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# Feeding Management of the Neutered Cat

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Neutering is one of the most common surgical procedures performed on pets in the U.S. There are known effects of neutering on the physiology and behavior of the cat that predispose to obesity, which is the most significant sequela from a nutritional perspective. Proactively addressing these changes with nutritional management strategies can help prevent weight gain and associated negative consequences. Likewise, successfully achieving the reversal of obesity in neutered cats may have benefits and should be pursued despite the challenges of the process.

## Introduction

There are almost one billion owned cats in the United States, and over 90% of those are neutered.<sup>1</sup> Epidemiological data have demonstrated that neutering is a risk factor for obesity in cats, especially in males.<sup>2-5</sup> Obesity is a common and serious problem in domestic cats. Studies have reported that some populations have a prevalence of overweight and obese cats of 28 to 63%.<sup>4,6-8</sup> Overweight cats are more likely to suffer from many problems, including diabetes mellitus, constipation, orthopedic disease, altered hemostasis, urinary tract disease, hepatic lipidosis, and skin disease.<sup>7,9,10</sup> As the majority of feline veterinary patients have a known risk factor (neuter status) for a disease that is likely to result in potentially significant morbidity (obesity), strategies aimed at prevention and, where necessary, intervention are indicated.

## Impacts of Neutering on Food Intake, Body Weight and Energy Expenditure

The relationships among food intake, body weight and condition, and energy expenditure after neutering are complex. However, it seems clear that when cats are fed *ad libitum* after neutering, weight gain is likely to occur,<sup>11-14</sup> and free availability of food results in greater body weight and body fat percentage after neutering of male<sup>15</sup> as well as female cats<sup>16</sup> compared to restricted access. This effect is even seen in feral cats participating in trap-neuter-release programs.<sup>17</sup> In addition, greater weight gain and body fat accumulation is seen after neutering when energy-dense diets are used.<sup>18-19</sup> Many studies have investigated whether an increase in food intake, a decrease in energy expenditure, or both, are responsible for the weight gain commonly

## Glossary of Abbreviations

**BCS:** Body Condition Score  
**IGF-1:** Insulin Growth Factor-1  
**LBM:** Lean Body Mass  
**NRC:** National Research Council  
**RER:** Resting Energy Requirement

seen after neutering. Further, what is the relationship among body mass, body composition, energy intake, and energy expenditure?

One study showed that neutered cats gained more body weight and fat mass when assessed at one and three months

postsurgery compared to cats left intact, and that males gained more weight than females.<sup>11</sup> When food intake was measured at the baseline and three-month time points, the authors reported a significant increase only for neutered and not intact males and females, with neutered males having higher food intake than neutered females.<sup>11</sup> They also reported that fasting but not resting metabolic rate, calculated on a metabolic body weight basis (kcal/kg total BW<sup>0.75</sup>/day), decreased at three months after neutering in females but not in males despite a smaller mean gain in the females at that time point. The question remained, however, whether energy expenditure on a lean body mass basis was altered by neutering or by gender, and whether reduced energy expenditure or increased food intake was driving the gain in body mass.

Another study investigated energy balance in male cats during the immediate postsurgical period and found that food intake increased almost immediately for neutered cats compared to intact cats, becoming significantly higher at three days after neutering, while body weight increases did not become significantly higher until seven weeks after neutering.<sup>13</sup> The gains in body weight plateaued at approximately 28% and were primarily due to increases in fat mass; however, it is interesting to note that energy expenditure on a lean body mass basis was not different before and after neutering and that there also was no difference in energy expenditure between neutered and intact cats in that study.<sup>13</sup> These findings agreed with a previous study that also reported no change in energy expenditure on a lean body mass due to neutering,<sup>20</sup> and were also confirmed by more recent data demonstrating that postneutering weight gain in adult male cats is the result of increased food intake and not a change in energy expenditure.<sup>21</sup>

In contrast, another study showed an increase in heat production in male and female cats neutered at 7 weeks or 7 months compared to those kept intact; however, the calculations used absolute body weight, and body composition, weight and body

condition of the cats were not reported.<sup>22</sup> Assuming that the neutered cats were heavier throughout the study as well as at the end point as reported by this author in lecture proceedings,<sup>23</sup> if ideal or lean body mass (LBM) had been used to calculate the heat coefficients, the differences between the intact and neutered cats would have been smaller and may not have been significant.<sup>22</sup>

The role of gender, and potential differential effects of neutering on females versus males, may also be significant.<sup>11,24</sup> One study showed that calorie intake to maintain body weight in neutered females was significantly decreased over time after surgery, though there was no significant reduction for neutered males up to 16 weeks after surgery.<sup>24</sup> Gender differences in hormonal responses (leptin, insulin, free thyroxin) to neutering were also noted.<sup>24</sup> Similarly, another study showed that significantly fewer calories were necessary to maintain body weight in ovariectomized versus intact queens.<sup>25</sup> These findings agree with another study that showed an over 30% restriction in food intake was necessary to maintain body weight in neutered queens; voluntary activity of the cats was also markedly decreased (60% and 33% of baseline measurements for the light and dark periods, respectively).<sup>16</sup> More work is needed to explore these differences and may help explain varied findings in studies of energy expenditure of neutered cats.

It should be noted that most studies vary as to when energy expenditure is measured after neutering, which may bias the findings when significant body weight and fat mass gains have occurred in the interim. In addition, the methodology used to measure energy expenditure is not standardized. Further, some studies rely on estimated energy intake or degree of restriction to maintain body weight as an indirect measure of energy expenditure. When measured using indirect calorimetry in the immediate postneutering period, and normalized for body composition, energy expenditure does not change in adult male cats.<sup>13,21</sup>

Although most evidence supports that energy expenditure (as determined by indirect calorimetry and adjusted for lean mass) does not change as a result of neutering regardless of body weight change, it has been shown that energy restriction per se results in a decrease in lean mass-adjusted energy expenditure.<sup>26</sup> Further, one study showed that energy restriction in overweight neutered female kittens to the amount consumed by intact littermates, after a period of *ad libitum* feeding of 18 weeks postneutering, resulted in continued accumulation of body fat, increased body weight and increased body condition score (BCS).<sup>14</sup>

It also has been demonstrated that body weight gain can be avoided after neutering provided that food intake is actively limited, though it seems clear that some cats need fairly severe restriction to maintain preneutering body weight.<sup>12,25</sup> Thus, it appears that the initial effect of increased food intake, when allowed, followed by resultant increases in body weight and fat mass, is probably responsible for the obesity seen in neutered cats.<sup>13</sup> This underscores the role of food intake and feeding management in pet cats after neutering and supports an individualized approach to the determination of the necessary degree of restriction.

## Mechanisms for Increased Food Intake

One of the consequences of neutering is a change in the hormonal milieu including impacts on cholecystokinin response,<sup>27</sup> increases in concentrations of prolactin, IGF-1 and leptin,<sup>28</sup> and decreases in concentrations of sex hormones, such as testosterone and estrogens. Decreases in sex hormones, are unsurprising; however, it is noteworthy that significant reductions in estradiol are seen in male cats after neutering, with reduction of plasma concentrations to approximately half the presurgical concentrations.<sup>15</sup>

Previous work has implicated this as a potential major factor influencing the increase in food intake seen with neutering. For example, it has been demonstrated that administration of low-dose estradiol to overweight, neutered male and female cats significantly reduced food intake.<sup>29</sup> In addition, low-dose exogenous estrogen can prevent the increase in food intake associated with neutering as well as reduce the degree of accompanying weight gain and increase in fat mass.<sup>30</sup> Further, plasma concentrations of estradiol were not impacted by food restriction versus free access, nor with the degree of adiposity, and exogenous injections of estradiol restored presurgical plasma concentrations and resulted in reduced food intake.<sup>15</sup>

These findings support the role of gonadal estrogens in both genders. It remains to be seen whether this therapy may be clinically useful for the management of cats after neutering and whether long-term treatment would be needed. Since the general agreement is that food intake is the key factor underlying weight gain after neutering, the current focus remains on feeding management and owner education.

## Management of Neutered Kittens

Cats are commonly neutered at a young age during the period of growth. Kittens require a specific balance of nutrients to support normal development, so it is important to feed a food designed for growth until approximately 1 year of age. Due to the timing of neutering, this presents a challenge for balancing the nutritional requirements of a growing kitten with the need to control food intake and avoid excessive weight gain. As there does not appear to be a difference in obesity risk dependent on age of neuter,<sup>22,31</sup> it might be prudent to delay neutering procedures until after the most rapid growth period is passed, when possible; however, in many circumstances earlier neutering is preferred (or mandated) to address overpopulation issues. In any case, portion-controlled feeding is recommended, and regular monitoring of body weight and body condition is necessary to enable adequate and timely adjustment of the amounts fed.

In addition, although diets formulated for growth tend to be more energy dense compared to those formulated for adult maintenance, there still is a wide range of options with varying energy densities in the kitten growth category. An informal and limited survey of over-the-counter products by the author revealed a range of energy density values for dry kitten foods of 3288-4420 kcal/kg as fed and for canned kitten foods of 847-1343 kcal/kg as fed. If food intake cannot be adequately controlled

and/or if the necessary volume restrictions are too severe, a growth diet with lower energy density should be used. However, this recommendation assumes the volume intake is consistent, though the drive for increased food intake may overcome the reduction in energy density. Using a canned diet may be an effective way to limit food intake<sup>32</sup> yet still meet the needs of a growing kitten. However, more active restrictions on food consumption are probably needed in many cases. Further, given the marked reduction in voluntary activity in neutered queens,<sup>16</sup> it is possible that actively encouraging increased activity may help offset the effect of neutering such that less-severe restrictions of food intake are needed. The difficulties in accomplishing weight loss in cats in addition to the risk of the cat regaining the weight help emphasize that any factors that help to prevent obesity are preferable to trying to reverse it.

### Energy Requirements for Growth and Maintenance

For adult cats undergoing neutering, energy restriction to prevent increased food intake is less complex, though many owners do not already monitor or control their cats intake, in which case this may require the institution of a new household routine. If known, the energy intake should be reduced by at least 15% and may need to be restricted over 30%, based on the degree of the increases reported for adult cats by several studies.<sup>13,15,16,21,25</sup> Although not ideal due to the individual variation in energy requirements, if the prior intake cannot be determined, reliance on equations to estimate these needs is necessary.

Many studies of the daily energy maintenance requirements of cats have been conducted, with a very wide range of values determined and primarily given on an absolute body weight basis (31-100 kcal/kg BW).<sup>33</sup> Many factors likely explain the variation; however, despite a relatively consistent body size and shape of domestic cats, allometric scaling and the use of metabolic body weight are justified. Based on work by Nguyen and agreement with other data, the National Research Council (NRC) provides different equations for lean versus overweight adult cats that use different coefficients for metabolic body weight:<sup>33-34</sup>

- Lean cats  $100 \text{ kcal} \times \text{kg BW}^{0.67}$
- Overweight cats  $130 \text{ kcal} \times \text{kg BW}^{0.4}$

For kittens after weaning, the equation provided is more complex and requires estimation of predicted adult body weight; this was based on pooled data from many published studies:<sup>34</sup>

$$(100 \text{ kcal} \times \text{kg BW}^{0.67}) \times 6.7 \times [e^{(-0.189p)} - 0.66]$$

where  $p$  = actual body weight/expected mature body weight and  $e$  = base of natural log ( $\sim 2.718$ )

Many veterinary nutritionists use a simpler equation based on a growth factor applied to the resting energy requirement (RER) at the current weight:<sup>35</sup>

$$2.5 \times \text{RER}$$

where  $\text{RER} = 70 \times \text{kg BW}^{0.75}$

Regardless, any equation used is a starting point, and recommendations for individuals necessitate reassessment and adjustments as needed to maintain ideal body condition during growth.

### Owner Education

Underestimation of the cat's overweight condition or a general unawareness of body condition is common among cat owners and may contribute to the development of obesity.<sup>3</sup> In fact, one recent study identified owner underestimation of cat body condition as a main variable influencing obesity in cats.<sup>8</sup> Pet owners should be counseled on appropriate body condition for their individual pet<sup>36</sup> and encouraged to perform body condition scoring at home on a regular basis (every two weeks during the growth period<sup>37</sup>).

Free feeding is common for cats and is a convenience factor that owners sometimes attribute to their preference of pet cats over dogs. Free feeding is often practiced regardless of body condition,<sup>38</sup> with 80% of pet owners using this method of feeding.<sup>39</sup> Some studies have found no link between feeding practices and the prevalence of obesity.<sup>6,8,40</sup> It is clear that some cats successfully regulate their food intake to maintain ideal body weight, though others tend to overeat and become overweight or obese. For many cases, consideration of the amount fed as well as the energy density of the diet is important. Monitoring the pet's BCS and body weight, accompanied by any necessary adjustment in the amount and type of food fed, is a critical component in providing recommendations that meet the needs of individual pets; this process starts with a veterinary assessment and is maintained by both the owner and the veterinary team.<sup>37</sup>

### Recommendations for Kittens and Adult Cats after Neutering

It is challenging to provide guidance to pet owners for feeding their neutered kitten. Growing cats have higher requirements for protein, amino acids, specific fatty acids, and most minerals compared to adults,<sup>34</sup> and foods intended for growth are necessary. Kitten owners should be counseled to look for the nutritional adequacy statement on the label, which will indicate whether the food has been formulated or feeding trials conducted for growth or all life stages; diets formulated or feeding trials conducted only for adult maintenance are not satisfactory options. Although it may be tempting to switch to an adult diet, these options may not provide the appropriate concentrations of nutrients that are essential for optimal growth. Although weight gain during growth is normal and expected, it is important that the pet owner understands how to assess body condition and proactively adjusts the amount of food offered to prevent gain of body fat. There is very little data providing information on the degree of restriction necessary to avoid weight gain after neutering. One study reported that neutered female cats had 17% higher food intake compared to their intact littermates.<sup>14</sup> However, individual kittens will vary in the degree of restriction needed, and a gender difference also is possible.

Cats neutered as adults may require quite dramatic energy restriction to avoid weight gain. Studies have reported reductions of up to 30-36% to maintain preneuter body weights in adult female cats.<sup>16,25</sup> Food intake in adult males increased by 12% after neutering in one study, which was modest yet allowed body

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weight increases of 27-29%.<sup>13</sup> Another study showed increases in food intake after neutering in 17% of females and 26% of males.<sup>11</sup> Therefore, it seems important to ensure that owners of cats of either gender understand the importance of food restriction immediately after neutering to avoid the development of obesity. Beginning with a restriction of at least 15%, and instituted immediately after the procedure, seems reasonable. Body weight and condition should be assessed regularly, with further reductions implemented as needed to maintain ideal BCS.

## Conclusion

Ultimately, evidence supports avoidance of allowing unrestricted access to food, consideration for energy density, provision of a life stage-appropriate diet, and regular monitoring of the body condition of neutered cats. Determination of energy needs should be based on prior intake, if known; however, the degree of restriction necessary to avoid weight gain is variable and underscores the importance of monitoring and adjustment.

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