Journal of Veterinary Behavior 80 (2025) 1–9

Contents lists available at ScienceDirect

Journal of Veterinary Behavior

journal homepage: www.elsevier.com/locate/jveb

Clinical relevance of rectal temperature measurement in cats showing marked signs of stress during routine veterinary examinations☆

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ARTICLE INFO

Keywords:
Physical examination
Stress
Feline
Body temperature
Welfare

ABSTRACT

Rectal temperature is a vital sign commonly measured during veterinary examinations. This procedure is known to be a major source of stress especially for cats. The purpose of this study was to evaluate the clinical relevance of rectal temperature measurement in healthy cats with signs of marked stress during a routine veterinary appointment. We hypothesized that since higher temperatures would be mostly found in cats with moderate to marked signs of stress, veterinarians would not change their clinical approach in these cats. A user-friendly Simplified Feline Stress Scale (SFSS) was developed. Its trial was the main objective of the pilot study (part 1) designed for 100 cats. Data surrounding temperature measurement in cats was documented (value of rectal temperature, time of restraint needed, and various factors related to cats and clinical staff such as age, sex and more) to evaluate potential associations with stress. Then, during a large-scale study (part 2) of 678 cats the previously validated SFSS was performed by clinical staff in 11 veterinary establishments concurrently with temperature measurements. The final portion of the study (part 3) was an online survey completed by veterinarians across the province of Quebec in order to document the reasons a high rectal temperature in a healthy cat might motivate a change of therapeutic plans. This study showed that veterinary appointments were associated with moderate to marked levels of stress in 62% of feline patients. Agreement between clinical staff-assessed and experienced observer-assessed SFSS scores during the temperature measurement was perfect in 74% of cases and even higher when clinical staff had received previous behavioral training. The majority of calm cats with low signs of stress were under 6 months of age. No change in the therapeutic plan was deemed necessary in stressed cats with an abnormal temperature if they were healthy. According to the online survey, 80% of veterinarians would not modify their treatment plan in such situations. The results of this study suggest that rectal temperature measurement in healthy cats during routine examination is not necessary and could be avoided in highly stressed feline patients.

Introduction

Veterinary visits, including transportation to the clinic, exposure to unfamiliar people and animals, and veterinary procedures are a stressful experience for the majority of cats (Yin, 2009; Volk et al., 2011; Lloyd, 2017; Fear Free, 2019). The associated fear response can influence physiological parameters including respiratory and heart rates, blood pressure, blood glucose, and temperature (Rand et al., 2002; Quimby et al., 2009). Such variations can be problematic for diagnostic accuracy (Belew et al., 1999; Rand et al., 2002; Quimby et al., 2011). Stress can also lead to arousal and aggression, increasing the risk of injuries and infections through bites and scratches for the staff (Westling et al., 2006; Palacio et al., 2007; Carney et al., 2012). Volk et al. (2011) reported that owners may be reluctant to take their cat for routine health visits partly due to the difficulties associated with transport and the cat's stress at the veterinary clinic.

The proxy for core body temperature in cats is most accurately and commonly obtained by measuring rectal temperature (Greer et al., 2007;

☆ Supported by a grant from Fear Free Research. Dr. Desmarchelier's research program is supported by a grant from the Natural Sciences and Engineering Research Council of Canada (#RGPIN-2023–03848).

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https://doi.org/10.1016/j.jveb.2025.05.002
Received 9 January 2025; Received in revised form 4 May 2025; Accepted 6 May 2025
Available online 10 May 2025

Sousa et al., 2011; Smith et al., 2015). This measurement is still considered a basic vital sign of the veterinary examination, particularly in sick animals as it can be an indication of inflammation, infection, neoplasia, or other pathologies (Wuestenberg, 2012; Sousa et al., 2013; Costa et al., 2022). However, restraint techniques often required for rectal temperature measurement are known to be a major source of stress during veterinary appointments (Kunkle et al., 2004; Smith et al., 2015). Stress and agitation during restraint can cause an increase in rectal temperature (Quimby et al., 2009; Harvey and Tasker, 2013).

There are many benefits to minimizing a cat's stress in a clinical setting, including improving the animal's experience at the hospital and thus its well-being, time efficiency of the veterinary team, and the owner's emotional state (Kessler and Turner, 1997; Rodan, 2010; Carney et al., 2012; Lloyd, 2017). As professionals dedicated to animal welfare, veterinarians should question the relevance of each potential stressful procedure. A recent study by Costa et al. (2022) suggests that temperature measurement may no longer be required as a key component in the healthy companion animal's physical examination (Costa et al., 2022). However, this assumption was based on veterinary opinions and not on scientific data.

The main objective of this study was to evaluate the clinical relevance of the rectal temperature measurement in healthy stressed cats during a routine veterinary appointment. This study was performed in three parts. To document cat stress levels, we first aimed to design and validate a new tool called the Simplified Feline Stress Scale (SFSS) (part 1). Our goal was to use the SFSS (part 2), as well as an online survey (part 3) to document if and how veterinarians adjust their therapeutic plan based on an elevated rectal temperature in healthy stressed cats. As a secondary objective, we intended to document which factors (linked to the cat and staff, time to take the temperature, temperature value) could be associated with the cat's stress levels and its assessment, using an experienced observer. We hypothesized that the results of this study would allow veterinarians to make better informed decisions on whether or not it is relevant to take the temperature of stressed cats presented for routine examinations.

Materials and methods

All procedures were approved by the Animal Care and Use Committee of the University of Montreal (21-Rech-2067) which operates under the auspices of the Canadian Council on Animal Care (animal procedures), and by the Science and Health Research Ethics Committee (human personal data) (#21-Rech-2067).

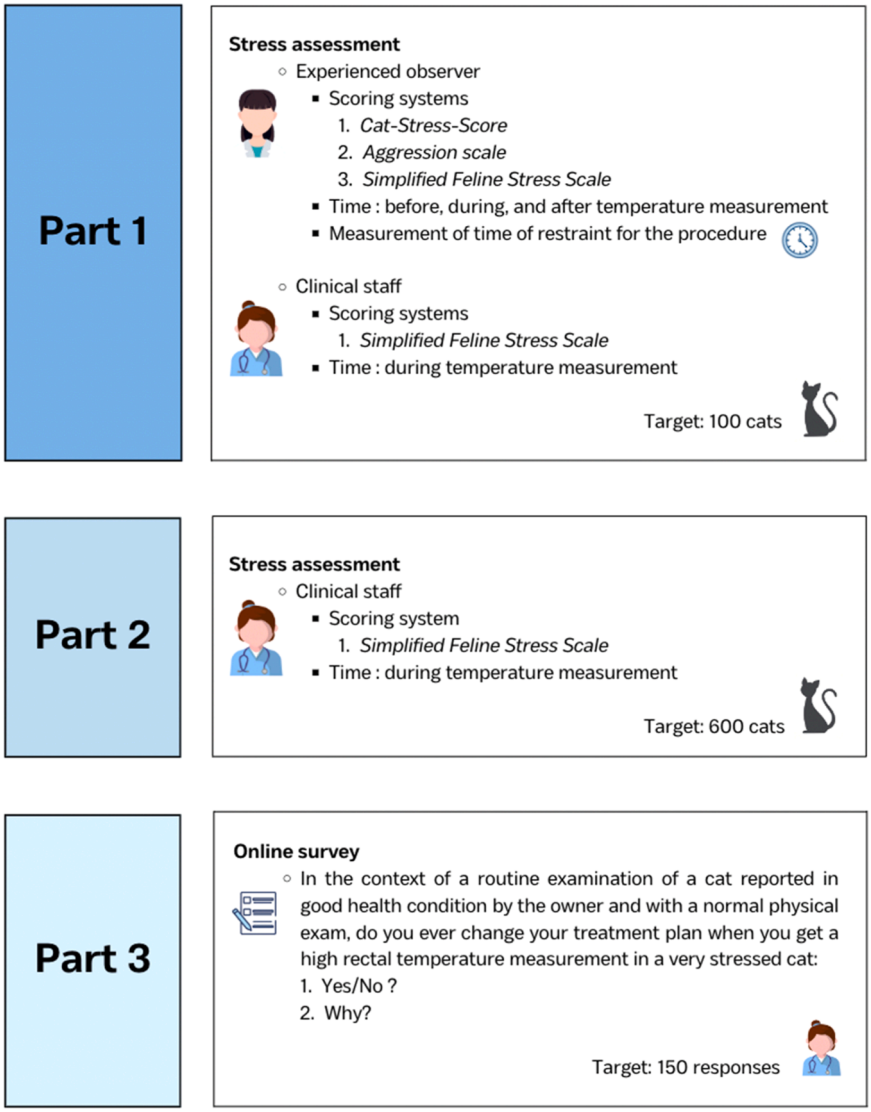

Fig. 1. Experimental design of the study.

Experimental design

The study was separated in three parts with specific procedures and objectives (Fig. 1). Between June 2021–2022, veterinary clinics across the province of Quebec, Canada were recruited to participate in data collection for the study. Various veterinary establishments were sought (clinics, hospitals, shelters, offices).

Part 1 – Clinics participating in the first part of this study. The experienced observer was present during each consultation to collect data on the cat's behavior.

Animals

The target for this first part of the study was 100 cats. Inclusion criteria were cats of any breed, gender, age, or reproductive status, reported in good health by the owner, presented for routine examinations (vaccination, sterilizations, claw trimming, et cetera), and with a normal veterinary physical examination. Cats with inactive chronic conditions (i.e., asymptomatic renal disease, heart disease, et cetera) could be included. Cats with any active health concern based on the owner's report or results of the veterinary examination were excluded.

Clinical staff

The following information on clinical staff participating in the study was recorded: age, gender, position (veterinarian, technician, veterinary student) and if they had received any behavioral training to minimize stress during veterinary care, such as certifying programs (Fear Free®, Low stress handling®), continuing education courses, and other possible training if deemed appropriate by a diplomate of the American College of Veterinary Behaviorists.

Temperature measurement

Rectal temperatures were obtained using a digital thermometer at any time during the veterinary appointment. No specific thermometer model was required, but the measurement had to be done rectally. Any staff member could perform the temperature measurement. The clinical staff had to determine if the rectal temperature obtained was normal or abnormal according to their own temperature reference range. No standardized temperature range was imposed to the clinical staff since the objective of our project was to assess the clinical relevance of the procedure based on each clinic protocol. In case of an abnormal temperature, they were asked if a change in the therapeutic plan was considered necessary and if so, why and how it was changed. Time needed to measure rectal temperature in cats, defined as the time from beginning to end of restraint for this procedure, was measured. If several attempts were made, the sum of the time for each attempt was calculated. Cats for which the temperature could not be measured were not excluded from the study and the reason for the non-measurement was recorded.

Stress assessment

Cat stress levels were assessed by a trained and experienced observer at three time points (before, during, and after the rectal temperature measurement) and with three scoring systems: the Cats-Stress-Score (CSS) adapted from the McCune scale (Kessler and Turner, 1997), an aggression scale (van Haaften et al., 2017), and the Simplified Feline Stress Scale (SFSS). The CSS contains seven well-detailed levels: 1 = fully relaxed; 2 = weakly relaxed; 3 = weakly tense; 4 = very tense; 5 = fearful or stiff; 6 = very fearful; and 7 = terrorized (Kessler and Turner, 1997). The aggression scale includes three levels: 0 = no aggressive behaviors; 1 = hiss, growl, or spit; and 2 = attempt to bite or swat (van Haaften et al., 2017). The SFSS, developed for the study by the authors, is a simplified version of the CSS with only three levels: 1= low stress; 2 = moderate stress; and 3 = marked stress (Fig. 2). The experienced observer was a Master student in Clinical Sciences who had completed the Fear Free training program and several other advanced level/post-graduate behavioral courses under an ACVB diplomate supervision. The clinical staff performing the examination also evaluated the patient's stress levels with the SFSS during the temperature measurement and had to answer eight questions on the provided form (Annex I). No specific training was required for the clinical staff participating in the study, but they were required to read attentively the details of the SFSS before starting, were reminded that non-aggressive cats can be stressed, and could ask any questions to the research team for any needed clarification.

Part 2 – Clinics participating in the second part of this study. The experienced observer was not present during the consultation for this portion of the study.

Animals

The target study population for this second part of the study was 600 cats. Inclusion criteria for the cats were the same as those described in part 1.

Clinical staff

The same information regarding clinical staff was recorded as during part 1 of the study.

Temperature measurement

The restrictions surrounding the temperature measurement were identical to those in part 1, aside from the time of restraint which was not calculated during this part of the study.

Stress assessment

Stress levels were evaluated by the clinical staff during the temperature measurement with the SFSS. Clinical staff had to answer eight questions on the form provided for each feline patient included in the study (Annex I).

Part 3 - The third part of the study was an online survey for veterinarians across the province of Quebec (Canada). The survey was composed of two questions, one being open-ended: *"In the context of routine examination of a cat reported in good health by the owner and with a normal physical examination, do you ever change your treatment plan based on a high rectal temperature in a highly stressed cat? Yes/no? Why?"*. Recruitment was done through the AMVQ (Quebec Association of Small Animal Veterinarians) and social media. Name or license number was asked to prevent any vote from non-veterinarians or accidental multiple votes.

Statistical analysis

A power analysis calculation was performed after part 1 and led to a required number of 600 cats for the large-scale study. We targeted 700 cats to maintain adequate statistical power in case of missing data in some patients and as there were no ethical issues related to this study. The agreement between the SFSS assessment obtained by the experienced observer and the clinical staff was estimated using the intraclass correlation coefficient (ICC). The difference between the two assessments is defined as Delta (SFSS experienced observer – SFSS clinical staff). A global linear mixed model (LMM) (part 1) and a cumulative link mixed model (CLMM) (part 2) were used to investigate if factors related to the clinical staff (position, behavioral training, gender) and cats (age, aggression score) influenced the Delta or clinical staff's SFSS score respectively. As this study was a multicenter trial, we also controlled for the clinic effect (random effect) to avoid potential pseudo-replication

Simplified Feline Stress Scale		
1 **Low stress**	**2** **Moderate stress**	**3** **Marked stress**
The cat shows no behavioral sign of stress. The rectal temperature is easily measured.	The cat shows some behavioral signs of stress. The cat may begin to demonstrate avoidance behaviors during the rectal temperature measurement.	The cat shows marked behavioral signs of stress. Measuring the rectal temperature requires more than 1 attempt or additional restraint.
• Laying on side or back, sitting • Abdomen exposed or not • Slow or normal ventilation • Legs fully extended or bent • Tail extended, loosely wrapped, upwards or loosely downwards • Blinking slowly or eyes normally opened • Normal pupils • Ears half back or erected towards the front • Whiskers lateral or a little forward • No vocalization • Resting, exploring slowly, or playing • Minimal restraint is needed.	• Laying ventrally, rolled, sitting, standing or moving • Back horizontal or higher in the front than the back • Abdomen not exposed • Normal or rapid ventilation • Legs bent or extended • Tail close to the body, curved backwards, may be twitching, up, tense downwards or curled forward • Eyes normally or widely opened • Normal to dilated pupils • Ears half back, erected towards the front, back, back and forward on head or partially flattened • Whiskers lateral, forward or back • Quiet, meowing, plaintive meow, yowling or growling • Licking nose • Actively exploring or pacing, alert • Trying to escape or to hide • One person is needed to hold the cat.	• Laying ventrally, crouched or standing • Can be shaking • Belly not exposed • Rapid ventilation • Legs bent or extended • Tail close to the body or curled forward • Eyes fully opened • Pupils fully dilated • Ears half back, erected towards the front, back, back and forward on head or partially flattened or fully flattened • Whiskers forward or back • Quiet, meowing, plaintive meow, yowling or growling • Licking nose • Can be panting • Piloerection can be present. • Alert • Pacing • Trying to escape or to hide • At least one person is needed to hold the cat. • More than 1 attempt needed to measure temperature

Fig. 2. Simplified Feline Stress Scale used by the experienced observer before, during, and after the rectal temperature measurement and by the clinical staff during the rectal temperature measurement.

bias. A generalized linear mixed model (GLMM) was used to test the effect of the cat's age on whether or not they were sterilized (part 2). Linear models (LM) were used to test the effect of the experienced observer's (part 1) and the clinical staff's (part 2) SFSS score on the temperature of the cats. The normality of the distribution of the data for the temperature variable as well as the homogeneity of variances between the groups had to be respected and tested respectively via a Shapiro-Wilk and a Levene test. Linear models were also used to verify whether medication, age and sex of the cat and factors related to the clinical staff influenced temperature, and time of restraint. For the aggression and SFSS scores, cumulative linkage models (CLMs) were used to test the effect of explanatory variables. Cumulative linkage models also served to examine if they were any differences between the cat's stress score during the three times of assessment (before, during, and after the rectal temperature measurement) (Hessian matrix = 56). Finally, to test whether there was an effect of the CSS on the Delta, we used a non-parametric Kruskal-Wallis test. Data of the two first parts of the study were analyzed using Microsoft Excel and R statistical software (version 4.0.3). Statistical significance was set at $P < 0.05$ for all the analyses.

Descriptive data was also presented: percentage of cats with abnormal temperature, percentage of different SFSS levels, percentage of cats in which the therapeutic plan was affected by the temperature value, and reasons why veterinarians chose to change their plans based on rectal temperature values. Means were reported in the result section with their associated standard deviations. Answers to the online survey's open-ended question were analyzed with a summative content approach using keywords.

Results

Animal

One hundred cats were enrolled in part 1 of the study: 53 females (20 intact and 33 spayed) and forty-seven males (18 intact and 29 neutered). Mean age was 2.5 years (+/- 3.6 years; range, 0.04–15.0 years; median, 0.6 years) (Table 1) and 7% (n = 7; gabapentin n = 4, fluoxetine n = 2, butorphanol n = 1) had received medication to reduce their stress before the veterinary appointment. Part 2 included 678 cats. Three hundred and fifty-seven females (217 intact and 140 sterilized) and three hundred and six males (174 intact and 132 sterilized). The sex of fifteen cats was not documented. Mean age was 2.7 years (+/- 3.5 years; range, 0.13–18.0 years; median, 1.0 years) (Table 1) and 1% (n = 7; gabapentin n = 7) had received a pre-visit medication. As expected, there was a

Table 1
Summary statistics for age according to a cat's reproductive status.

Part 1			
Reproductive status	Age range (years)	Age average (years)	+/- SD (years)
Intact female	0.04 – 7.0	0.78	1.51
Spayed female	0.17 – 15.0	3.75	4.33
Intact male	0.04 – 3.0	0.44	0.70
Neutered male	0.17 – 14.0	3.44	3.67
Part 2			
Reproductive status	Age range (years)	Age average (years)	+/- SD (years)
Intact female	0.17 – 7.0	1.08	1.19
Sterilized female	0.25 – 18.0	5.25	4.02
Intact male	0.13 – 8.5	0.72	1.07
Sterilized male	0.19 – 15.0	5.06	4.18

significant positive effect of age on whether the cats were sterilized or not (GLMM, $P < 0.001$).

Clinical staff

Twenty-five staff members participated in part 1 (8 veterinarians, 10 veterinary technicians, 6 veterinary students, 1 receptionist). Clinical staff came from four veterinary clinics with 76% of women (n = 19) and 24% of men (n = 6). Mean age was 34.9 years (+/- 13.0 years) and 36% (n = 9) had received behavioral training to minimize stress related to veterinary care. Ninety-seven staff members (14 veterinarians, 21 technicians in animal care, 62 veterinary students) from eleven clinics were involved in Part 2. Women represented 95% (n = 92) of the clinical staff and 5% were men (n = 5). Mean age was 28.5 years (+/- 8.2 years) and 22% (n = 21) had received prior behavioral training.

Validation of the SFSS and stress assessment

The SFSS was easier and more rapid to use than more complex scales with larger score ranges according to the experienced observer. Cats SFSS scores during the temperature measurement of part 1 were distributed as follows: 20% low stress (SFSS = 1) (n = 20), 47% moderate stress (SFSS = 2) (n = 47), 32% marked stress (SFSS = 3) (n = 32), and 1% (n=1) was not evaluated according to the experienced observer. The cat that was not evaluated was a feral cat and had escaped before examination. No further information was available other than he was an intact male. During part 2, clinical staff reported 38% of cats as experiencing low stress (n = 258), 47% moderate stress (n = 316), 13% marked stress (n = 90), and 2% (n =14) were not evaluated. Among cats with low stress scores (SFSS=1), 90% (n = 18) were under six months of age during part 1. In the sample population as part 2, 43% (n = 110) of cats with low stress scores (SFSS=1) were under six months of age.

The agreement between SFSS scores obtained by clinical staff and the experienced observer was perfect in 74% (n = 74) of the cats with an ICC of 0.71 (F99 = 7.3, $P < 0.001$). Repeatability was therefore good between the two types of observers. Differences between the two observers occurred mainly when cats displayed high stress scores (SFSS = 2 or 3) associated with low aggression scores (AS = 0) (n = 21). According to the Bland-Altman graph (Fig. 3), clinical staff rated the cat's stress lower than the experienced observer ($P < 0.05$). In contrast, the agreement was perfect for cats with the highest level of aggression (AS = 2) (n = 3). Overall, no statistically significant difference was found between factors related to clinical staff (gender, age, position, behavioral training) and to cat (age, aggression score during temperature measurement) for the observed agreement between SFSS scores ($P > 0.10$). However, agreement with the experienced observer tended to be better for clinical staff with behavioral training compared to those without (LMM, $0.05 < P < 0.10$). We also tested whether the result obtained with the CSS had an effect on the agreement between SFSS scores performed by different observers (Deltas). According to the SFSS, a CSS of 1 or 2 corresponded to the low stress level (SFSS=1); a CSS of 3 or 4 was associated with moderate stress (SFSS=2), and a CSS of 5, 6 or 7 expressed marked signs

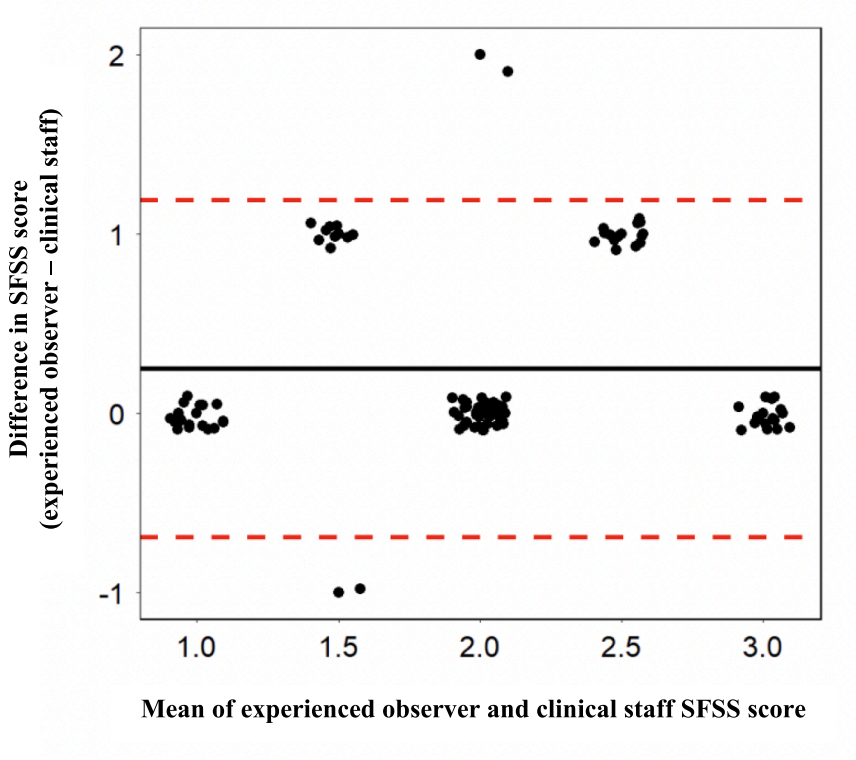

Fig. 3. Bland Altman plots illustrating the difference between the SFSS score assessed by the experienced observer and by the clinical staff. *To facilitate reading, the data points that were overlapping have been shifted from one another. The black line represents the average difference, and the two red lines represent the upper and lower bounds of the 95% confidence interval.*

of stress (SFSS=3). Results showed a significant difference between CSS 5 and score 2, 3 and 4 (Kruskal-Wallis test, respectively $P = 0.001$; $P = 0.037$; $P = 0.007$) (Fig. 4).

The cat's sex, age, reproductive status, and medication received were not associated with the value of the aggression score. However, younger cats tended to have lower SFSS stress scores in part 1 (LM, $P = 0.059$). A statistically significant difference was also observed between the SFSS score and the cat's reproductive status. Intact male cats had lower SFSS scores than other cats (LM, $P = 0.001$ part 1; CLMM, $P < 0.001$ part 2). During part 2, we noticed that sterilized cats had significantly higher SFSS scores than non-sterilized ones (CLMM, $P = 0.014$).

To test if the stress assessment can be evaluated by the clinical staff at any moment of the examination during part 2, we analyzed the CSS before the temperature measurement and the CSS after the temperature for each cat of part 1. Eight cats had an increased CSS score after the procedure of temperature measurement, but this was not statistically significant ($P = 0590$).

Evaluation of the relevance of the temperature measurement in part 1 and 2

The mean temperature was 38.2°C (± 0.7°C) (100.8°F (± 1.3°F)) (n=99) and 38.5°C (± 0.5) (101.3°F (± 0.9)) (n=615) for parts 1 and 2 respectively. The mean duration of restraint needed for the temperature measurement was 31 s (± 17 s). No difference was found between factors related to the cats (sex, age, reproductive status, medication) and the duration of restraint. The SFSS scores were not associated with duration of restraint.

Temperature measurements were determined to be abnormal in 4 % (n = 4) of cats in part 1 and in 2% (n = 15) in part 2. Temperature occurred to be rarely abnormal according to the clinical staff (2% in part 1 and 2 combined, n = 19). Seventy-nine percent of cats with an elevated temperatures had moderate (SFSS 2; n = 11 cats) to marked (SFSS 3; n = 4 cats) signs of stress. Based on the temperature value and normal physical examination, no change in the therapeutic plan was made for any cat. Clinical staff commented that no change was made as they considered the increase in temperature to be due to stress (n = 12) or gave no reason (n = 7).

Sex, age, and reproductive status did not affect the value of temperature in part 1. However, in part 2, male cats had a significantly lower rectal temperature (LMM, $P < 0.001$). A significant negative correlation was found between cat age and temperature (LMM, $P < 0.001$). Cats receiving medication prior their veterinary examination (n = 7) had significantly (part 1) or tended to have (part 2) lower rectal temperature (LM, $P = 0.034$ part 1; LMM, $P = 0.053$ part 2). Finally, cats with lower stress levels (SFSS = 1) had significantly lower rectal temperatures than cats with moderate signs of stress (SFSS = 2) (LM, $P = 0.009$ part 1, $P = 0.026$ part 2) and marked signs of stress (SFSS = 3) (LM, $P = 0.026$ part 2) (Table 2).

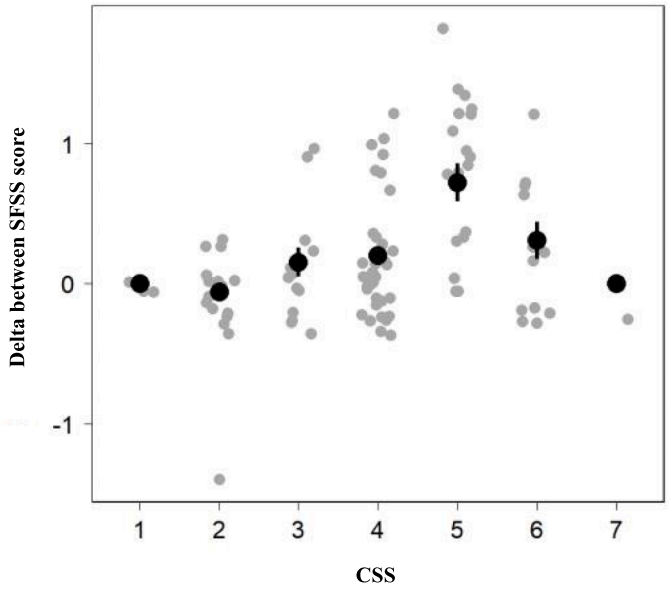

Fig. 4. Mean (± SD) of Deltas (SFSS experienced observer - SFSS clinical staff) according to CSS during the temperature measurement.

Online survey

One hundred and seventy-six veterinarians answered the online survey. Eighty percent of veterinarians (n = 141) responded that they did not change the therapeutic plan based on the value of rectal temperature in a healthy but stressed cat compared to 20% (n = 36) who did. Veterinarians who opted for a potential change in therapeutic plan, did it by fear of missing an underlying pathology. Of these, 8% (n =3) specified that it depended on whether the cat went outside (n = 3), 8% on if it was a kitten (n = 3), 39% (n = 14) on if the temperature was > 40°C, and 45% (n = 16) did not specify.

Discussion

This study examined feline stress during a routine veterinary examination and its association with the rectal temperature measurement in order to determine its clinical relevance. Veterinary appointments were associated with moderate to marked signs of stress in 62% of cats in parts 1 and 2 combined. Cats with moderate to marked signs of stress had higher rectal temperatures than cats with low signs of stress. These results support the assumption that stress may affect some physiologic parameters including temperature (Rand et al., 2002; Quimby et al., 2009). Past studies have also reported that rectal temperature measurement is an invasive and stressful procedure (Michaud, 1996; Kunkle et al., 2004). Additionally, clinical relevance of this measurement in healthy cats was found to be low in our study. Despite the fact that 20% of veterinarians surveyed in part 3 indicated that they could consider changing their therapeutic plan based on a high rectal temperature, no such change occurred in the clinical parts of our study. These findings suggest that we should question the relevance of taking the rectal temperature of healthy but stressed cats since no change is made subsequently, even if the measured temperature is considered abnormal. This result is consistent with the study by Costa et al. (2022) in which veterinarians were questioned on the benefits of the rectal temperature measurement. Participating veterinarians responded that temperature results rarely affected the decision-making process of a healthy animal's examination (Costa et al., 2022). Consequently, our results suggest that abnormal temperatures in healthy cats may be considered as a consequence of stress rather than a sign of an underlying condition. In order to

Table 2
Summary statistics for rectal temperature measurements according to the SFSS score.

Part 1			
SFSS score	Temperature range (°C)	Temperature average (°C)	+/- SD (°C)
Low stress (1)	37.1 – 38.7	37.8	0.49
Moderate stress (2)	36.8 – 40.0	38.4	0.68
Marked stress (3)	36.1 – 39.3	38.1	0.69
Part 2			
SFSS score	Temperature range (°C)	Temperature average (°C)	+/- SD (°C)
Low stress (1)	36.2 – 39,9	38.4	0.52
Moderate stress (2)	36.4 – 39.9	38.5	0.52
Marked stress (3)	37.3 – 40.0	38.6	0.57

improve to welfare, rectal temperature may no longer be routinely measured in healthy stressed cats.

The relationship between the cat's age and the assigned stress score was not statically significant. However, it is noteworthy that amongst calm cats (SFSS = 1), 46% were under six months age. This could be considered a clinically significant difference as younger cats had a tendency to show lower stress levels. A statistically significant correlation was seen between intact male cats, low signs of stress and lower temperature values. Interestingly, the mean age of intact male cats was under six months (Table 1). A likely interpretation of this result is that younger cats were not sterilized yet. Therefore, the difference between the SFSS score and the rectal temperature may be due to age and not to reproductive status. This study also showed that sterilized cats were older and showed more signs of stress than intact cats. Based on these results, stress related to veterinary care appears to increase with the cat's age and, consequently, with the number of veterinary visits. A kitten's first examination can be decisive. One negative experience can lead to generalized fear associated with veterinary care which may persist into adulthood (Lloyd, 2017). Low stress approaches are thought to prevent the development of a cat's stress related to veterinary care by creating a first positive experience (Lloyd, 2017). Although this was not the primary objective of this study, the results obtained support the use of stress reducing techniques, particularly in young cats.

The suggestion that a cat's stress increases with age would mean that the temperature of older cats should also be higher. However, this finding is not consistent with the significant negative correlation found between cat age and temperature. These results may be explained by the fact that there were more values from young cats, implying more variability, and therefore possible error.

The SFSS score distribution during parts 1 and 2 had the same percentage of cats assessed to have moderate stress (SFSS = 2), which was around 50%. However, during part 2 more cats were assessed to have a low stress score (SFSS = 1) than during part 1. This observation is interesting but does not necessarily mean that the cats were less stressed during this part of the study. The actual number of stressed cats may have been underestimated. Staff could choose not to obtain the rectal temperature if a cat showed excessive signs of stress. Consequently, many forgot to perform a stress score as well even if the staff noted in the form that the temperature was not measured because the cats were too stressed. On the other hand, during part 1, the experienced observer was present during the examination and ensured that all data was documented. The difference may also be due to the fact that during part 2 there were more intact, and therefore younger cats that showed fewer signs of stress.

This study tended to show better agreement between the experienced observer's stress assessment than the one obtained by clinical staff with behavioral training. By using low stress approaches, clinical staff will achieve greater patient cooperation (Yin, 2009; Lloyd, 2017). The staff's understanding of the cat's body language and detection of fear and anxiety can prevent aggression (Rodan, 2010). Differences in stress assessments between observers occurred mostly when cats had low aggression scores. This suggests that cat stress is often evaluated according to aggressive behavior as seen by the clinical staff and therefore the cat's physiological fear response of freezing is frequently misinterpreted. Veterinarians should be mindful that due to the prey nature of these animals, stressed cats in clinical contexts tend to respond first by freezing before fleeing or fighting (Tsyrlin et al., 1983; Harvey and Tasker, 2013; Bennett et al., 2017).

According to our scale, a CSS of 1 or 2 corresponded to a low stress level (SFSS=1); a CSS of 3 or 4 was associated with moderate stress (SFSS=2), and a CSS of 5, 6 or 7 expressed marked signs of stress (SFSS=3). A score of 5 on the CSS scale represents the lowest value possible for the marked stress level on the SFSS scale. The agreement between the staff and experienced observers in part 1 was significantly reduced when cats were assessed with a CSS of 5 by the experienced observer. Clinical staff had a tendency to underestimate a cat's signs of stress (Fig. 4). This finding may be attributed to the difficulty in correctly assessing stress when signs are not extreme. Bennett et al. (2017) research has reported the complexity of the cat's facial expressions (Bennett et al., 2017). Recognition of fear and anxiety signals is crucial and may require behavioral training to achieve. Kessler and Turner (1997) had already expressed to difficulty to distinguish highly stressed cats that shows little activity and non-stressed cats. To avoid misinterpretation, they suggested to use scale of scoring with detailed descriptions of body language such as the CSS (Kessler and Turner, 1997).

As an additional point of interest in our study, cats who received medication to reduce their stress before the veterinary exam had significantly lower rectal temperatures. A previous clinical study by van Haaften et al. (2017) has shown that gabapentin can be used as an anxiolytic for cats prior to veterinary visits (van Haaften et al., 2017). Gabapentin was also used in the study of Pankratz et al. (2017) to attenuate fear responses in cage-trap confined community cats (Pankratz et al., 2017). However, there is no scientific evidence that anxiolytic medication has an effect on the rectal temperature. Considering that gabapentin reduces stress, and that stress can increase the value of temperature, these findings suggest that the lower temperatures in cats that had received this medication could be due to stress reduction (Quimby et al., 2011; Erickson et al., 2021).

Factors that could have affected the outcome of this study include a potential bias due to the volunteer-based selection of participating clinics and veterinarians for the online survey.

Additionally, several veterinary clinics have already stopped taking the rectal temperature for routine examinations or now use alternative methods such as auricular temperature measurement, although most studies concluded that ear temperature does not correlate tightly with rectal temperature (Michaud, 1996; Kunkle et al., 2004). Hence, many clinics did not meet the inclusion criteria for the study. Within the participating clinics, cats with marked signs of stress often did not have their temperature taken to minimize the risk of aggression. Accordingly, this study may underestimate the number of cats experiencing stress in the entire population.

Participation of the experienced observer in part 1 added a person in the consultation room which may have affected the cat's attitude.

Because they knew they were being observed, the staff's interaction with the cats could have altered. However, since most of the time the experienced observer was replacing the technician to help with the handling, this effect was likely minimal. Most of the time the temperature was taken at the end of the physical examination so that the clinic routines were not disrupted; however, order of temperature was not standardized. The effect of stress increases throughout the examination so timing of temperature measurement may be relevant.

Finally, the statistical power was not sufficient to demonstrate possible correlations between factors related to staff and stress assessment.

Conclusion and clinical relevance

In conclusion, the Simplified Feline Stress Scale proved to be functional and could be used in veterinary clinics to detect feline stress rapidly. Behavioral training increased the ability of clinical staff to correctly detect the cat's body language and therefore is relevant to veterinary care. Findings of the present study support that high rectal temperature in healthy but stressed cats during a routine veterinarian examination do not lead to any changes in the therapeutic plan. According to those findings in this specific situation, veterinarians could use their professional judgment and choose to not take the rectal temperature in order to improve the cat's welfare.

Ethical considerations statement

After evaluation of the project prior to the study, no ethical

certificate was deemed necessary by the Animal Care and Use Committee of the University of Montreal which operates under the auspices of the Canadian Council on Animal Care (animal procedures), and by the Science and Health Research Ethics Committee (human personal data) due to its observational nature.

CRediT authorship contribution statement

Bazin Isabelle: Writing – review & editing, Conceptualization. **Desmarchelier Marion:** Writing – review & editing, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Bigras-Fontaine Claudel:** Writing – original draft, Visualization, Validation, Software, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: This study was financially supported by a Fear Free Research grant. The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

Tristan Juette, PhD, for the statistical analyses and Yasmeen Prud'homme for her thorough revision of the manuscript.

Appendix

Appendix 1: Example of the form that clinical staff had to answer for each cat participating in parts 1 and 2 of the study.

Date:	Name:		Sex: M / MS / F / FS	Age:	
1		2	3		Initials
Rectal temperature	°C	Not measured ☐ → why?			
Rectal temperature considered normal?			Yes	No	
If not, did you change the therapeutic plan?			Yes	No	
Why/how did the abnormal temperature affect the therapeutic plan/clinical outcome?					

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