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Dog obesity: Epidemiology, risk factors, diagnosis and management: A review paper

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Abstract
Obesity is a globally growing concern for both veterinarians as well as for pet owners. Obesity usually results from a state of positive energy balance due to either excessive dietary intake or inadequate energy utilization. Risk factors associated with obesity are food types fed, breed, sex, age, sexual status along with other possible social and environmental factors. Obesity not being a disease itself can predispose to number of disorders like osteoarthritis, cardiac-respiratory problem, diabetes mellitus, neoplasia, dermatological disease and anesthetic complications. Various diagnostic approaches for obesity in dogs have been suggested for estimation of obesity in dogs but the most subjective, easiest and handy technique is body condition scoring system. Advanced techniques for diagnosis of obesity include radiography, ultrasound and CT scan. There is no particular drug licensed for management of obesity in dogs. Dietary modifications along with increased exercise and behavioral management are the cornerstone of weight management of dogs.

Keywords: BCS, diagnosis, dogs, obesity, risk factors

Introduction
Obesity is defined as 30%weight over and above ideal body weight and is characterized by the accumulation of adipose tissue to the point that health is adversely affected (Brooks *et al* 2014) [9]. It is a major health concern and is emerging as an 'Upcoming challenge' both to veterinarians and the pet owners (Laflamme, 2012) [45]. Obesity leads to increased morbidity and mortality risk with increasing body fat mass, include comorbidities (Mao *et al* 2013) [52], reduced quality of life, and a shortened lifespan (Montoya-Alonso *et al* 2017) [60]
The determination of obesity in humans is done using the standard metric such as body mass index (BMI) and abdominal circumference (Bray *et al* 2017) [7]. It is also consistent and broadly supported by veterinary studies. Body condition scoring (BCS) is the current subjective method used to determining adiposity, with a 9-unit system most widely recommended for estimation of obesity in dogs (Laflamme 1997) [44].

Prevalence/Epidemiology
The prevalence of obesity in both dogs and humans is progressively and continuously increasing despite the efforts on promotion of physical activity and dietary attempts to control body weight. The prevalence of obesity has been reported between 22.00% and 40.00% globally (German, 2006) [26]. The estimate of obesity in dog population assessed in hospitals in Australia, Netherlands, United Kingdom, Japan, United States, and Spain, was 30%, 19.7%, 59.30%, 54.9%, 36.4%, and 66.1% respectively (Pena *et al* 2008; Weeth *et al* 2007; Bland *et al* 2010; Courcier *et al* 2010; Corbee 2013; Usui *et al* 2016) [69, 93, 5, 16, 15, 87]. Epidemiology of obesity in dogs in India is yet to be studied.

Risk Factors
Major predisposing factors that resulted in obesity were found to be breed (Cocker Spaniel, Beagles, Labrador Retriever and Golden Retriever), age (40% obese dogs being more than 8 year of age), gender (females more predisposed than males) (Zentek 2008) [99]. Only 3% cases of canine obesity were attributed to dog specific factors while 97% cases were attributed to human specific factors like-diet, exercise and owners attitude (Bland *et al* 2010) [5].
Environmental factors associated with obesity in dogs are owners age, income, frequency of treats/snacks and hours of weekly exercise dog receives were strongly associated with canine obesity (Courcier *et al* 2010) [16]. Gender (female), good or very good appetite, consuming table scraps are possible risk factors associated with canine obesity (Sallander *et al* 2010) [77].

Other risk factors associated with canine obesity were types of food, activity, neutering, and frequency of feeding in dogs (Mao *et al* 2013) [52]. Nandini *et al* (2012) [65] found that majority of obese dogs (52%) were being fed 2-3 meals per day with 44% population having sedentary lifestyle that led to increased energy intake. The amount of walking a dog receives, socio-demographic factors and dog-related characteristics were important risk factor associated with obesity in canine population (Degeling *et al* 2012) [18].

Age- From 2-3 years of age, obesity increases 2.74 folds and for more than 12 years of age, obesity increases 4.65 folds (Colliard *et al* (2006) [14]. Increase in bodyweight was significantly associated with increase in age in dogs (Martin *et al* 2006) [54]. Holmes *et al* (2007). Mao *et al* (2013) [52]. The highest possibilities of dogs being obese are between 7-9 years of age (middle aged dogs) followed by decline in rate of obesity in older dogs (Usui *et al* 2016) [87].

Breed- Few pure bred dogs of some breeds are more prone to obesity than others in general (Robertson 2003) [76]. Retriever breeds are 4.65-fold more prone to obesity than other breeds (Colliard *et al* 2006) [14]. Breeds like Cocker Spaniels, Labrador Retrievers, Shetland Sheepdogs, Rottweilers and mixed breed dogs were more likely to be obese than other breeds of dogs (Lund *et al* 2006) [50].

Gender- Prevalence of obesity in canines was higher in female (32%) than in male (23%) dogs **(**Mason 1970 [55]; Colliard *et al* 2006 [14]; Holmes *et al* 2007 [35]; Sallander *et al* 2010 [77]; Usui *et al* 2016) [87] but McGreevy *et al* (2005) [57] stated that there is no difference in the prevalence of obesity among sex in canines.

Neutering- Neutering is a risk factor for obesity in both dogs and cats. (Robertson 2003) [76]. The risk of obesity increased 2.23 fold in neutered dogs than normal dogs (Colliard *et al* 2006; Holmes *et al* 2007; Courcier *et al* 2010; Usui *et al* 2016) [14, 16, 35, 87]**.** Chances of being obese in neutered females were twice as that of normal females (Edney and Smith 1986; Mao *et al* 2013) [52].

Feeding- Dogs that were fed proprietary dog biscuits or meals, table scraps or home prepared foods are prone to obesity than those fed on proprietary canned dog meals (Mason 1970) [55]. Improper feeding patterns and diet selection, ad-libitum feeding, supplementation, feeding home cooked meals and the conditioning of abnormal feeding behavior all lead to excess calorie consumption (Crane 1991; Bland *et al* 2009; Heuberger and Wakshlag 2011) [17, 4, 32]. Begging, competitive eating with other pets and specific food addictions are potential risk factors leading to obesity in dog in some homes.

Obese dogs are provided more number of meals and snacks than normal dogs Kienzle *et al* (1998) [41]; Courcier *et al* 2010) [16] (Mao *et al* 2013) [52]. Other studies suggest that dogs fed once a day, are more prone to obesity than those fed smaller quantities more than once in a day (Robertson 2003) [76]. Excessive feed intake followed by inadequate utilization of energy led to positive energy balance that result in obesity (German 2006) [26]. Dogs fed semi-moist foods, canned or homemade food items are at increased risk of being overweight or obese (Lund *et al* 2006) [50].

Lifestyle- For every 1 hour exercise per week obesity decreases by almost 0.9 times, but the intensity of walking has no effect on obesity and prevalence of obesity is more in single-dog households than dogs in households with two or more pets (Robertson 2003) [76]. Dogs of rural and semi-rural region are at more risk of obesity than those of urban and suburban dogs (McGreevy *et al* 2005) [57].

Lifestyle of dogs/owner, region (urban/rural), exercise status emerge as risk factors for obesity (Lund *et al* 2006; Bland *et al* 2009; Courcier *et al* 2010) [50, 4, 16]. Owners health status, age and lifestyle has direct effect on the health status of dogs as Holmes *et al* 2007 [35]; Courcier *et al* 2010 [16]; Heuberger and Wakshlag 2011 [32]; Montoya-Alonso *et al* 2017 [60] reported that overweight and obese dogs are owned by either overweight or obese or older persons. According to the owner's perception, the most handy and agreeable mode of communication and interaction with dogs is feeding which ultimately results in obesity. The owners of obese dogs easily ignored their exercise and occupation further adding to obesity.

Underestimation of the body condition score of dogs by their owners as compared with assessment of veterinarian is another risk factor for obesity (Colliard *et al* 2006) [14].

BMI of owner and degree of overweight of their dogs are significantly correlated while no correlation between length of ownership, gender and age of the animal and gender, age, education level and activity score of the owner with obesity Nijland *et al* (2009) [66].

Etiology of Obesity

Various factors that are responsible for development of obesity in dogs are genetic predisposition of certain breeds, lower metabolic rates, excessive calories intake reduced physical activity, neutering, certain diseases like hypothyroidism (Panciera 1994) [67] and hyperadrenocorticism, rare genetic defects and therapeutic agents such as glucocorticoids, progestogens, phenobarbitones that can induce polyphagia resulting in obesity (Sloth 1992; Burkholder and Toll 2000) [79, 10].

Dietary factors for obesity included feeding frequency, feed type, table scraps, feeding snacks and presence of pet in front of owner while cooking or eating their food (Kienzle *et al* 1998) [41].

Neutering leads to decreased metabolic rates, altered feeding behavior (increased feed intake) and decreased activity. So, it acts as an important factor for obesity in both dogs and cats (Hoenig and Ferguson 2002) [33].

Patho-Physiology of Obesity

Earlier, obesity was thought to cause disease through increased body weight which led to stress on joints and increased workload on heart. Adipose tissue is source of hormone (leptin, adiponectin etc) production, cytokines and other cell signaling substances and are collectively known as adipokines that can directly or indirectly contribute to obesity-related diseases (Kershaw and Flier 2004) [40].

Metabolic disorders like hypo-thyroidism (reduced metabolic rate due to low serum thyroxine concentration), hyper-adrenocorticism (increased fat deposition due to hyperphagia and suppression of ACTH secretion factor in hypothalamus caused by higher concentration of glucocorticoids), hyper-insulnemia (causing hyperphagia), increased growth hormones (hyperphagia) result in obesity (Lund *et al* 2005) [49].

Leptin is also known as anti-obesity hormone and functions to regulate food intake and energy expenditure, modulates glucose and fat metabolism. In obese subjects, leptin receptors become defective leading or impaired signaling leads to decreased leptin sensitivity and leptin resistance (Wynne *et al* 2005) [97].

Gender, breed, age, reproductive status, living environment and feeding behavior are some of the predisposing factors that can also lead to the development of obesity in dogs (Lusby and Kirk 2009) [51]. Besides these factors, there are some other factors that play a crucial role in the development of obesity are genetic and environmental factors (Nijland *et al* 2009) [66].

Although, the physiological functions of all the adipokines are yet to be ascertained but many of them are involved in energy balance or metabolism, pro-inflammatory or anti-inflammatory regulation or promote insulin resistance. Some adipokines have endocrine or inflammatory effects while others affect pancreatic function (Wozniak *et al* 2009) [96].

Certain hormones which play important role in regulation of appetite are leptin, cholecystokinin, adiponectin, ghrelin, pancreatic peptide YY and few others which either act by stimulating appetite or increasing satiety or improving energy expenditure (Hoenig 2010) [34].

Increased fat mass leads to dysregulation in the production of adipokines contributing to obesity-related metabolic diseases (Kil and Swanson 2010) [42].

Adiponectin is a beneficial adipokine that improved insulin sensitivity, suppresses hepatic gluconeogenesis and inhibits inflammatory response. Obesity results in decreased production due to defective adiponectin secretion caused by increased feedback inhibition by inflammatory cytokines (TNF-α, IL-6) and obesity also results in decreased expression of adiponectin receptors thus leading to adiponectin resistance, insulin resistance (Verkest *et al* 2011) [91].

Obesity plays a crucial role in development of chronic diseases like osteoarthritis, cardiovascular diseases, diabetes mellitus and many other diseases including oxidative stress that also leads to insulin resistance due to persistent low-grade inflammation secondary to obesity (Laflamme 2012) [45].

Role of Leptin- Regulating food intake and calorie burn rate to maintain energy balance is the main role of leptin which is 16-kDa protein secreted by adipocytes and helps in maintaining balance between energy intake and its expenditure (Zhang *et al* 1994) [100]. Depending upon the amount of fat stored in cells, leptin is secreted in blood that sends signal to brain to make an animal eat more or less (Brennan and Mantzoros 2006) [8].

Leptin levels in overweight group are (3.00 ng/ml) is significantly higher than normal weight dogs (<0.1ng/ml) (Yamka *et al* (2006) [98]. Due to less expression of leptin, there is dysregulation of energy maintenance leading to development of obesity (Blüher *et al* 2009) [6]. Higher serum leptin and reduced adiponectin concentrations were found in obese dogs than normal weight dogs (Piantedosi *et al* 2016) [70].

Obesity Related Diseases/Disorders

Excess body weight is associated with a wide range of potentially serious conditions, such as locomotor and musculoskeletal problems (Marshall *et al* 2009) [53], respiratory distress, hypertension, cardiac disease (Poirier and Eckel 2002; Bergman *et al* 2007; Guh *et al* 2009) [71, 3, 28], diabetes mellitus (Watson *et al* 2010; Adamama-Moraitou *et al* 2014; Thengchaisri *et al* 2014) [92, 1, 83] dystocia, decreased heat tolerance, neoplasia, increases surgical risk and impaired fertility (Edney and Smith 1986; Fettman *et al* 1997; Burkholder 2001; Kuruvilla and Frankel 2003; Zentek 2008; German *et al* 2010) [21, 22, 12, 99, 26], increased dermatological problem, developed pressure sores, decreased immune function and lesser resistance to development of infections (Fiser *et al* 1972) [23], endocrinal disorders (Gayet *et al* 2004) [24], chronic renal failure and proteinuria (Praga *et al* 2000) [72].

Traumatic and degenerative orthopedic disorders were one of the health risk associated with increase in body weight and obese dogs have reduced heat tolerance and stamina (Burkholder and Toll 2000) [10]. Besides age and neutering status, obesity is one of influencing factor responsible for occurrence of canine mammary tumor (Alenza *et al* 2000) [2].

Excess adipose tissue may cause compression of visceral organs like kidneys increasing intrarenal pressure and tubular reabsorption, structural changes in kidneys, loss of function of nephrons, increasing arterial pressure leading to severe renal diseases. Weight gain is responsible for 65-75% increase in the risk of hypertension due to increased renal sodium retention (Hall *et al* 2003; Montoya *et al* 2006; Mehlman *et al* 2013) [29, 69, 58], anesthetic risks catheter placement and prolonged operating time (Van-Goetham *et al* 2003).

Assessment of Obesity

Measurements of adiposity involve defining body composition, or relative amount of various biological components of body and the main division of importance is Total Fat Mass (FM), and Lean Body Mass (LBM). Various techniques are used to measure body composition, but they differ in their applicability to research, routine veterinary practice or first-opinion practice. Practitioner should be well aware about precision and accuracy of method being used to measure adiposity. A test having both most accuracy and precision should be applied but lacuna is most tests either lack precision while other lack accuracy and another important aspect is cost, ease of use, knowledge and acceptance by veterinarians and clients and invasiveness (German 2006) [26].

Morphometry-It is defined as measurement of "form" and refers to a variety of measured parameters used to estimate body composition. Obesity is diagnosed primarily by 3 main morphometric approaches like body condition scores, dimensional evaluations and measurement of skin fold thickness (German 2006) [26].

Body Condition Score System- Body Condition Score (BCS) system is a semi-quantitative method of assessing body composition of companion dogs which is based on palpation and visual assessment (Laflamme 1997) [44]. Assessing body condition of an animal using BCS is a subjective, semi quantitative method of evaluating body fat and muscle mass. BCS is not a replacement for body weight but it is to be used in conjugation with body weight while assessing the body condition of animal. BCS is good tool to place animals in thin, average and overweight categories that measures body fat with 95% confidence and can be useful in convincing owners about body condition of their dogs (Burkholder (2000) (Adamama-Moraitou *et al* 2014) [1]**.** Currently, there are three main system of evaluation of body condition in companion dogs using BCS and all of them use similar methods of evaluation i.e. palpation and visual examination but differ

only in scoring system using different integer scales that include five points scale (1= very thin, 2= lean, 3= ideal, 4 = overweight and 5 = obese), six points scale and nine points scale (1 = emaciated, 2 = underweight, 3 = lean, 4 and 5 = ideal, 6 = slightly overweight, 7 = overweight, 8 = obese and 9 = grossly obese) (Scarlett and Donoghue 1998; Lund *et al* 1999; Mawby *et al* 2004; McGreevy *et al* 2005) [78, 48, 56, 57].
German *et al* (2006) [26] developed a new system i.e. SHAPE (Size, Health And Physical Evaluation) of body condition evaluation. It is a 7 points algorithm based system of evaluation that also uses palpation and visual characteristics for evaluation of body condition in companion dogs in which animals are assigned an alphabetic character from A-G based on the body condition of that animal where A means underweight, B and C means lean, D means normal, E and F means overweight and G means obese and this system is equivalent to that of the commonly used 9-points silhouette system.
On a 5/9 point BCS scale (1 = extremely thin, 2 = slightly thin, 3 = normal, 4 = Slightly obese/overweight and 5 = obese) for evaluating bodyweight and body condition of dogs, for each increment in BCS there is approximately 6.5% to 7.2% change in body weight (Dorsten and Cooper 2004; Witzel *et al* 2014) [20, 95] and for each unit increase in BCS there is 5% increase in body fat (Mawby *et al* 2004) [56].

Dimensional Measurements- Measurements of "length" (e.g., head, thorax, and limb) are correlated with lean body components, whereas measurements of girth correlate with both LBM and FM (Fat Mass) (Stanton *et al* 1992) [81]. Dimensional evaluations are performed using measuring tape and measurements of length (head, trunk, limb) are correlated with both lean body mass and fat mass (Hawthorne and Butterwick 2000) [30]
BMI = body weight (kg) / [body length (m) × height (m)]
Body fat (%) = {[(Ribcage/0.7067) – LIM]/0.9156} – LIM (LIM=Limb index measurement)
(Burkholder and Toll 2000) [10]
Ribcage measurement is the circumference measured at 9th rib and LIM is the distance between the patella and calcaneus of the left hind limb. All the measurements are taken in centimeters with the animal kept in standing position and legs perpendicular to the ground and head held upright (German 2006) [26]
Morpho-metric measures can be easily performed in dogs using measuring tape with the dog standing and looking straight ahead (Mawby *et al* 2004) [56], moreover take approximately 5 minutes to perform and is most widely used as it provides an accurate estimate of total body fat percentage in over weight and obese dogs (Witzel *et al* 2014) [95]. Segmental limb measures and truncal length are better measures and correlate best with lean body mass (LBM) (German 2006) [26].

Skin Fold Thickness- Skin in dogs and cats is readily lifted away from subcutaneous tissue and cannot be captured and measured using a caliper so skin fold thickness used to measure subcutaneous fat thickness by caliper does not correlate well with obesity in dogs (Crane 1991) [17].

Advanced Techniques to Measure Body Fat- Numerous methods have been developed for quantifying the body composition and body fat mass in companion animals. Potential research techniques include Chemical analysis, Densitometry, Total body water measurement, Absorptiometry (including dual-energy X-ray absorptiometry–DEXA), Ultrasonography, Electrical conductance, and Advanced imaging techniques (CT and MRI) (German 2006) [26].

Ultrasound- A non-invasive ultrasonographic method is used to evaluate subcutaneous fat thickness at six anatomical sites i.e. Axilla, Flank, Sternum, Abdomen, Thigh and Lumbar in dogs (Wilkinson and McEwan 1991; Carreira *et al* 2016). Subcutaneous fat thickness measured at mid-lumbar region between 3rd to 7th lumbar vertebrae is the best measurement that can be used to predict the total body fat in dogs (Wilkinson and McEwan 1991; Morooka *et al* 2001) [62] and lesser efficient in flank region (Carreira *et al* 2016).

Radiography- Another technique to measure body composition is using dual energy X-ray absorptiometry scans in dogs (Munday *et al* 1994; Grier *et al* 1996) [63, 27]. The chance of error while measuring body fat and lean components is less than 2.5% (Burkholder 2001) [12]. In addition to measurement of bone mineral contents, DEXA can also be used to measure body fat and non-bone lean tissue using two different energy levels (70 and 140 kVp) that helps to distinguish type and amount of tissue scanned (Elliott 2006). Few reports suggest (Jeusette *et al* 2010; Witzel *et al* 2014; Rae *et al* 2016) [38, 95] there was poor correlation between Body Mass Index (BMI) and DEXA as fat mass was less accurately evaluated than fat-free mass while using DEXA scans.
Radiography can be used to measure subcutaneous fat thickness in dogs at the level of 8th rib head on dorso-ventral or ventro-dorsal view and is also helpful to evaluate subcutaneous fat only and not the visceral fat. There is significant association between BCS and subcutaneous fat thickness measured in thoracic radiographs with strong correlation between BCS and T4 ratio (subcutaneous fat thickness measured at the level of eight rib head on dorso-ventral view divided by the length of mid body of T4 on lateral view) and between BCS and T8 ratio (subcutaneous fat thickness measured at the level of eight rib head on dorso-ventral view divided by the length of mid body of T8 on same view) (Linder *et al* 2013) [47].

Computed Tomographic Scanning- Computed tomographic scanning can be used to assess the subcutaneous and visceral fat in normal and obese dogs and can help to evaluate visceral and subcutaneous fat separately **(**Ishioka *et al* 2005) [36].

Blood Biochemical changes in Obesity- Over weight/ obese dogs have higher levels of alkaline phosphatase, cholesterol, triglycerides, total protein, albumin, thyroxine, calcium, phosphorous, glucose, insulin, insulin-like growth factor-1, low-density lipoprotein, leptin and type II cartilage (Jeusette *et al* 2005; Yamka *et al* 2006; Rafaj *et al* 2016) [37, 98] and lower levels of creatinine, serum urea nitrogen, C-reactive protein and chloride (Yamka *et al* 2006; Rafaj *et al* 2016) [98] while there is no effect on Aspartate Aminotransferase (AST), Alanine Aminotransferase (ALT) and Non-Esterified Fatty Acids (NEFA) (Diez *et al* 2004) [19].
Few studies suggested there is higher levels of triglycerides, NEFA, total cholesterol (Ricci *et al* 2007; Pena *et al* 2008; Stone *et al* 2009; Mori *et al* 2011; Park *et al* 2014; Usui *et al* 2015) [75, 69, 68, 88] and creatinine kinase and lower levels of

creatinine in obese dogs while there is no effect of obesity on blood parameters like blood glucose, total protein, albumin, globulin, urea, bilirubin (total, indirect and direct), alanine aminotransferase, aspartate transferase, alkaline phosphatase, γ-glutamyltransferase and lactate dehydrogenase (Ricci *et al* 2007) [75].

Tribuddharatana *et al* (2011) [85]; Li *et al* (2012) [46]; Nandini *et al* (2012) [65]; Mori *et al* (2013) [61]; Tvarijoviciute *et al* (2013); Soder *et al* (2016) suggested increase in the levels of triglyceride, total cholesterol, glucose, HDL-C, LDL-C, ALP, ALT, GGT and BUN in obese dogs as compared to non-obese or control group of dogs.

Hematological parameters like Packed Cell Volume (PCV), hemoglobin and mean Total Leukocyte Count (TLC), neutrophils, monocytes, lymphocytes are increased with a significant decrease in eosinophils in obese dogs as compared to normal weight dogs (Nandini *et al* 2012) [65].

Clinical Complications- In obese animals' increased anesthetic risk has been recognized due to difficulty in estimation of correct dose of anesthesia, prolonged operating time due to excess fat deposition and difficulty in catheter placement (Van-Goethem *et al* 2003) [90]. Basic and routine clinical evaluation techniques like physical examination, auscultation of chest, palpation and aspiration of fluid, cystocentesis, blood collection and diagnostic imaging are quite difficult in obese animals (German 2006) [26].

Treatment And Management

There are no specific treatment for the correction of obesity. It mainly involves weight reduction by dietary management and physical exercise. Control of obesity will subsequently prevent all other effects on heart, urinary bladder, joints etc.

Dietary management- Dietary factors mainly include L-carnitine conjugated linoleic acid (CLA), and high-fiber diets. L-carnitine (@50–300 ppm) acts by enhancing fatty acid oxidation and energy availability for protein synthesis during times of need (Hoe *et al* 2000). Conjugated linoleic acid possess anti-adipogenic effect and inhibits Stearoyl-CoA desaturase activity, which inhibits the synthesis of monounsaturated fatty acids involved in triglyceride synthesis, and ultimately suppresses elongation and desaturation of fatty acids into long-chain fatty acids (Kennedy *et al* 2010) [39].

Diets enriched with omega-3 polyunsaturated fatty acids help by reducing the production of lipid inflammatory mediators (Titos and Clària 2013) [84]. Obese dog provided with low-fat, high fibre, high potein diet are found to have beneficial effects on weight loss.

Exercise and lifestyle management: Dietary therapy along with exercise results in rapid fat loss and weight management. Exercises for dogs include walking, running, hydrotherapy, treadmill, swimming (van Dale and Saris 1989) and many more. The combined people and pet exercise program result in weight loss in both owner and their pets.

Prevention

Recommendations for maintenance of a ideal weight in dogs should include the following (Brooks *et al* 2014) [9]:

1. Evaluating body condition score (BCS) and knowledge to adjust feeding when owner notices change in BCS.
2. Maintaining an ideal adult weight
3. Maintaining exercise and activity
4. Behavior training using interactive rewards as alternatives to food
5. Educating clients about the limitations

Designing a Weight Loss Program: The plan should include the following:

1. Caloric restricted diet plans (Low fat, high fiber, high protein diets)
2. Food selection, treat allowance and alternatives
3. Feeding management and exercise/activity plans
4. Scheduled follow-up during weight management programme

A successful weight management program will greatly improve the health of pets, reduce the potential for future health concerns, increase the level of activity of pets, and ultimately will improve the client/patient bond

Conclusion

It is assumed that obesity is becoming one of the emerging health isseue at global level to both the veterinarians and pet-owners which requires newer methods of diagnosis and treatment approaches for its effective control.

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