diabetic animal is not dependent on exogenous insulin for maintaining the non-ketotic state, there is both a fasting hyperglycemia and abnormal glucose tolerance test response. Non-insulin dependent diabetes mellitus caused by obesity may be reversible by weight loss in some cats. Obesity decreases longevity in pets.

Diagnosis of obesity

The diagnosis of obesity is often obvious on clinical inspection and palpation of the patient. The differential diagnosis for obesity includes pregnancy, peripheral edema, intra-abdominal organomegaly, abdominal masses, ascites, hypothyroidism, and hyperadrenocorticism. Quantification of obesity requires the use of objective methods, but the convenient measurement of body composition is not practical in practice settings. Therefore, indirect methods are substituted and their limitations accepted.

Body weight

Body weight can be an indirect measurement of obesity in pets and it is a procedure that is familiar, easily determined, and universally available. The dog's weight at its first birthday or during the first year of maturity probably reflects the "ideal" adult weight if skeletal development and juvenile nutrition are normal. Another useful generalization from weight measurement is that the mature domestic cat weighs 3.5-5.0 kg (8-11 lb) at a normal body composition. The major disadvantage of using body weight as a standard for body composition is that "overweight" may not mean "overfat". This is true in athletic or working animals. Breed weight tables serve as guidelines for diagnosis in individual patients. Normal intra-breed body weight and height variability, determining ancestry in mixed breed animals, and the lack of statistically validated age- and gender-specific adjustment factors to the purebred dog averages are the major limitations in using weight tables too literally.

Body condition score

Subjective clinical observations for obesity assessment are the loss of an "hourglass" shape when viewed from above, protuberant or draped accumulations of fat around the tailhead and neck, and the inguinal "udder" in cats. Different fat accumulation patterns are specific for men versus women and are predictive for cardiovascular disease risks in human beings. Such patterns are of attenuated diagnostic importance in the companion animal. Inability to easily distinguish the individual ribs by palpation means that excess subcutaneous fat is present. This is a practical means of physical diagnosis, but may under-diagnose obesity if there are substantial, localized fat accumulations elsewhere. A 5-point and 9-point scale have been published. The middle of the scale represents optimal condition; lower values represent various degrees of under-conditioning and higher values represent various degrees of 'over-conditioning'. The problem with these scales is that the highest condition score (5/5 or 9/9) equates to an estimated body fat content of 45%; however, morbidly obese pets may have 65-70% fat. Thus, the upper end of the scale underestimates body fat content.

Treatment of obesity

Treatment of obesity requires a team effort and convincing the client to be a part of the solution and not part of the problem. Set a goal for the clients and stick to it. Giving positive feedback even if the success is small is very important and helps to support the client in their effort to not only change habits, perhaps long-standing, in their pets, but in themselves as well. When possible, a combination of dietary therapy and exercise is effective. This is difficult in dogs that have pre-existing orthopedic problems and in cats.

Diet

There are basically five dietary options available for the management of obesity. The first option is feed lesser amounts of the same diet. While this has the advantage of allowing the owner to purchase and feed the same diet, many times the pet will develop habits of

begging or of scavenging for food. It is thought that the pet experiences a feeling of hunger because of this technique. Furthermore, owners often feel guilty because their pet appears to be constantly hungry, and many times their perception is that a “healthy pet is a full pet”. The second option is starvation. Starvation results in rapid weight loss; however, initial losses are often due to changes in water content of the body. This is a very dangerous technique and requires the animal to be hospitalized. As a result, owners are not part of the effort. This is an especially dangerous technique in cats because obese cats that suddenly stop eating are at risk for developing hepatic lipidosis and failure. The third option is to feed a low carbohydrate containing diet. The idea is that by limiting carbohydrate intake and providing protein, vitamins, minerals, and fat, the body begins to mobilize peripheral fat for energy. This strategy works in some cats, but not all, and has not been shown to be effective yet in dogs. The fourth option utilizes a high protein diet. In human beings, this is usually a liquid diet. This type of weight loss diet is not utilized any more because of fatalities associated with electrolyte and mineral imbalances. Lastly, substituting “empty calories” for digestible calories can decrease the caloric content of the diet. A safe and effective formulation must provide for complete nutrition and nutrient balance in relation to dry matter intake. There must be complete bioavailability of all nutrients except energy. Using unbalanced diets in weight reduction programs may produce deficiency states that can be dangerous or lethal. Replacing dietary fat with indigestible fiber creates a hypocaloric diet. Fiber reduces the caloric density of the diet by physically insulating nutrients from digestive enzymes, and reducing food transit time. The reduced total and energy digestibility of a high fiber diet requires offsetting increases in protein and micronutrients to compensate for the diet’s reduced digestibility. Because the patient is treated with a low fat, high fiber diet, it is able to ingest familiar volumes of dry matter and dietary bulk and neuroendocrine responses to mechanical and chemical gastrointestinal fullness are retained as contributory signals to the satiety center. Hyperphagia and begging are less frequent. Whether high fiber diets in fact induce satiety is controversial. There are also “low fiber” diets available for weight management. Although the crude fiber content is perhaps low, the types of fiber that are used in these diets are not analyzed by the crude fiber method; therefore, the unmeasured fiber is reported as part of the carbohydrate (NFE) fraction. Dietary fiber is defined as chemically and morphologically diverse plant substances resistant to hydrolysis by digestive enzymes including plant cell wall substances (cellulose, hemicellulose, pectin, and lignin) as well as intracellular polysaccharides (gums and mucilages). Fiber can be classified based on solubility or fermentability, and each imparts different physiological effects. There are several diets that are manufactured and marketed for weight reduction. Usually these diets are higher in fiber.

There are two techniques that are available for weight reduction in pets. The first uses an estimation of the ideal weight, and the second uses a target goal of weight loss per week and monitoring and adjusting dietary intake to meet this goal (iterative approach).

Using ideal weight

Using this technique, an ideal weight for the animal is estimated. The maintenance energy requirements for that animal are estimated using the ideal weight. In order to induce weight reduction, it is necessary to restrict caloric intake further, to approximately 60-75% of the maintenance energy requirement calculated using the ideal body weight. Different pet food companies recommend different percentages, and they range from 40% to 80%. At least 2 studies show that in dogs, using 75% of maintenance energy requirement results in a 1-2% rate of weight loss per week and minimizes rebound weight gain once the target weight is reached and the diet is changed to a maintenance diet.

A weight reduction diet is chosen, typically a high fiber/low fat diet or a low carbohydrate diet if a cat, and the amount to feed to meet this calculated weight loss goal is determined by dividing the MER for weight reduction by the caloric content of the diet. The diet is gradually changed over 5-7 days to avoid inducing gastrointestinal upsets such as vomiting, diarrhea, and inappetence. Following this period, the pet should be weighed every 2 weeks and the body weight charted. This accomplishes several things. First, it provides graphical representation of the weight loss period. Secondly, it provides encouragement for the owner. Once the target weight is reached, the diet can be switched from a weight loss diet to a diet designed for weight maintenance.

Iterative process

Using this technique, the ideal weight is not estimated. Rather, a target rate of weight loss is estimated, and a weight loss diet is fed to achieve this rate. For example, a target rate of 2% loss of body weight per week may be chosen. The amount of a weight loss diet to feed in order to induce this 2% loss of body weight is then calculated, and the diet is slowly switched. The pet is returned every 2 weeks and the food intake is adjusted to continue this controlled rate of weight loss. A computer program developed by Ralston Purina Company is available to facilitate using this technique.

Pharmacologic treatment

Dehydroepiandrosterone (DHEA) is an agent that has been evaluated in dogs, and is not effective. Slentrol (diriloptapide), a selective microsomal triglyceride transfer protein inhibitor that blocks assembly and release of lipoproteins into the bloodstream, has been approved by the FDA to decrease weight in dogs. Its primary mechanism of action is decreasing appetite; however, a slight decrease in fat absorption also occurs. The drug is given to the dog in varying amounts over the course of the treatment. The dog is given an initial dose for the first 14 days. After that, assess the dog's progress at monthly intervals, adjusting the dose depending on the dog's weight loss. After the dog has achieved the goal weight, the drug is continued during a three-month period, while the optimal level of food intake and physical activity needed to maintain the dog's weight is established. Adverse reactions associated with treatment

with Slentrol include vomiting, loose stools, diarrhea, lethargy and loss of appetite. Unfortunately, while this drug was very effective, it has been removed from market and is no longer available.

There are two groups of approved drugs that can be used to manage weight in obese humans: medications approved for obesity per se and medications that affect body weight for obese patients who have complications from their obesity and are receiving these medications for chronic disease management. For obesity per se, treatment is with one of the three drugs currently approved for long-term treatment of obesity or one of a few others that can be used for short-term treatment. Among these, orlistat partially blocks intestinal digestion of fat and produces weight loss of 5-8 kg but major limitations are associated gastrointestinal symptoms; lorcaserin, a serotonin-2C agonist with few side effects, produces a mean weight loss of 4-7 kg; and the combination of phentermine and topiramate (extended release) produces a mean weight loss of 8-10 kg, but should only be used after verifying a woman is not pregnant. Failure to lose more than 3% of body weight within 3 months with any of these agents should lead to reevaluation of therapy. The short-term drugs for treating obesity per se are sympathomimetics, with phentermine being most widely used. The second group of drugs is for weight-centric prescribing for patients with a chronic disease such as diabetes, depression, or psychiatric disorders. For each disorder, some drugs produce weight gain, others are weight neutral, but the best choice for these patients is the combination of drugs that treat the underlying condition and also produce weight loss

Prevention

In order to prevent obesity, it is necessary to modify risk factors that led to obesity in the first place. This involves altering behaviors of not only the pet, but of the owners as well. In animals that have difficulty in keeping weight off, diets are available that are less calorically dense, contain higher fiber content, and are complete and balanced for maintenance (see table of diets). Animals that are high risk for recurrence of obesity should be evaluated periodically. Examination should involve not only a good physical examination, but also measurement of body weight, and estimation of body condition using a body condition score. This can be accomplished as part of an overall health maintenance plan. This allows the veterinarian to recommend changes that may aid in preventing obesity from recurring. Also, it establishes a good patient-client-doctor relationship. Owners require positive reinforcement for doing a good job and a gentle “push in the right direction” if their pet is beginning to gain weight back.

Snacks may be an important part of development and maintenance of obesity. Therefore, they should be used sparingly. If used, they should not represent more than 5% of energy intake, and they must be accounted for in estimation of dietary intake necessary to meet maintenance energy requirements. Because “snacking” is a large part of human existence, it is difficult to break owners of this habit. Instead of punishing owners for giving snacks to their pets, in which case they may be dishonest about providing such treats, it is better to counsel them on what treats and what amount is acceptable.