Title

Severity of Nasal Inflammatory Disease Questionnaire for Canine Idiopathic Rhinitis Control: Instrument Development and Initial Validity Evidence

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Severity of Nasal Inflammatory Disease Questionnaire for Canine Idiopathic Rhinitis Control: Instrument Development and Initial Validity Evidence

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Background: Effective treatments are needed for idiopathic chronic rhinitis in dogs, but assessment of efficacy requires a practical, quantifiable method for assessing severity of disease.

Objectives: To develop and perform initial validity and reliability testing of an owner-completed questionnaire for assessing clinical signs and dog and owner quality of life (QOL) in canine chronic rhinitis.

Animals: Twenty-two dogs with histopathologically confirmed chronic rhinitis and 72 healthy dogs.

Methods: In this prospective study, an online questionnaire was created based on literature review and feedback from veterinarians, veterinary internists with respiratory expertise, and owners of dogs with rhinitis. Owners of affected dogs completed the questionnaire twice, 1 week apart, to test reliability. Healthy dogs were assessed once. Data were analyzed using the Rasch Rating Scale Model, and results were interpreted using Messick's framework for evaluating construct validity evidence.

Results: Initial item generation resulted in 5 domains: nasal signs, paranasal signs, global rhinitis severity, and dog's and owner's QOL. A 25-item questionnaire was developed using 5-point Likert-type scales. No respondent found the questionnaire difficult to complete. Strong psychometric evidence was available to support the substantive, generalizability, content, and structural aspects of construct validity. Statistical differences were found between responses for affected and control dogs for all but 2 items. These items were eliminated, resulting in the 23-item Severity of Nasal Inflammatory Disease (SNIFLD) questionnaire.

Conclusions and Clinical Importance: The SNIFLD questionnaire provides a mechanism for repeated assessments of disease severity in dogs with chronic rhinitis.

Key words: Lymphoplasmacytic; Psychometrics; Survey.

Chronic idiopathic rhinitis (chronic rhinitis) in dogs is a disease of high morbidity of dogs that adversely affects owners. Profuse and viscous nasal discharge, congestion, sneezing, and other signs related to nasal inflammation are common. Dogs are treated with a multitude of drugs in an attempt to ameliorate signs, but often with little, or only temporary, success.[1–3] Newer anti-inflammatory drugs and topical drug delivery systems hold promise for controlling clinical signs of rhinitis, thus providing relief to dogs and their owners. However, there are no practical, quantifiable means

Abbreviations:

chronic rhinitis	chronic idiopathic rhinitis
NCSU	North Carolina State University
QOL	quality of life
RCAT	Rhinitis Control Assessment Test
RRSM	Rasch Rating Scale Model
SNIFLD	Severity of Nasal Inflammatory Disease

to determine the effectiveness of such treatments and their value to the veterinary community.

A well-designed client-completed questionnaire can provide a quantifiable method for monitoring severity of disease and would be ideal for assessing effectiveness of treatments for rhinitis. The predominant clinical signs and client concerns are readily observed without specialized training or testing. A measure of disease severity could be determined at multiple time points without repeated hospitalizations, expensive procedures, or risk. Widespread acceptance of the instrument could allow for comparisons between studies. Further, such a questionnaire would be valuable for monitoring response to treatment in individual dogs.

The goal of this study was to create a well-designed questionnaire for owners that would provide a valid, quantifiable assessment of severity of chronic rhinitis in dogs, the Severity of Nasal Inflammatory Disease (SNIFLD) questionnaire. Such a questionnaire would allow accurate comparisons of disease severity in dogs before and after specific treatments, making it a valuable tool for prospective treatment trials. Creation of a well-designed questionnaire requires an iterative process, including peer-reviewed item development and rigorous

psychometric evaluation. A primary tenet is to model the new questionnaire after an established instrument.[4–7] As this will be the first questionnaire for assessing severity of rhinitis in dogs, this study was modeled after the Rhinitis Control Assessment Test (RCAT) for people.[8–10] Psychometric evaluation of the SNIFLD was conducted using the Rasch Rating Scale Model (RRSM), a measurement model from the item response theory family of psychometric models that explores data structures and response patterns of observed data against model-specific requirements. Rasch models are considered by many to be the "gold standard" measurement approach for survey validation studies.[11–13]

Materials and Methods

Qualitative Development of the Preliminary Instrument

Item Generation. Candidate questions were identified through textbook and scientific literature review, including veterinary literature addressing rhinitis in dogs and cats, and articles describing questionnaires for assessing quality of life (QOL) and clinical signs of people with rhinosinusitis,[2,3,8,14–21] interviews with owners of dogs with chronic rhinitis, interviews with veterinary internists with respiratory expertise, and a panel discussion with internal medicine residents.

Owners of dogs with chronic rhinitis were identified through a search of the North Carolina State University (NCSU) Veterinary Hospital histopathology database using the search term "rhinitis." Dogs were included that had a diagnosis of lymphoplasmacytic rhinitis, with or without concurrent neutrophilic or eosinophilic rhinitis, and no evidence of neoplasia, fungal infection or other primary etiology based on CT, rhinoscopy, and histopathology. Dogs were excluded if their owners could not be reached or declined to participate. Twenty-six owners were interviewed by phone by 1 investigator (JB) and asked a series of predetermined, open-ended questions related to their dog's clinical signs and overall health. Responses were recorded in writing, documenting specific terminology used by the client.

Interviews were conducted with 6 internists with respiratory expertise by 1 of 2 investigators (LG, EH) asking open-ended questions about the expert's experiences with dogs with rhinitis and their owners. Experts were selected based on board certification by the American College of Veterinary Internal Medicine (Small Animal Internal Medicine) and authorship of articles, book chapters, or both related to nasal disease. Geographical diversity within the United States and Canada and representation from academic and private practice were considered in their selection. Similarly, a panel of 6 NCSU internal medicine residents in their second and third year described their experiences. Responses were recorded in writing and confirmed with the interviewees.

The RCAT[8] was used as the model for questionnaire design, with a 5-point Likert scale created for each item. Items with identical response categories were grouped into matrices, with remaining items as single questions. The items were loaded into an online commercial survey platform, accessible by computer, tablet, or smartphone.[a]

Evaluation of Initial Items by Content Experts. Additional questions were inserted to allow content experts to assess each item using the online platform. The content experts were a diverse group of 20 veterinarians that included the respiratory experts. Represented were internists in academic (n = 10) and private practice (n = 1), internal medicine residents (n = 3), and general practitioners (n = 6). Experts were from geographical regions throughout the United States and Canada. Content experts were asked to respond whether each item was appropriate and relevant, and if the rating scale was appropriate. Additional comments were welcomed. Items were modified, based on this feedback, and a preliminary instrument was created.

Testing for Clarity and Ease of Use. To confirm that the preliminary instrument was unambiguous, understandable, and easy to complete, 6 owners of reportedly healthy dogs were interviewed by 1 investigator (EH) and observed while viewing the questionnaire online. The owners were asked to "think aloud" about what the items were asking. On completion, they were asked how easy they found the questionnaire to use.

In addition, the preliminary instrument was evaluated for readability by measuring the Flesch Reading Ease test and the Flesch-Kincaid Grade level test using commercially available software.[b] Higher scores of the Flesch Reading Ease test indicate that the subject is easier to read, whereas lower scores of the Flesch-Kincaid Grade level test indicate greater readability. For both tests, scores are determined by the ratios of total words to total sentences and total syllables to total words.

Psychometric and Statistical Evaluation of the Preliminary Instrument

To evaluate the psychometric properties of the preliminary instrument, the questionnaire was completed by owners of dogs with chronic rhinitis (rhinitis group) and owners of healthy dogs (control group). Within the control group, a subset of dogs was matched by age, weight, and muzzle length to the rhinitis group (matched control group). Owners of rhinitis dogs completed the questionnaire a second time, approximately 1 week later, to evaluate test–retest reliability. Responses were used for the psychometric evaluation of validity, and inferential statistical analyses were performed to compare substantive results across the groups. To confirm owner acceptance, a question was added to the preliminary instrument regarding ease of questionnaire use. Based on the results of these analyses, a revised questionnaire (SNIFLD questionnaire) was designed.

Study Groups. Owners of dogs diagnosed with chronic rhinitis at NCSU were identified as for item generation but were excluded if their dog did not have active signs of rhinitis. One additional dog was included that met the criteria but was evaluated elsewhere. Owners of healthy dogs were recruited by group e-mail to faculty and staff of the NCSU College of Veterinary Medicine. Questionnaires were completed by a member of the household that was not a veterinarian or veterinary technician. Preliminary questions were added to the questionnaire to confirm that the dog had no major health problems, seasonal allergies, nose or lung disease, or any other respiratory disease within the past 2 years. Any "yes" response resulted in exclusion. A healthy dog was matched to each dog in the rhinitis group by owner reported muzzle length ("extra short" [brachycephalic], "medium" [mesocephalic], or "extra long" [dolichocephalic]), body weight (within 10 kg), and age (within 2 years).

Psychometric Evaluation. As there was very little variation between the 2 surveys completed by the rhinitis group (see Results: Substantive Analysis of Responses), the second set of responses was arbitrarily selected for further testing. To conduct the evaluation procedure, the RRSM was used.[11–13] Psychometric analyses were conducted using Winsteps measurement software.[c] Construct validity was evaluated according to the framework for construct validity presented by Messick.[22] Messick's framework for validity essentially states that validity is a uniformed concept and consists of 6 unique "aspects": substantive, generalizability, content, structural, external, and consequential.

Substantive Analysis of Responses. Comparisons were made between responses from the first and second questionnaires from

the rhinitis group. Responses from the second questionnaire were then compared with responses from the full control group and from the matched control group. Questions with identical response categories were compared using independent samples *t*-tests for the full control group and paired samples *t*-tests for the matched control group. A Bonferroni correction was applied to control for compounding error due to multiple comparisons. Thus, the traditional *P*-value of .05 was reduced to .0031 as the criterion for statistical significance. Chi-square tests (χ^2) were used for comparisons of responses between groups to single questions with unique response categories.

Results

Qualitative Development of the Preliminary Instrument

Twenty-four items were initially created that fell under 5 domains: nasal signs, paranasal signs, global rhinitis severity, dog's QOL, and owner's QOL. (Table 1) Observations reported by owners of dogs with chronic rhinitis were similar and were in general

Table 1. Mean responses by group to items of the preliminary instrument and comparisons with the second survey of the rhinitis group.

Item	Domain	Rhinitis 2nd Survey (n = 22) Mean (SD)	Control (n = 72) Mean (SD)	P^a	Matched Control (n = 22) Mean (SD)	P^a	Rhinitis 1st Survey (n = 22) Mean (SD)	P^a
Rating scale Never (1) to Extremely often (5)								
Snot from the nose[b]	Nasal	3.64 (0.95)	1.18 (0.45)	<.001	1.36 (0.58)	<.001	3.64 (1.40)	1.00
Any blood[c]	Nasal	1.27 (0.46)	1.00 (0.00)	<.001	1.00 (0.00)	.011	1.23 (0.43)	.67
Redness of eyes	Paranasal	1.96 (0.90)	1.35 (0.65)	.006	1.32 (0.72)	.019	1.82 (0.85)	.42
Sneezing[b]	Nasal	3.41 (0.80)	1.76 (0.93)	<.001	1.77 (0.87)	<.001	3.68 (0.95)	.056
Snoring while sleeping	Nasal	3.14 (1.04)	2.51 (1.35)	.027	2.41 (1.26)	.11	3.18 (1.10)	.75
Snoring while awake[b]	Nasal	3.00 (1.20)	1.54 (1.06)	<.001	1.50 (1.01)	.001	3.23 (1.41)	.33
Congested sound[b]	Nasal	3.00 (1.27)	1.11 (0.32)	<.001	1.14 (0.35)	<.001	2.91 (1.19)	.74
Blown snot when sneezing[b]	Nasal	3.64 (1.22)	1.24 (0.57)	<.001	1.32 (0.65)	<.001	3.91 (1.27)	.19
Coughing/hacking[b]	Paranasal	3.23 (1.19)	1.32 (0.78)	<.001	1.32 (0.78)	<.001	3.18 (1.18)	.80
Wipe nose[b]	Nasal	3.36 (1.26)	1.07 (0.31)	<.001	1.18 (0.50)	<.001	3.41 (1.44)	.83
Snot around home[b]	Nasal	3.55 (1.22)	1.00 (0.00)	<.001	1.00 (0.00)	<.001	3.50 (1.34)	.75
Difficulty breathing at rest[b]	Nasal	2.82 (1.01)	1.06 (0.29)	<.001	1.05 (0.21)	<.001	2.96 (0.95)	.45
Difficulty breathing when active[b]	Nasal	3.09 (1.02)	1.18 (0.64)	<.001	1.09 (0.43)	<.001	3.27 (0.98)	.10
Difficulty breathing while asleep[b]	Nasal	2.86 (1.08)	1.15 (0.52)	<.001	1.05 (0.21)	<.001	2.82 (1.10)	.79
Kept from activities with dog[b]	Nasal	2.32 (1.32)	1.07 (0.35)	<.001	1.09 (0.43)	.001	2.23 (1.11)	.67
Interfered with owner's sleep[b]	Owner QOL	3.05 (1.29)	1.18 (0.56)	<.001	1.09 (0.43)	<.001	2.96 (1.25)	.65
Rating scale Not at all (1) to Extremely (5)								
Bothered you to clean snot from nose[b]	Owner QOL	2.05 (1.05)	1.00 (0.00)	<.001	1.00 (0.00)	<.001	2.09 (1.19)	.75
Bothered you to clean snot from house[b]	Owner QOL	2.14 (1.13)	1.00 (0.00)	<.001	1.00 (0.00)	<.001	2.36 (1.14)	.057
Worried about dog[b]	Owner QOL	3.27 (1.24)	1.04 (0.26)	<.001	1.09 (0.43)	<.001	3.68 (1.29)	.071
Rating scale Excellent (1) to Terrible (5)								
Dog's QOL[b]	Dog QOL	2.59 (0.85)	1.17 (0.41)	<.001	1.09 (0.29)	<.001	2.59 (0.80)	1.00
Owner's QOL[b]	Owner QOL	2.50 (0.74)	1.11 (2.50)	<.001	1.09 (0.29)	<.001	2.50 (0.86)	1.00
Single Questions								
Reverse sneeze, only revealed if familiarity with concept confirmed. Scale: Never (1) to extremely often (5)[b]	Nasal	3.00 (1.47)	1.20 (0.40)	<.001	1.21 (0.43)	.002	3.07 (1.27)	.86
Consistency of snot. Scale: no snot (1) to very thick (5)[b]	Nasal	3.45 (1.10)	1.15 (0.36)	<.001	1.23 (0.43)	<.001	3.45 (1.22)	1.00
Color of snot. Scale: clear, white, yellow, green, red[d]	Nasal	NA	NA	NA	NA	NA	NA	NA
Overall severity of nasal disease. Scale: no clinical symptoms (1) to very severe (5)[b]	Nasal	3.18 (0.73)	1.07 (0.31)	<.001	1.05 (0.21)	<.001	3.14 (0.83)	0.67

SD, standard deviation; QoL, quality of life.
[a]*P* values when compared with second survey of rhinitis dogs.
[b]*P* < .0031 for comparisons between either control group and rhinitis dogs (Bonferroni correction applied to traditional P < .05 to control for compounding error due to multiple comparisons).
[c]*P* < .0031 for comparisons between full control group and rhinitis dogs (Bonferroni correction applied as described in footnote b).
[d]See text for comparisons between groups.

agreement with those reported in the literature. Respiratory experts unanimously mentioned nasal discharge and sneezing as classic signs. Other signs mentioned by 3 or more experts included reverse sneezing, and nasal discharge characteristics of unilateral or bilateral, serosanguinous, yellow-green in color, and potentially having a component of epistaxis. Owners frequently used the term "snot" (9 of 26 respondents), 4 mentioned "congestion," and 5 perceived their dog having difficulty breathing. With respect to QOL issues, owners more often considered their own QOL to be decreased (n = 16), compared with a decrease in their dog's QOL (n = 6), and owners provided comments under these categories that generated specific items related to QOL for the questionnaire.

To simplify completion by owners, matrices were created for questions with identical response categories, regardless of domain. Questions requiring unique response categories were left separate. Matrices and individual questions were preceded with instructions to consider the previous 48 hours in selecting responses.

Each of the initial 24 items was considered relevant by 95% or more of content experts and appropriately presented by 80% or more. Minor modifications were made in response to comments, resulting in a preliminary instrument with 25 items and a comment box. The question regarding frequency of reverse sneezing was adjusted so that owners would not see the item unless they responded affirmatively to understanding the concept.

This preliminary instrument was readily understood and was considered easy or very easy to complete by the 6 owners of healthy dogs. The Flesch Reading Ease score of the questionnaire was 73.3 (corresponding with a 7th grade reading level), and the Flesch-Kincaid Grade level was determined to be 6.3 (corresponding with the number of years of education required to understand the questionnaire).

Study Populations

The rhinitis group comprised 22 owners. The represented dogs were 4 mixed breed dogs, 3 beagles, 3 dachshunds, 2 Siberian huskies, and 1 each of the following: Australian cattle dog, Bernese mountain dog, Brittany spaniel, Dutch shepherd, Jack Russell terrier, mastiff, Pembroke Welsh corgi, shih tzu, Wheaten terrier, and Yorkshire terrier. The median age was 10.3 years (range, 3.5–15.0 years). The median body weight was 16.1 kg (range, 4.1–40.9 kg). Nineteen dogs were mesocephalic, 2 were dolichocephalic, and one was brachycephalic.

The control group comprised 72 owners. Dogs had a median age of 8 years (range 0.5–14.0 years). Median body weight was 19.5 kg (range, 2.7–47.3 kg). Fifty-eight dogs were mesocephalic, 8 were dolichocephalic, and 5 were brachycephalic. Matched healthy dogs had a median age of 9.0 years (range 3.0–14.0 years) and median weight of 14.1 kg (range 2.7–47.3 kg).

Ease of Questionnaire Use

Owners of dogs in the rhinitis group rated the questionnaire as "very easy" (n = 15), "easy" (n = 6), or "neutral" (n = 1). The control group provided similar ratings ("very easy," 50; "easy," 17; "neutral," 3; no response, 1), $\chi^2(2) = 0.09$, $P = .96$.

Psychometric Properties

The substantive aspect of validity was investigated by performing a principal components analysis (PCA) of standardized residual correlations as outlined by Linacre.[23] A great deal of variance was explained (95%): 58.1% by the respondents' measures, and 36.6% by the items. Analysis of the generalizability aspect of validity indicated high levels of score reproducibility (Cronbach's alpha reliability estimate, 0.91).[24] The content aspect of validity was assessed by evaluating mean square fit statistics. Overall infit and outfit mean square fit statistics approximated ideal values of 1.00 for both persons (both infit and outfit, 0.99) and items (1.00 and 0.99, respectively), indicating excellent data-to-model fit. Wright, et al.[25] recommended mean square fit statistics should range between .60 and 1.40 for exceptional measures of fit. Item mean square fit statistics ranged between .62 and 1.59, indicating excellent item fit. The structural aspect of validity was assessed by investigating rating scale diagnostics. According to Linacre,[26] category measures should advance in a stepwise manner with the direction of the scale. Measures of −2.79, −1.35, −0.12, 1.32, and 3.04 confirm adequate rating scale functioning, indicating dog owners were able to appropriately interpret the meaning of the scale and also made full use of the various rating scale categories.

Substantive Analysis of Responses

Responses by owners in the rhinitis group to each item were compared between the first and second times the questionnaire was completed, and no significant differences were identified (Table 1). Cronbach's alpha reliability estimates of 0.926 on the first administration and 0.929 on the second administration confirmed that responses regarding rhinitis signs were very stable over the duration of 1 week. Subsequent comparisons with the control groups were arbitrarily made using the second survey completed by owners in the rhinitis group.

The first matrix of questions used a rating scale with the following values: 1 = never, 2 = rarely, 3 = sometimes, 4 = often, and 5 = extremely often (Table 1). Of 16 items, 14 were significantly different between the rhinitis and full control groups, and 13 were significantly different between the rhinitis and matched control groups. Redness of eyes and snoring during sleep were not different for either comparison. Of 72 dogs in the control group, 50 had some snoring during sleep. Only 4 of these 50 dogs were brachycephalic. Presence of blood in nasal discharge was not different when comparing rhinitis cases to matched controls but was

different when comparing rhinitis cases with all controls. As blood was also mentioned as an important consideration by several experts, this item was retained in the final questionnaire.

Three items comprised the second matrix, using the values: 1 = not at all, 2 = a little, 3 = some; 4 = quite a lot, and 5 = extremely. Two items comprised the third matrix, using the values: 1 = excellent, 2 = good, 3 = fair, 4 = poor, and 5 = terrible. All items in both matrices showed significantly different results between the rhinitis group and both control groups.

The remaining 4 items were single questions. Dog owners that were familiar with the concept of reverse sneezing were asked to approximate how often they heard their dog reverse sneeze. The 41 owners in the control group who were familiar reported they "never" (n = 33) or only "rarely" (n = 8) heard their dog reverse sneeze. The 14 owners in the rhinitis group who were familiar reported much more reverse sneezing. Six owners reported "rarely" or "never" hearing reverse sneezing, 2 indicated "sometimes," 4 indicated "often," and 2 indicated "extremely often." These responses were significantly different ($\chi^2(4) = 33.7$, $P < .001$).

Dog owners were also asked about the consistency and color of the "snot." Owners in the control group indicated their dogs either had "no snot" at all (n = 61), or that it was "watery" and "clear" (n = 11). In contrast, all owners in the rhinitis group reported their dogs produced snot, with 5 describing it as "watery," 7 as "slightly thick (like syrup)," 5 as "moderately thick (like honey)," and 5 as "very thick (like rubber cement)." These results were significantly different, $\chi^2(4) = 74.8$, $P < .001$. Snot color also differed significantly, with only 6 rhinitis dogs having "clear" snot, compared to 10 with "white," 4 with "yellow," and 2 with "green" snot, $\chi^2(4) = 15.5$, $P = .001$.

Lastly, owners were asked to rate the overall severity of their dog's nasal disease as 1 = no signs, 2 = mild, 3 = moderate, 4 = severe, and 5 = very severe. Owners in the control group ($M = 1.07$, SD = 0.31) reported significantly lower ratings than owners in the treatment group ($M = 3.18$, SD = 0.73), $t(91) = -13.1$, $P < .001$.

Severity of Nasal Inflammatory Disease Questionnaire

Based on a failure to discriminate between dogs with rhinitis and healthy dogs, 2 items (assessing redness of the eyes and snoring while sleeping) were eliminated. As the remainder of the questionnaire performed well and was easy to use, the layout of the preliminary instrument was retained, resulting in the 23-item SNIFLD questionnaire (See Supplemental Materials).

Discussion

Evidence indicates the 23-item SNIFLD questionnaire is a psychometrically sound instrument for the assessment of the severity of signs associated with chronic rhinitis in dogs and could readily distinguish between dogs with and without rhinitis. The questionnaire demonstrated excellent substantive, generalizability, content, and structural validity. Such a tool is critical for identifying effective treatments for this challenging disease through prospective clinical trials. The questionnaire has the advantages of being inexpensive, convenient, and risk-free to the dog and, thus, can be performed repeatedly over time. It can also be applied to individual dog monitoring in a clinical setting.

The RRSM approach was applied in this study as it is considered more robust than simply using statistical methods to describe and compare data collected between groups. There are 6 major weaknesses and limitations of traditional statistical analyses of survey data: (1) ordinal rating scale data are erroneously treated as interval level measures, which is a statistical violation; (2) all items are erroneously assumed to be of equal importance; (3) measurement error is assumed to be equally distributed across all measures; (4) results from any analysis are inherently linked to the specific sample from which they were produced (sample-dependency); (5) most analyses require normally distributed data; and (6) the treatment of missing data is suspect.[11] Rasch models, a family of models within the larger item response theory family of models, have been championed in the social, behavioral, and health sciences because these models overcome each of the aforementioned limitations. More specifically, Rasch models are logistic, latent trait probabilistic models that are derived not from the data, but rather from the requirements for objective measurement. Unlike statistical models that typically are created to describe or summarize data, Rasch models are static and imposed upon the data. Rasch models explore structures within response patterns and when data sufficiently fit the model, a common linear, interval-scaled continuum is produced onto which both person and item measures can be mapped.

For the present study, the RRSM was utilized to evaluate the psychometric properties of the newly developed SNIFLD questionnaire. Once the results of the RRSM analysis confirmed the SNIFLD possessed the necessary psychometric properties for further use, attention then turned to substantive analyses of clinical data. It is understood that clinicians who will ultimately use the SNIFLD questionnaire will not likely perform their own Rasch analyses of data, nor will they find the use of "logits" and the logarithmic scale particularly user-friendly or informative. Therefore, the RRSM primarily was used as a quality control check to ensure the SNIFLD questionnaire possessed the properties necessary to produce valid and reliable measures. As sufficient evidence for psychometric quality was discernible, clinicians could use the SNIFLD questionnaire in a traditional manner for dogs with rhinitis.

Chronic idiopathic rhinitis in dogs is a disease that causes frustration for owners and veterinarians because of the lack of consistently effective treatments. Although the causes remain elusive, the continuing addition of anti-inflammatory and immune-modulatory drugs and novel topical drug delivery systems to the marketplace gives hope for better options for symptomatic control in the future. Conveniently, signs of nasal inflammation are usually readily apparent to

owners, making it possible to measure disease severity repeatedly over time without hospitalization, or invasive or expensive testing. The questionnaire approach has been accepted in human medicine for testing of treatments for chronic allergic rhinitis.[27–29] Typically, patients report the severity of individual clinical signs on a Likert scale, and responses for individual clinical signs are often used to generate a total severity score for comparison before and after intervention. These questionnaires have also proven useful for individual patient management. In veterinary medicine, no such questionnaire exists for rhinitis, although they have been used to assess QOL associated with diseases such as brachycephaly, chronic pain, skin disease, cancer, idiopathic epilepsy, and cardiac disease.[30–38]

Owner input into the development of the SNIFLD questionnaire was critical to address relevant items from their perspective and using their terminology. For instance, difficulty breathing was identified as a concern by owners but is not a sign typically considered by veterinarians, and owners used words such as "snot" or "congestion." Owner feedback was also needed to insure that the questionnaire was easy to understand, unambiguous, and easy to complete. Such properties are essential for successful, accurate data collection in future studies.

The 48-hour time frame over which owners were asked to consider their dog's clinical signs was established from preliminary interviews with owners of rhinitis dogs, based on reports that some days the signs were worse than others. It could be argued that an even longer period of time would better capture fluctuations in signs. One owner in the rhinitis group commented that their dog had relatively few signs at the particular period of time it was evaluated. That dog continued to have relatively few signs a week later when the questionnaire was completed a second time. However, at some point, accuracy of memory becomes a factor. Accurate recall may be more difficult to attain for second-hand observations, such as for questionnaires completed by parents about their children, compared with first-hand reports of one's own clinical symptoms. The potential impact of fluctuations in signs over time should be taken into account in treatment trials through inclusion of a placebo control group, and in individual dogs through assessment at multiple time points.

We chose to use terms such as "rarely" or "often," consistent with the 5-point Likert scale used in the RCAT for people, rather than adopting a numerical rating scale, such as "1–3 times." The relative terminology was especially preferable in this setting because owners may not be with their pets the same number of hours each day, which could make interpretation of a specific number of events difficult. Further, the goal of the SNIFLD questionnaire is to measure changes in disease severity between time points in an individual dog, rather than to compare disease severity between dogs, so consistency in interpretation of the terms within each scale between individual owners is not essential. Owners must only remain consistent with their own interpretation. Such consistency was supported by the highly consistent ratings and Cronbach's alpha reliability estimates (0.92) between the first and second questionnaires from the rhinitis group. Adequate rating scale functioning was also confirmed by category measures, indicating that owners did not have difficulty perceiving the relative severity of the item rating scale.

Two items were eliminated from the preliminary instrument due to lack of significant difference between the rhinitis and control groups. Of particular interest was a significant difference for snoring while awake, but not snoring while asleep. Over two-thirds of dogs in the control group snored during sleep, most of which were not brachycephalic. Snoring during sleep appears to be a normal phenomenon in dogs, as it can be for people. By contrast, snoring while awake in dogs with rhinitis is likely associated with nasal inflammation and obstruction.

The final SNIFLD questionnaire is composed of 23 questions, which as a longer instrument, allows greater precision. This is important when considering use of the SNIFLD questionnaire as a tool for prospective treatment trials, because it is possible that a novel treatment would improve some, but not all, clinical signs. Having the detail afforded by responses to multiple questions could be of great importance for inferring mechanisms of action, making modifications to specific drugs tested, or designing future trials with combination therapies. The potential negative impact of a relatively long questionnaire is respondent fatigue. Some studies indicate that respondent fatigue is not associated with length of questionnaire, but rather how involved the respondent feels in the purpose of the research.[39,40] The authors' experience is that owners of pets with chronic rhinitis are passionate about finding a treatment that will result in relief of clinical signs for their pets and sought active involvement even in the development of this questionnaire, let alone the future use of the questionnaire in evaluating efficacy of novel treatments. Further, owners of dogs with chronic rhinitis and of control dogs indicated overwhelmingly that the questionnaire was very easy or easy to use.

Some limitations of the study design should be considered. Results of the questionnaire were not compared with an objective standard for assessing severity of canine nasal disease, such as histopathology scorings systems or CT scan results. In people, chronic rhinitis is not associated with reliable physical signs or laboratory markers of disease severity.[41] Although the respiratory and content experts were chosen in part due to diverse geographical location, the affected and control populations (with 1 exception) were from North Carolina and might have introduced regional bias regarding the most common clinical signs or owner terminology. The rhinitis group was limited in number, and mesocephalic conformation was most common in both rhinitis and control groups. Because signs of brachycephalic airway syndrome overlap with signs of rhinitis, having a higher proportion of dogs in either group with brachycephaly could have altered results. From a practical perspective, because the SNIFLD questionnaire is designed to compare different time points for individual dogs, the

background brachycephalic nasal signs should not prevent a measurable improvement in severity of signs after successful treatment of rhinitis.

The questionnaire exhibited an abundance of desirable psychometric properties, indicating the instrument is both psychometrically sound and capable of attaining results that distinguish dogs with rhinitis from dogs without rhinitis. However, because no other measure of severity of clinical signs in dogs with rhinitis exists, it was not possible to assess external or consequential validity.[42]

Continued assessment of the SNIFLD questionnaire's discriminatory abilities and utility will be appropriate as it is applied to dogs undergoing treatment for chronic rhinitis. Adaptation of the questionnaire to assess severity of other nasal diseases, such as neoplasia, fungal rhinitis, and feline idiopathic rhinitis, will be of great value for a practical objective measure of response to treatments in these equally challenging diseases. The authors suspect that the SNIFLD questionnaire might have direct application for the assessment of fungal rhinitis and feline idiopathic rhinitis, in which nasal discharge and sneezing are common clinical signs. Modification of the questionnaire may be required for the assessment of nasal neoplasia, in which the owner's perception of congestion and reduced airflow and epistaxis might be predominant clinical signs.

In conclusion, a great deal of validity evidence was discernible to support the psychometric properties and functioning of the SNIFLD questionnaire. The SNIFLD is the first instrument in veterinary medicine to assess the severity of clinical signs in dogs with chronic rhinitis. We contend the SNIFLD should prove to be a valuable tool in the objective assessment of current and novel therapeutics for the effective treatment of this debilitating and frustrating disease that impacts the QOL of dogs and their owners.

Footnotes

Acknowledgments

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Supporting Information

Additional Supporting Information may be found online in the supporting information tab for this article:

Data S1. The formatted SNIFLD Questionnaire as exported from Qualtrics software (www.qualtrics.com).