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Prevalence and risk factors of obesity in an urban population of healthy cats

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The incidence of overweight in cats has been reported in various studies to range between 6 and 52% depending on such factors as gender, neutering, age, being cross-bred, living in a single or two-cat household, no dog living in the household, inactivity, feeding fresh meat or fish, eating a premium or therapeutic food, distribution of food on a free choice basis and owner underestimation of their cat's body weight or body condition (BC). The purpose of this study was to assess the prevalence of overweight and to determine the risk factors associated with excess body weight, including owners' perception of their cat's BC in the studied population. Between March and June 2006, all owners presenting healthy cats for vaccination at the National Veterinary School of Alfort were questioned by a veterinarian using a standardised and validated questionnaire. Owners and veterinarians gave an oral evaluation of the cat's BC first verbally and then by comparison with a legend free visual scale. Univariate analysis was performed for all variables. Multivariate logistic regression analysis was applied to variables strongly associated with overweight or regarded as major risk factors. On a total population of 385 cats, 19.0% were found to be overweight and 7.8% to be obese. The evaluation of overweight cats' BC by their owner was better with the visual scale than with the verbal description. This study confirmed earlier reports identifying being male, neutering, and underestimation of the cat's BC by the owner, as risk factors for being overweight.

Obesity has been defined as 'a condition of positive energy balance and excessive adipose tissue formation with adverse effects on morbidity and mortality'.[1] A working definition of obesity was suggested for pets as 15% or more excess over the ideal body weight.[2] Overweight was defined by body weight excess below 15%.

The prevalence of overweight and obesity in dogs was estimated to vary between 18 and 44% depending on the dog populations studied and on the evaluation techniques used.[3−12]

In cats, earlier studies carried out in various countries demonstrated a prevalence of overweight and obesity of 6 to 52%.[4,9,13−21] Figures for French cats are lacking as no study of this type has been published.

Earlier studies suggest as risk factors for feline obesity: male gender,[13,18,21] neutering,[13,14,18−22] being cross-bred,[13,18,21] middle age,[13−15,18,20,21−23] living in a single or two-cat household,[18,20] no dog living in the household,[19] inactivity and confinement indoors,[13,14,18] feeding fresh meat or fish,[20,23] eating a premium or therapeutic food,[13,17,21] giving food on a free choice or ad libitum basis[20,23,24] and underestimation by owners of their cat's body weight or body condition (BC).[19,23]

This study had three objectives: first to assess the prevalence of overweight in healthy cats in a French urban population; second to identify the risk factors associated with feline excess body weight and obesity; and third to evaluate the owner's perception of their cat's BC.

Materials and methods

All cat owners attending the Vaccination Department at the National Veterinary School of Alfort, from March to June 2006 were questioned by a veterinarian. A single questionnaire was filled out for each cat, regardless of multiple visits during the survey period.

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The questionnaire had been tested and validated in a preliminary study. The two interviewing veterinarians were trained to estimate BC using a 5-point visual scale adapted from Laflamme.[25] A BC score (BCS) of 1 was given to 'cachectic' cats, 2 for 'lean', 3 for 'optimal', 4 for 'overweight', and 5 for 'obese'.

The owners of 497 cats were asked by a veterinarian to supply details regarding their social status, age and lifestyle. Then, the cat's BC was evaluated by each owner: once through a verbal description by selecting one of the five descriptors: too thin, little too thin, optimal, little too fat and too fat and once by choosing one out of five legend free drawings of cats of increasing BCS randomly arranged in a circle. The owners were then asked to estimate the body weight of their cat. Finally, they provided information about the cat: age, gender, neutering status, type of diet, number of meals per day and quantity of food offered. BCS estimated by the veterinarian was used as the 'gold standard' and the cat's actual body weight was measured on Soehne scales, calibrated monthly.

The questionnaires were entered in Excel (Microsoft) and statistics were performed with SAS for Windows version 9.1 (SAS Institute, Cary, NC, USA). The level of agreement between BCS estimate by the owner and the veterinarian was measured by kappa coefficient ($0 \leq \kappa \leq 1$ with: $0.61 \leq \kappa \leq 1$: high agreement; $0.41 \leq \kappa \leq 0.60$: moderate agreement; $0 \leq \kappa \leq 0.40$: poor agreement). For body weight (estimated and actual), the level of agreement was measured by a correlation coefficient. To identify associations between overweight and various presumed risk factors, crude odds ratios (ORs) and 95% confident intervals (CIs) were calculated. Then, a multivariate logistic regression analysis (multivariate OR, mOR) was used for variables associated with overweight identified in earlier studies and for variables strongly suspected to be risk factors. OR estimates were considered significantly different from 1 if the 95% CI did not include 1.0. A variable was considered to be a confounder if its inclusion in the multivariate model altered the OR for overweight by 20% or more.

Results

From a total of 497 cat vaccinations were carried out during the study period, 385 questionnaires were collected and analysed. Of the 112 cases that were not considered, 26 persons were not questioned because they were not cat's owner, 85 owners were on a second visit in the survey period, and one person refused to cooperate.

Age distribution

The mean age of the cats was 3.5 years old (2 months to 16 years). A total of 44.4% of cats were under 24 months old (25.7% were less than 1 year old and 18.7% between 1 and 2 years old), 28.3% between 2 and 5 years old, 18.4% between 5 and 10 years old and 8.6% of cats were 10 years old or more (eight cats were 14 years old or more). One owner did not know the age of his cat.

Breed

Overall, 9.6% of the cats were morphologically identified as purebred, one third of which were registered as purebred. Persian ($n = 15$), Birman ($n = 6$), Siamese ($n = 6$), Chartreux ($n = 3$), Maine coon ($n = 2$), and one of each of the following breeds: Abyssinian, Korat, Norwegian Forest Cat, Ragdoll and Turkish Angora. The remaining cats were identified as European breed (cross-bred). Most cats were shorthaired (80.3%).

Gender

The cat population surveyed ($n = 385$) comprised, 14% entire males, 30% neutered males, 25% entire females and 31% neutered females (Table 2). Thus a higher percentage of males, 68% compared to 55% of females, was neutered. The sexual status was unknown for one female.

Housing and ownership

All but two owners were living in the Paris-area (eight districts including Maisons-Alfort and Paris). Of the total of households ($n = 342$), 48.5% were composed of three or more persons, 31.9% by two persons and 19.6% by only one. There were no children in 59.9% of the households and three or more children lived in 5.8% of the households.

Three quarters of owners (72.8%) were 26 to 60 years old, 16.1% between 18 and 25 years old and 11.1% more than 60 years old.

Overall, 68.9% lived in apartments, 30.6% in houses and 0.5% in the street; 47.7% of cats had an access to a garden and/or to the street, 23.4% to balcony, and 29% had no outdoor access.

Of the 385 cats, 44.4% (171) lived with at least one other animal: 80 of these cats lived with one, two or three other cats, 30 lived with 'exotic pets' (fish, rabbit, birds, tortoise, rodents, ferret or stick insect), and 26 lived with one to four dogs. Of the remaining 35 cats (20.5%): 13 lived with both cat(s) and dog(s), 10 with both dog(s) and exotic pets, six with both cat(s) and exotic pets, and six with various species (cat, dog and exotic pets).

Diet

The majority of owners fed their cats with a commercially prepared dry and/or canned food (98.7%). Half of these cats (56.3%) were fed both dry and canned food, 36% only dry food and 7.7% only canned food. Only five cats never received commercially prepared pet food. Of the 380 cats receiving commercially prepared pet food, 66.3% were fed an adult maintenance diet, 23.4% a growth diet and 10.3% premium or therapeutic food.

Owners mainly bought commercially prepared food in a supermarket (79.9% dry food, 94.8% canned food). Alternatively, commercially prepared food was bought in a pet store and pet supermarket (12.8% dry food, 4.1% canned food) or from a veterinary clinic (7.3% dry food, 3% canned food).

Of the 385 cats, 28.3% received supplemental meat or fish and 30.6% had some prepared human food on a regular basis. Few cats (four) received commercially prepared snacks.

Of the 385 cats, nearly half (49.4%) were fed on a self-choice basis, 39.7% were offered several meals a day whereas 10.9% were fed a single meal a day. The quantity of food per day allowed by the owner to the cat was determined mainly by the cat itself (68.8%), based on the pet food manufacturer's (16.4%) or the veterinarian's (11.4%) recommendations. Of the remaining 13 cats, friends' or neighbours' advice was the major factor in the choice of the quantity allowed.

It is recognised that estimation by the owners of the amount of food given daily to their cats are at best approximate.

Body weight and overweight rating

For adult cats (1 year old and more), the average body weight was 5.0 ± 1.3 kg for males (from 2.5 to 12 kg), and 4.2 ± 1.0 kg (from 2.1 to 8.0 kg) for females. For adult cats (1 year old and more) with normal BC (BCS 3, determined by the veterinarian), the average body weight measured on the scales was 4.7 ± 1.0 kg for males, and 4.0 ± 0.9 kg for females.

The assessment by the veterinarian showed that 26.8% [95% CI: 22.8–31.8%] of all cats exceeded optimal BC: 19% [95% CI: 15.1–22.9%] were overweight (BCS 4) and 7.8% [95% CI: 5.1–10.5%] were obese (BCS 5). Cats in optimal BC (BCS 3) accounted for 71.2% [95% CI: 66.6–75.7%], lean (BCS 2) for 2.1% [95% CI: 0.7–3.5%]. None were cachectic (BCS 1).

The agreement between the owner's and the veterinarian's assessment of the cat's BC was moderate for the verbal description ($\kappa = 0.46$) and poor for the visual scale ($\kappa = 0.30$), mainly due to the owner's underestimation of the cat's BC. This underestimation was lower when using the verbal description compared to the visual scale for cats of normal BC, but lower by the visual scale than by verbal description for overweight and obese cats (Table 1, Fig 1).

In the same way, the correlation between measured and estimated weight was high for veterinarian ($r = 0.94$), but lower for owners ($r = 0.8$).

Among the risk factors considered, being cross-bred, living with other animals in the household, feeding fresh meat and giving food on a free choice or ad libitum basis did not demonstrate a correlation with overweight and obesity in cats. By contrast, there was a higher risk of overweight associated with male gender, neutering in either sex, age over 2 years, feeding a light diet or therapeutic food, owners aged over 40 years, purchase of dry food in a veterinary clinic, feed allowance determined by a veterinarian and owner underestimation of a cat's BC. Cats aged less than 1 year old, being purebred, having longhair, living with one child in the household, and feeding kitten food, were associated with a lower risk of being overweight. Outdoor access showed no significant association (Table 3).

The multiple logistic regression confirmed a positive OR (higher risk of overweight and obesity) for neutering,

Table 1. Comparison of BC estimation by owner using two methods, compared with veterinarian estimates

Estimate by owner			Estimate by veterinarian % (*n*)			
			Lean	Optimal	Overweight	Obese
			BCS = 2	BCS = 3	BCS = 4	BCS = 5
BC and BCS		Method	*N* = 8	*N* = 274	*N* = 73	*N* = 30
Cachectic	Too thin	D	(0)	(0)	(0)	(0)
	BCS = 1	S	(1)	10.6% (29)	(1)	(0)
Lean	Thin	D	(5)	10.6% (29)	(0)	(0)
	BCS = 2	S	(2)	29.2% (80)	(4)	(0)
Optimal	Optimal	D	(2)	81.4% (223)	50.7% (37)	(3)
	BCS = 3	S	(3)	51.1% (140)	27.4% (20)	(2)
Overweight	Little too fat	D	(0)	8% (22)	46.6% (34)	63.3% (19)
	BCS = 4	S	(1)	8.4% (23)	60.3% (44)	53.3% (16)
Obese	Too fat	D	(1)	(0)	(2)	26.7% (8)
	BCS = 5	S	(1)	(2)	(4)	40% (12)

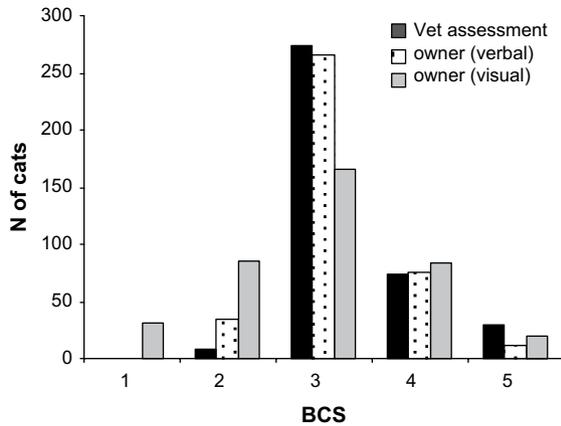No cat was cachectic (BCS 1). D = verbal description; S = visual scale.

Fig 1. Assessment of BC by veterinarian and cat owner. The cat's BC was twice evaluated by each owner: once through a verbal description (too thin = BCS 1, little too thin = BCS 2, optimal = BCS 3, little too fat = BCS 4, too fat = BCS 5), once by choosing one out of five legend free drawings of cats of each BCS (visual assessment).

cats aged between 2 and 9 years, owners aged between 41 and 60 years, and underestimation of cat's BC by owner. It also confirmed a significantly lower risk of obesity for cats aged less than 1 year, longhair, and living with one child in the household (Table 3).

Discussion

To our knowledge, this is the first study carried out in France on cats' BC based on a reasonably sized cat population ($n = 385$). No claim can be made that the population in this study can be regarded as representative of the French feline population. Thus, our results have to be considered with caution. Nevertheless, it can be considered as a healthy cat population, and the prevalence of overweight (19%) and obese (7.8%) cats recorded in this study is one of the highest reported. The difference might be related to the type of population (urban) and to the methodology of earlier studies (owners' interviews and owners' underestimation of their cat's BC). A total of 71.2% of cats had an ideal BC.

In our study, as in the some of the previous studies, the major risk factors for feline obesity were neutering in both sexes and underestimation of BC by an owner. Middle age and gender are also significant. Below 1

year old is a lower risk factor, which is not surprising, and adult age (2–9 years old) is a positive risk factor for feline obesity. This study was carried out in a relatively young population (average 3.5 years) so that no conclusion can be drawn regarding the relationship, if any, between advanced age and overweight in cats. In France, neutering rarely occurs before 6 months old. Although neutering in cats (especially kittens) may be accompanied by veterinary nutritional advice to help prevent obesity, all previous studies have identified neutering as a risk factor for obesity. The veterinarian may help pet owners by teaching them to recognise what an optimal BC is. From visual scale, owners underestimated their cat's BCS, considering normal sized cats to be underweight. This may make them feed more to encourage them to gain weight, so making them more likely to become overweight as they get older. Nevertheless the visual scale produced better results than a verbal description for estimating an overweight cat. Perhaps a better scoring system should be designed for both preventive education and obesity management. The owner's age was not a real risk factor, but as people aged between 41 and 60 years old owned adult cats, the age of the cat was confounded with the age of the owner. The presence of one child was associated with a significant lower OR: he might be a playmate.

In this study, owners mostly fed commercially prepared pet food purchased in a supermarket. Fresh food (meat, milk) was offered to the cat from time to time, but the quantity was often unknown. Then, the implication of fresh food in feline overweight is difficult to establish. Therapeutic food, purchased in a veterinary clinic and prescribed by a veterinarian appeared as a risk factor for obesity. That is a confounder as diets are prescribed for overweight and obese cats. The energy density of premium food may be up to 30% higher than supermarket foods, so that they represent de facto a risk of overfeeding and overweight. In addition to this, even if the quantity of food allowed to the cat is prescribed by a veterinarian or read on the label of the food, owners mainly do not weigh it. In our study, the free choice basis as food allowance did not appear as a risk factor, in contrast with previous studies.[20,23,24] One reason might be confusion in the owner's mind between a self-choice (weighed amount of food per day) and ad libitum feeding (as much as the cat eats). Care should be taken in further studies to avoid this misinterpretation.

Table 2. Sexual status (entire or neutered)

	Male	Female	Total
Entire	14% (54)	25% (97)	39% (151)
Neutered	30% (115)	31% (118)	61% (233)
Total	44% (169)	56% (215)	100% (384)

The neutering status was unknown for one female ($n = 384$).

Table 3. Crude OR and mOR and respective confidence interval (95% CI), among overweight or obese cats (BCS 4 to 5), compared with non-overweight cats (BCS 2 to 3) (only significant data or data of interest are shown)

Variable		Number of cats					
		Not overweight or obese (BCS 2 to 3)	Overweight or obese (BCS 4 to 5)	OR	95% CI	mOR	95% CI
Sex	Female	167	49	1.00	−	−	−
	Male	115	54	1.60	1.02−2.52	1.77	0.86−3.64
Neutered	No	141	10	1.00	−	−	−
	Yes	140	93	9.3	4.65−18-59	3.79	1.27−11.34
Cat's age	1 to <2 years	50	10	1.00	−	−	−
	<1 year	119	3	0.13	0.03−0.48	0.20	0.03−0.77
	2 to <5 years	56	45	4.02	1.83−8.80	3.43	1.16−10.19
	5 to <9 years	34	27	3.97	1.70−9.26	3.43	1.04−11.29
	≥9 years	21	18	4.29	1.70−10.82	3.35	0.80−14.11
Breed	European	232	94	1.00	−	−	−
	Breed	33	4	0.30	0.10−0.87	0.70	0.10−4.79
	Cross-breed	17	5	0.73	0.26−2.02	1.19	0.25−5.77
Hairs	Short	214	95	1.00	−	−	−
	Long	95	8	0.26	0.12−0.57	0.15	0.04−0.50
Owner's age	26−40	119	31	1.00	−	−	−
	<25 years old	51	9	0.68	0.30−1.52	0.66	0.19−2.26
	41−60	86	47	2.1	1.23−3.57	2.66	1.16−6.10
	>60 years old	26	16	2.36	1.13−4.94	0.99	0.28−3.57
Number of children	0	161	65	1.00	−	−	−
	1	57	11	0.48	0.24−0.97	0.29	0.10−0.86
	2	51	19	0.92	0.51−1.68	0.77	0.31−2.16
	3 or more	13	8	1.52	0.60−3.85	0.87	0.16−3.67
Outdoor access	Yes	187	74	1.00	−	−	−
	No	95	29	0.77	0.47−1.27	1.55	0.68−3.52
Underestimation of owner (vs veterinarian)	No	252	46				
	Yes	30	57	10.41	6.05−17.9	19.12	7.82−46.78
Food type	Adult	175	77	1.00		−	−
	Growth	89	2	0.051	0.01−0.21	0.31	0.05−1.89
	Light	6	9	3.41	1.17−9.91	3.57	0.68−18.53
	Therapeutic (prescription)	5	15	6.82	2.39−19.43	8.03	0.64−100.81
Purchase of dry food	Supermarket	222	72	1.00	−	−	−
	Pet supermarket	33	14	1.31	0.660−2.58	0.70	0.22−2.26
	Veterinary clinics	14	13	2.86	1.27−6.37	0.26	0.02−3.12
Choice of quantity allowed	Cat's appetite	196	69	1.00	−	−	−
	Pet food company	50	13	0.74	0.38−1.44	3.66	1.36−9.89
	Veterinarian	24	20	2.37	1.23−4.55	1.61	0.54−4.81
	Others	12	1	0.23	0.03−1.85	0.178	0.01−2.30

No cat was cachectic (BCS 1).

Surprisingly in our study, confinement and living with no other animal did not appear to be significant as risk factors, in contrast to some previous studies.[13,14,18–20] All the cats in our study lived in an urban environment: access to outdoors may use up less energy expenditure than a country yard.

In the present study, purebred and especially long-hair are associated with a lower risk factor for obesity. Persians were over-represented in purebred cats and none were obese. Breed is a confounder. It might be interesting to confirm this point in further studies.

This study confirms that the major risks for overweight in cats in this study population were the cat's age, neutering and underestimation of the cat's BC by owners. Veterinarians need to correct cat owners' perception of the BC of their cats if weight loss is to be successful. Prevention is a priority, as the management of a weight loss programme is relatively difficult in practice. BCS education prior to overweight may reduce the incidence of obesity in cats as they grow older.

Acknowledgements

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