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Outcomes of weight management in obese pet dogs: what can we do better?

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Obesity is arguably the biggest health and welfare issue affecting pet dogs. Although successful weight loss has health benefits, current strategies are far from ideal. Many obese dogs that start a weight programme fail to lose weight, or subsequently regain the weight they have lost. Given that current weight loss strategies are not perfect, clinicians need to focus carefully on tailoring the programme, perhaps setting a pragmatic target for weight loss, so as to ensure the benefits are maximised. This review will summarise key findings from recent clinical research into pet obesity, and present a framework for improving success, by better tailoring weight management regimens and end points to the individual.

Overweight: Canine: Dietary energy restriction: Success: Rebound

The significance of obesity in pets

The medical profession now classifies human obesity as a disease[1], with the condition predisposing to numerous other diseases including: type II diabetes mellitus, CVD (e.g. CHD, atherosclerosis and hypertension), renal disease (typically secondary to diabetic nephropathy), liver disease (e.g. steatosis, cirrhosis and hepatocellular carcinoma), osteoarthritis, respiratory impairment (e.g. obstructive sleep apnoea and asthma), and neoplasia (e.g. breast, prostatic, ovarian, colonic/rectal, renal cell and oesophageal cancer[2–5]. Not surprisingly, obesity conveys increased risk of mortality to affected human subjects[6]. Similarly, the veterinary profession now recognises obesity to be the most important medical disease in dogs[7], with previous studies suggesting that 34–59 % of dogs[8–10] are either overweight or obese. Although published evidence is limited, the prevalence of canine obesity appears to be gradually increasing[11]. As with obesity in man, overweight dogs are at risk of developing other diseases such as diabetes mellitus, osteoarthritis, and urinary incontinence, as well as altered respiratory function[12,13]. Metabolic derangements also arise[14–17], and there are alterations in renal function[18]. All in all, obesity adversely affects quality of life[19], and shortens lifespan[20]. Given these adverse effects on health and quality of life, canine obesity presents a major welfare challenge for veterinary surgeons.

A variety of predisposing factors may contribute to the development of obesity in dogs, and these include underlying diseases (e.g. hypothyroidism and hyperadrenocorticism), breed predispositions (e.g. Labrador retriever, Cairn terrier, cavalier King Charles spaniel, Scottish terrier, cocker spaniel) and neutering[7,9]. In addition, owner and lifestyle factors might contribute, with examples including socioeconomic status, middle age, apartment dwelling, physical inactivity and a lesser interest in preventive veterinary care[9,21–23]. Dietary factors have also been implicated such as food type and the use of treats and table scraps[21,22].

Overview of obesity management

In human subjects, bariatric surgery is the most successful approach for treatment of obesity, but this is not ethically justifiable or practical in dogs. For a while, the

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microsomal membrane transfer protein inhibitor drugs, dirlotapide and mitratapide, were approved for controlled weight loss, and good efficacy was reported from clinical trials[24,25]. However, performance in clinical practice was disappointing and both drugs have now been withdrawn. Therefore, the use of a purpose-formulated diet remains the principal method for controlled weight loss, usually in conjunction with changes in lifestyle designed to increase activity and control feeding of extra food (e.g. as treats or table scraps)[26–29].

Rather than simply reducing body weight to reach a nominal target, the main aims of weight management are to improve quality of life and reduce associated disease risk. To ensure long-term success, weight management involves not only the controlled weight loss phase, but also subsequent weight maintenance so as to stabilise body weight and prevent rebound. Unless owner habits are changed permanently, to ensure a healthier relationship develops between the dog and its owner, weight management will fail in the long run.

Dietary management

Purpose-formulated weight loss diets are recommended because they have a restricted energy content whilst, at the same time, being supplemented in protein and micronutrients. Altering the macronutrient content of a weight management diet can also improve satiety, especially when fibre content is increased. However, in dogs supplementing both protein and fibre relative to energy content provides the greatest benefit[30], and such a formulation improves outcome of weight loss[28].

Food intake during weight loss should be accurately calculated, and based upon the estimated ideal weight rather than current weight. The exact recommendation on energy intake during the weight loss period can vary depending upon the food used, sex, whether the dog has been neutered, and if there is any concurrent disease. The owner should be taught to measure food out precisely using electronic gram scales; measuring cups should not be used because measurements are imprecise and commonly lead to overfeeding. If possible, the feeding of any additional food (in the form of treats, table scraps or scavenged food) should be avoided. If this is not acceptable to the owner, certain healthy treats could be sanctioned, as long as they are taken into account in the energy intake calculations and, ideally, provide <5 % of total daily requirements.

Lifestyle management

Increasing physical activity is also recommended for most weight management programmes, since there are many benefits. Activity is thought to help preserve lean tissue mass, and promote the loss of adipose tissue instead. The activity plan should be tailored to the individual and take into account the capabilities of the owner, as well as any concurrent medical diseases that the animal has. Suitable exercise strategies in dogs include lead walking, playing, swimming, hydrotherapy and the use of puzzle feeders.

Monitoring of weight loss

To ensure success, any weight loss protocol requires close monitoring, typically by scheduling regular measurements of body weight. At the start, most clinicians choose to undertake such checks every 2 weeks, but the interval can be altered if consistent progress is made, and it better suits the owner. The same set of electronic scales should be used, to ensure consistency[27]. Body weight checks should be continued periodically after target weight has been reached, in order to reduce the likelihood of rebound occurring (see mention later).

Benefits of weight loss

As mentioned earlier, obesity can have a number of adverse effects on health, including shortening lifespan, predisposing to disease, causing metabolic and functional derangements and worsening the severity of pre-existing disease. Whilst it is commonly suggested that successful weight loss may have positive impact on all of these adverse effects, there is limited direct evidence for this. The author is not aware of any studies that convincingly demonstrate that weight loss leads to either increases in lifespan or decreased disease risk. However, there is emerging evidence of benefits to function and alleviation of concurrent disease severity. For instance, even modest weight loss (e.g. exceeding 6 %) can improve mobility in obese dogs with concurrent osteoarthritis[31,32]. Improvement in respiratory function is also seen when obese dogs lose weight[13]. Further, there is evidence of improved insulin sensitivity and other metabolic derangement when successful weight loss occurs[16–18]. Thus, whilst clinicians should be cautious in overstating the benefits of weight loss, there are clear-cut improvements in health that can be emphasised.

Of course, the benefits of weight loss should not only be judged by improvements in health. Arguably, poor quality of life has at least at much impact on wellbeing. In a recent study, a validated questionnaire was used to assess quality of life, which was scored using four factors: vitality (assessing activity levels), chronic pain, as well as anxiety and emotional disturbances (both assessing psychological effects on quality of life)[19]. The questionnaire was completed when dogs were obese, and repeated after successful weight loss, enabling changes in quality of life to be assessed. Overall, quality of life scores were low when dogs were obese, and improved in the dogs that successfully lost weight. In particular, vitality scores increased, whilst emotional disturbance and pain scores decreased. Changes in body composition were concurrently assessed using dual-energy X-ray absorptiometry, and demonstrated that changes in vitality score were positively correlated with changes in body fat mass.

Outcomes of weight loss in obese dogs and cats

Rate of weight loss and energy intake during weight management

When assessed in a colony setting, weight loss protocols for obese dogs are very successful with typical rates of

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weight loss consistently over 1 % per week, when restricting caloric intake to 50–75 % of maintenance energy requirements[33–36]. Whilst there are many advantages to performing such studies in a colony, most notably in consistency and control, the results are not necessarily representative of how obese dogs lose weight when supervised by their owners.

In light of this, some recent studies have assessed weight loss in cohorts of obese pet dogs. Weight loss is usually slower, with a typical rate of weight loss of 0·5–1·0 % of starting body weight per week[27,37]. Despite this slower rate, a greater degree of energy restriction is needed, typically 55–65 % of maintenance energy requirement at target weight[27,37]. There may be various reasons why outcomes differ between colony research and studies using pet dogs, but owner compliance is likely to be a major factor. When owners are responsible for overseeing their dog's weight loss programme, non-compliance is common with self-reports confirming that additional food (e.g. treats and table scraps) is given against veterinary advice, and this could represent as much as 10 % of maintenance energy requirement[10,13]. Such non-compliance is most likely to caused by increased begging and scavenging activity in the dog, which itself arises from the energy restriction imposed. Dietary strategies can be used to minimise the development of these behaviours, for instance using particular macronutrient profiles to reduce hunger. For example, increasing both the protein and fibre content of a food reduces voluntary food intake[14], and feeding such a food to obese dogs improves success, in terms of faster rates of weight loss and greater fat loss than with standard weight loss diets[11].

Changes in body composition during weight loss

A number of colony studies have assessed body composition during weight loss, and some of these infer that tissue mass is exclusively lost from the adipose tissue compartment[24,36]. However, such studies typically only examine modest amounts of weight loss (often 10–20 %). Work in obese pet dogs undergoing controlled weight loss have contradicted these findings, and revealed that lean tissue loss is common in many animals that lose weight[27,37]. The discrepancy between colony and clinical studies can readily be explained by the fact that significantly more weight loss is required to return an obese pet dog to its ideal weight than is typically assessed in a colony study; for example, median weight lost in one such study was 25 %, with some dogs losing over 40 %[27]. It is now known that the magnitude of lean tissue loss increases in proportion to the overall percentage of weight lost[18,27], meaning that lean tissue loss is really only an issue when dogs lose more than 20 % of their starting body weight.

Likelihood of successfully reaching target weight

Whilst a number of clinical studies have now been conducted to determine the outcomes of weight management in obese dogs, most studies are only of short duration, assessing the initial phase of weight loss (e.g. the first 2–3 months)[26,29,32,36]. Such work certainly provides useful information on the early stages of a weight loss protocol, such as initial rate and initial energy intake required for weight loss. However, the duration of study is usually not sufficient to capture outcomes of a complete weight loss cycle. Arguably, studies that assess the whole of the weight loss period and beyond are most realistic and valuable for the veterinary profession. Further, studies rarely examine compliance with the programme or overall success, in terms of the proportion of dogs that start a programme who actually complete it. Studies of human obesity have demonstrated that rate of weight loss tends to plateau after about 6 months on diet-based weight loss programme, meaning that most people never reach their target weight[38], and often then regain the weight they originally lost[39]. The author is aware of only one previous canine study that assessed actual success[29]. In this study, about half the dogs completed a 6-month programme, but it was unclear whether they actually reached target in this time. In a recent study, the records of obese dogs attending a weight management referral clinic were reviewed, and cases were classified according to their outcome (i.e. whether or not they had completed or stopped their programme)[37]. Factors associated with the likelihood of reaching target weight were assessed with simple and multiple logistic regression. Of the 143 dogs included, eighty seven (61 %) completed the programme and reached their target weight. The remaining dogs stopped prematurely, either because they were euthanased (for an unrelated reason; eleven (8 %)) or because the owners chose to stop (forty five (32 %)). Reasons for dogs stopping the programme included owners refusing to comply with the requirements of the weight loss programme, because their dog developed another disease or for personal reasons. Simple and multiple logistic regression analysis revealed that dogs fed a dry weight loss diet were more likely to complete the programme that those on wet food or a mix of wet and dry foods, whilst the most overweight dogs (i.e. those with the greatest starting body fat determined by dual-energy X-ray absorptiometry) dogs were far less likely to complete. Whilst these findings may be somewhat disappointing, it should at least be remembered that over 85 % of the dogs did lose >6 %, the magnitude where another study observed measurable health benefits[32].

Outcomes at different stages of a complete weight loss cycle

As mentioned earlier, most existing studies assessing weight loss in obese dogs only examine the early stages, and this is not representative of a complete weight loss cycle. In light of this, a recent study reported a range of outcomes at key stages during a complete weight loss cycle[40]. Outcomes examined included rate of weight loss, percentage weight loss and energy intake, and status (e.g. still on programme, completed, stopped or euthanased). Rate of weight loss was relatively fast in the early stages (e.g. 1·2 (SD 0·67) % starting body weight per week), but had steadily decline to a rate of just 0·1 (SD 0·1) % starting body weight per week by day 672 (Fig. 1). This decline in rate happened despite a gradually

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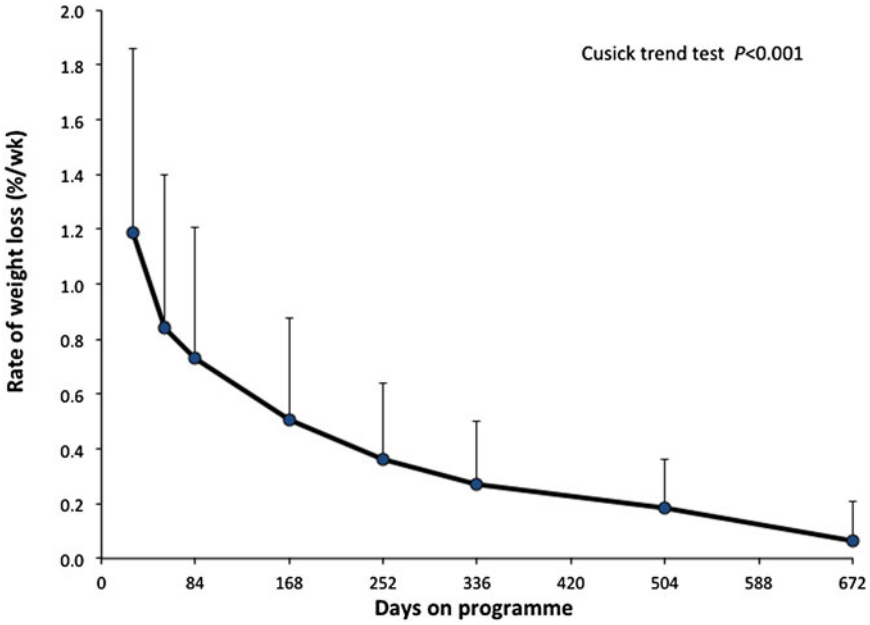

Fig. 1. Rate of weight loss in obese pet dogs at different stages of a weight loss programme. Rate of weight loss was relatively fast in the early stages (e.g. 1·2 (SD 0·67) % starting body weight per week), but had steadily decline to a rate of just 0·1 (SD 0·1) % starting body weight per week by day 672[40].

reducing energy intake throughout weight loss (Fig. 2). In the early stages, compliance was good (e.g. 86 %) and dogs has lost about 11 % body weight on average. However, very few had completed their programme within this time. Thereafter, many dogs did start to reach target, but the number of discontinuing steadily increased such that, by day 672, 59 % had completed and 32 % had stopped. These results highlight the fact that initial weight loss is usually good, but the response steadily worsens thereafter. It also confirms the fact that, unless the complete weight loss cycle is examined, the results of weight loss studies can be misleading.

The rebound phenomenon

One final limitation with most clinical weight loss studies is the fact that they only look at the weight loss phase, and do not examine subsequent maintenance of weight. Arguably, permanently keeping weight off is more important than losing it in the first place, in order that any benefits in quality of life should be maintained. Long-term success is disappointing for obese people who lose weight through dietary means, with studies suggesting that some participants regain more weight than they had originally lost[39]. A recent study has examined follow-up after reaching target weight in obese pet dogs[41]. Of the thirty-three dogs studied, fourteen (42 %) of dogs maintained weight, three (9 %) lost further weight, and sixteen (48 %) regained weight. However, whilst rebound was common, its magnitude (median weight change +4 %) was typically less than that seen in similar human studies, meaning that the majority of dogs kept much of the weight off. The likelihood of regaining weight was significantly less if the purpose-formulated weight management diet continued to be fed during weight maintenance, rather than switching back onto a standard maintenance diet. This study highlights the fact that weight management is a lifelong process with clinicians needing to continue to monitor body weight after ideal weight has been achieved.

How can we do better?

As described, clinical research about weight management in obese pet dogs has revealed a number of key insights into both the success of the weight management process, but also the challenges it brings, and the realities in terms of long-term outcomes. Clinicians must accept that current strategies are not perfect, and that many animals will fail. To recap, the following clinically proven facts should be considered:

(i) There are potential health and welfare benefits when an obese dog loses weight. Clinically proven benefits of weight loss include lessening the impact of existing medical conditions, normalising metabolic derangements including insulin resistance, improving organ function (notably respiratory system and kidneys) and improving overall quality of life. Although not proven, the association between overweight body condition and shortened lifespan might also suggest that weight loss could extend life. In a similar manner, the associations between overweight condition and a range of diseases might mean that other diseases can be avoided.

(ii) Weight management is challenging for owner and pet. Successful weight loss in obese pet dogs and

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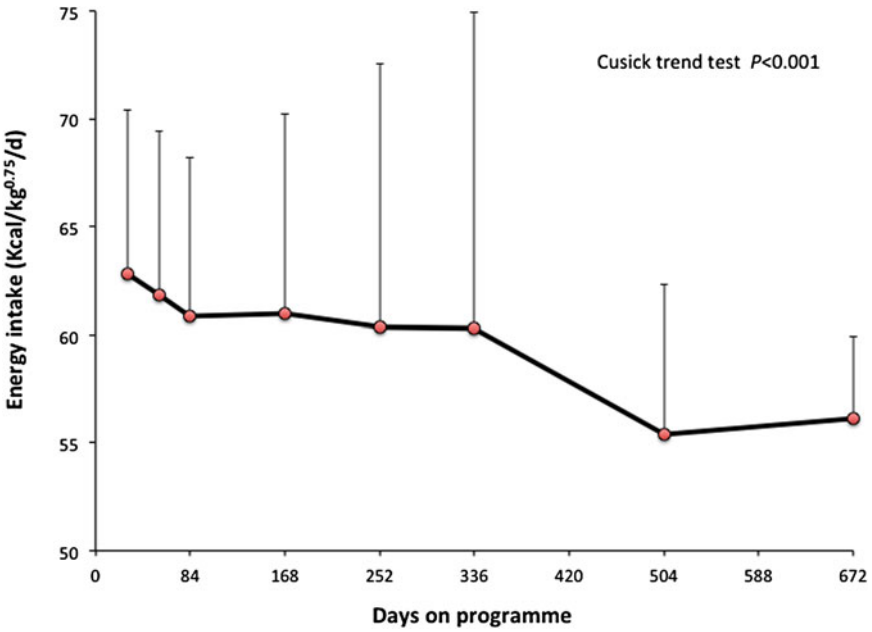

Fig. 2. Energy intake in obese pet dogs at different stages of a weight loss programme. Data are expressed as kcal/kg metabolic body weight (e.g. $kg^{0.75}$)/d. Energy intake gradually declines as weight loss progresses[40].

cats is more challenging than suggested by research conducted in colony studies. Weight loss progresses more slowly, and marked energy restriction is required. The rate of weight loss declines steadily during the weight management process, and requires steadily more energy restriction. This can lead to frustration for the owner, and the increased begging activity that can result may mean that owners do not comply with the programme.

(iii) Weight management can lead to loss of lean tissue. Lean tissue loss is a potential effect of the weight loss process, but is mainly a feature for dogs losing more than 20 % of body weight.

(iv) Not all obese dogs and cats succeed in losing weight. Just over half of dogs starting a weight loss protocol succeed in reaching their target weight. Compliance is good in the early stages of weight loss with over 80 % remaining on the programme, but few have reached target weight in this time. The dropout rate increases steadily after 3 months, meaning that only about half of all obese animals are actually likely to reach target. Not surprisingly, dogs with the most weight to lose are least likely to be successful because their programmes tend to be longest.

(v) Most dogs lose some weight, even if they do not reach target. Although many dogs and cats are unsuccessful, the majority will lose some weight in the early stages, and generally more than 6 % weight.

Most importantly, the weight loss process in obese dogs is a clear example of diminishing returns, namely that the more weight that must be lost, the more difficult it is. The payoff of success in these circumstances is dramatic energy restriction, and the likelihood of some lean tissue loss. In the author's opinion the process of tailoring weight management to the individual is key to maximising success. This concept involves understanding the priorities of weight management in each case, setting case-specific targets, and establishing a realistic plan that will maximise the chance of benefitting the patient long-term. Broadly speaking, two strategies could be considered, complete weight loss and partial weight loss. As the name suggests, the purpose of a complete weight loss programme would be to return the dog to its ideal weight. In contrast, with a partial weight loss programme, a target weight is deliberately set which is above the ideal weight.

Complete weight loss has the benefits of 'normalising' adipose tissue mass, with the aim of producing the maximal benefit to health in terms of improving metabolic status and organ function. Although not proven, returning a dog to ideal condition, and keeping it there might also increase the likelihood of a longer lifespan. Such an approach would be most applicable where obesity develops early in life, i.e. young adulthood, where rapid return to normal weight would maximise any potential for extending lifespan. A complete weight loss strategy might also be beneficial for obese dogs that do not yet have an obesity-associated disease, since many such diseases, for instance osteoarthritis, are chronic in nature developing insidiously over many years. Once again, return to ideal weight would reduce the impact of obesity on the chronic disease process, thereby delaying its onset or preventing signs from manifesting at all.

The disadvantage of a complete weight loss programme is the fact that the chance of failure is greater, and there is a risk that any weight initially lost might be regained again. Further, as mentioned earlier, there

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is no evidence yet available that potential benefits such as increased lifespan and disease prevention actually occur. Moreover, such benefits are less likely to be pertinent for older animals and for those with pre-existing disease. Instead, the main priorities for weight management should be to improve quality of life and to lessen the impact of any concurrent disease. In this respect, evidence is available that modest amounts of weight loss (e.g. ≥6 %) can lead to alleviation of signs of concurrent disease such as osteoarthritis[32]. Devising a shorter-term plan with a more realistic target might be preferable for such dogs, and the clinician could be confident that over 80 % would succeed. Of course, if progress is good at that stage and if the owner is willing, then the weight loss programme could be extended further.

Conclusions

Obesity is a major issue in pet dogs, and dietary strategies can be very successful. However, it can be challenging to reach target weight, especially for the most obese animals. Tailoring the weight loss plan involves not only devising an appropriate management strategy, in terms of dietary energy restriction and increased activity, but also setting a realistic target weight. Returning an obese animal to ideal weight may not suit all, and may not be necessary to achieve the benefits, not least if these relate to alleviation of signs of pre-existing disease or improving quality of life.

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Conflict of Interest

None.

Authorship

The paper was written solely by the author.

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