Evaluation of a Quality-of-Life Tool for Dogs with Diabetes Mellitus

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Background: Diabetes mellitus (DM) management primarily focuses on improvement in blood glucose concentrations and clinical signs. A tool to assess the psychological and social impact of DM and its treatment on quality of life (QoL) previously has only been validated for feline DM.

Hypothesis/Objectives: To validate a diabetic pet and owner-centered individualized measure of impact of DM (DIAQoL-pet) for diabetic dogs and their owners.

Animals/Subjects: A total of 101 owners of insulin-treated diabetic dogs were recruited to complete the DIAQoL-pet.

Methods: Discussions and pilot surveys with clinicians and owners of diabetic pets led to the design of 29 specific DM-associated QoL questions. Each item was scored according to impact frequency and perceived importance. An Item-Weighted-Impact-Score (IWIS) for each item was calculated, as was an Average-Weighted-Impact-Score (AWIS) by averaging all IWISs. Principal component analysis and Cronbach's α calculation assessed the measure's reliability.

Results: The DIAQoL-pet showed high reliability (Communalities ≥ 0.5; Cronbach's α 0.85). The AWIS was -2.74 ± 1.7 (mean ± SD). Areas reported as most negatively impacting QoL included: "worry" (IWIS ± SD: -5.92 ± 4.3), "difficulties leaving dog with friends or family" (-5.68 ± 5.1), "worry vision" (-5.58 ± 4.6), "boarding difficulties" (-5.18 ± 5.2), "worry hypoglycemia" (-4.95 ± 4.3), "social life" (-4.82 ± 4.4), "costs" (-4.11 ± 4.7), and "future care"(-4.07 ± 4.6). Eighty-four percent of owners reported negative impact of DM on QoL.

Conclusions and Clinical Importance: The DIAQoL-pet proved robust when used by owners of insulin-treated diabetic dogs and identified specific areas most negatively impacting dogs' and their owners' QoL. This tool could be used as an additional assessment parameter in clinical and research settings.

Key words: Canine; Endocrinology; Owner; Psychometry.

Evaluation of quality of life (QoL) in companion animals is important, especially when dealing with companion animals suffering from an illness. Despite this, the body of work in veterinary literature dealing with the standardized and structural qualification, and especially quantification of QoL in healthy and diseased companion animals is of rather modest size, particularly when compared with the situation in human medicine.[1,2] Among others, Wojciechowska and colleagues reported one of the first attempts to methodically assess QoL of dogs, which represented an example of a general QoL tool that can be used in healthy animals as well as animals suffering from a range of different diseases.[3] The disadvantage of a general QoL tool, however, is that it does not provide detailed specific information on the specific impact of a disease process and its treatment. An alternative

Abbreviations:

AWIS	average-weighted-impact-score
DIAQoL-pet	Diabetes Mellitus Quality of Life assessment tool for pets and their owners
DM	diabetes mellitus
HBGM	home blood glucose monitoring
IWIS	item-weighted-impact-score
PCA	principal component analysis
PDSA	People's Dispensary for Sick Animals
QoL	quality of life
SD	standard deviation
UK	United Kingdom
USA	United States of America
VIN	Veterinary Information Network

approach would be the design and use of a QoL tool specific for 1 disease process. Previously, the authors designed a diabetic pet and owner-centered, individualized measure of the impact of diabetes mellitus (DM) on the QoL of diabetic pets and their owners (DIAQoL-pet), and validated its use specifically in a diabetic cat population.[4] The reason for development of such tool included a perceived lack of attention by veterinary clinicians and researchers to routinely record, evaluate, and address the psychological and social effects of the impact of DM and its relatively complex daily treatment regimen on QoL of both the animal and owner. Indeed, often clinicians focus primarily on control of blood glucose concentrations in conjunction with the resolution or amelioration of clinical signs attributable to DM. Interestingly, in the cat study, using a QoL tool that also included a large number of items focusing on owner-related QoL, 9 of the 10 areas reported to be most negatively impacted by DM and

its treatment concerned these owner-focused areas rather than cat-focused areas. Specific examples of these areas included owners experiencing difficulties when trying to arrange for their diabetic cat to go into boarding kennels, a perceived lack of autonomous control over the treatment of their cat, difficulties leaving their cat with friends or family, worrying about their cat generally, worrying about possible hypoglycemic crises, experiencing a negative impact on the owner's work and social life, worrying about costs, and general restrictions of the owner's activities. Admittedly, this study might have been influenced by a large part of the featured diabetic cat population being well controlled, leading to cat-focused items to rank lower. Nevertheless, regular generation and assessment of both pet- and owner-focused data seems important because should an owner perceive a negative impact on his or her QoL or the QoL of his or her pet as a result of DM or its treatment, a decision to cease treatment could result regardless of the apparent clinical success (based on blood glucose concentrations and clinical assessment). Previously, the authors also used the DIAQoL-pet in a research setting to assess the impact of home blood glucose monitoring on diabetic cat and owner QoL.[a]

Nevertheless, despite QoL being acknowledged as an important outcome in human diabetology,[2] the above 2 studies represent the only reports on structural, detailed, and quantified assessment of pet and owner QoL in veterinary diabetology. In general, studies on the validation and use of instruments designed to assess companion animal QoL have been published rarely, especially compared with the number of studies in other fields of companion animal medicine. In addition, previous studies have focused mainly on general, not disease-specific, QoL assessment or pain assessment. The current study therefore validates and applies the DIAQoL-pet in a population of owners of insulin-treated diabetic dogs and describes owner-perceived QoL of their dogs with DM, as well as measures owners' individual feelings about the impact of the diagnosis and treatment on the dogs' and owners' everyday lives.

Material and Methods

Design and Description of the DIAQoL-pet

The initial design of the DIAQoL-pet has been described previously and also formed part of the current study.[4] To summarize, qualitative research was conducted to ensure that the items were diabetes-centered and valid to diabetic pets and their owners. Studies with questionnaires for children with DM also were used as a basis for the tool's design.[5,6] Detailed discussions were held with a wide range of individuals (veterinary surgeons and nurses, human DM QoL survey designers, a human diabetology lecturer and consultant, a clinical epidemiologist, and owners of diabetic dogs and cats). This allowed identification of 29 specific canine and feline DM QoL issues or items, leading to the design of 29 corresponding specific DM-associated QoL questions and corresponding multiple-choice answers (DIAQoL-pet), which were digitalized and publicized online by the software package Questionmark Perception Manager.[b] An initial pilot trial identi-

fied areas of confusion which subsequently were amended. The final version was the same for cats and dogs and thus allowed direct interspecies comparison, and was made available to a larger population of owners of diabetic dogs. As was the case with the diabetic cats, to ensure the individualized and quantitative character of the tool, each item was scored according to the frequency at which it impacted the owner's and dog's lives and how important the item was in the individual owner's and dog's lives (Fig 1). Multiplying frequency and importance ratings for each item provided a so-called item-weighted-impact-score (IWIS).[5] Table 1 contains the description of each item and shows the abbreviations used in this report. Items representing areas of the owner's and dog's lives potentially negatively impacted by DM were awarded negative frequency scores, or 0 if there was no influence (range −3 to 0), whereas possible positive impact areas were given positive frequency scores or 0 (range 0–3). An average-weighted-impact-score (AWIS) was calculated to provide a single quantitative measure of diabetes-dependent-QoL by dividing all IWISs by the number of items (ie, 29).

Two separate overview questions measured current overall QoL, as well as diabetes-dependent-QoL, as described for diabetic cats,[4] although these were not included in calculating the AWIS (Table 2). Diabetic dog owners also were asked to answer the 3 following hypothetical questions: "If your pet had not been insured for the treatment of diabetes, would you have been willing or able to go ahead with treatment?", "In the unfortunate event that another one of your pets were to get diabetes, would you treat this pet with insulin too?", and "Would you recommend friends and family with pets diagnosed with DM to go ahead with insulin injection treatment on the basis of your experiences with your pet?" A free comments section served for cognitive feedback and asked if diabetic dog owners had anything else they wanted to report about their experiences of life with a diabetic dog receiving insulin injections.

Recruitment of Respondents

To facilitate interspecies comparison, recruitment methods were the same as for the diabetic cat study and included making

Fig 1. Example DIAQoL-pet question with corresponding multiple choice answers. All the time = 3, often = 2, occasionally = 1, and never = 0. Very important = 4, important = 3, moderately important = 2, low importance = 1, and not at all important = 0.

Table 1. Overview of DIAQoL-pet items and abbreviations, as well as the descriptive statistics of the items applied to a population of diabetic dogs and their owners.

Item Number	Abbreviation	Item	% Never (Frequency Rating)	% All the Time (Frequency Rating)	% Very Important (Importance Rating)	IWIS (Mean ± SD)
1.	Worry	Do you worry about your pet's diabetes?	3.1	33.7	31.6	−5.92 ± 4.27
2.	No treats	Do you ever feel you want to give your pet treats but you don't because of the diabetes?	18.4	12.2	7.2	−3.11 ± 3.07
3.	Injections restrict life	Do you feel your life is restricted because of the daily insulin injections?	11.2	12.2	14.4	−3.31 ± 3.47
4.	Injection pain	Does your pet ever react annoyed or in pain when injected?	47.9	1.0	32.3	−1.50 ± 2.14
5.	Injection worries	Do you ever worry about whether you have given the insulin correctly?	41.8	3.1	27.1	−2.25 ± 2.90
6.	Resent inject	Do you resent having to give your pet insulin injections?	71.1	3.1	21.6	−0.98 ± 2.39
7.	Restrict your activities	Do you ever find the diabetes of your pet restricts or limits what you are doing or what you want to do, like going on holidays, away for weekends, away for the day/night, working?	11.2	19.4	17.7	−3.88 ± 3.85
8.[a]	Extra things	Do you ever give your pet extra things, like snacks, treats, extra attention or extra walks because of the diabetes?	27.4	9.5	15.5	+2.91 ± 3.31
9.	More control	Do you ever feel you want to take more control of the diabetes on your own, without the help from vets and other people?	39.8	19.4	28.4	−3.51 ± 4.42
10.	Pet's moods	Do you think the diabetes affects your pet's moods?	17.7	9.4	28.4	−3.68 ± 3.53
11.	Pet unwell	Does your pet ever feel unwell, tired or in any other way negatively affected since treatment with insulin was started?	19.8	5.5	37.2	−3.42 ± 3.42
12.	Boarding kennels	Do you ever choose not to put your pet into boarding kennels because of the diabetes?	19.2	57.7	37.6	−5.18 ± 5.21
13.	Friends & family	Do you ever choose not to leave your pet to stay with friends or family because of the diabetes?	20.7	43.5	45.8	−5.68 ± 5.07
14.	Hypoglycemia	Does your pet ever show signs of a low blood sugar? (eg, wobbliness, collapse)	54.8	0	58.1	−1.72 ± 2.38
15.	Active day	Do you ever choose not to take your pet with you on an active day (eg, walking longer distances, going to the beach etc.) because of the diabetes?	30.5	12.6	30.5	−3.53 ± 3.87
16.	Drinking	Does your pet still drink more than before the diagnosis?	23.1	8.8	35.8	−3.17 ± 3.45
17.	Hungry	Is your pet still hungrier than before the diagnosis?	31.4	12.8	33.3	−3.09 ± 3.79
18.	Urinate	Does your pet still urinate more than before the diagnosis?	18.7	9.9	34.7	−3.15 ± 3.35
19.	Weight loss	Is your pet still losing weight since treatment has begun?	43.8	9.0	34.7	−2.29 ± 3.34
20.	Future care	Do you ever feel worried you will not be able to take care of your pet in the future because of the diabetes?	40.6	19.8	54.2	−4.07 ± 4.62
21.	Worry hypo	Do you ever feel worried about your pet suffering from an episode of low blood glucose?	10.8	21.5	54.4	−4.95 ± 4.26
22.	Worry DKA	Do you ever feel worried about your pet suffering from an episode of ketoacidosis?	20.5	16.9	44.2	−3.76 ± 4.11
23.	Worry vision	Do you ever worry about your pet getting vision problems due to cataracts or did you worry about this prior to your pet suffering from such problems?	14.0	31.2	43.1	−5.58 ± 4.63
24.	Play less	Are you less inclined to play with your pet now that he/she has diabetes?	87.4	0	30.2	−0.53 ± 1.58

(continued)

Table 1 (continued)

Item Number	Abbreviation	Item	% Never (Frequency Rating)	% All the Time (Frequency Rating)	% Very Important (Importance Rating)	IWIS (Mean ± SD)
25.[a]	Play more	Are you more inclined to play with your pet now that he/she has diabetes?	36.7	12.2	29.5	+3.20 ± 4.01
26.	Social life	Do you ever find you need to fit your pet's diabetes into your social life? (eg, carrying needles, food, insulin, providing food on time)	13.8	25.5	34.4	−4.82 ± 4.41
27.	Working life	Do you ever find you need to fit your pet's diabetes into your working life? (eg, having to make special arrangements when you need to work late or need to start working earlier)	32.6	22.8	32.6	−3.88 ± 4.48
28.[a]	Special bond	Do you feel you have a more special bond with your pet now that you are managing his/her diabetes?	22.0	37.4	40.0	+5.28 ± 5.12
29.	Costs	Do your ever worry about how much money your pet's diabetes costs you and your family?	33.3	26.0	34.0	−4.11 ± 4.74

Items 1–29: DIAQoL-pet items; IWIS, item-weighted-impact-score.
[a]Indicates positive items; possible range IWIS −12 to 0 (negative items) and 0 to +12 (positive items).

Table 2. Description of overview items of DIAQoL-pet and abbreviations, as well as the descriptive statistics of these items applied to a population of diabetic dogs and their owners.

Item Number	Abbreviation	Item	Most Popular Answers with % of Total Respondents	Median	Range
A.	General QoL pet	I feel that the quality of my pet's life is	as good as it could possibly be: 33% good: 26% fairly good: 23%	+3	−2 to 3[a]
B.	Diabetes-dependent QoL pet	If your pet did not have diabetes, his/her quality of life would be:	quite a lot better: 31% a little better: 30% a great deal better: 23%	−1	−3 to 3[a]

Items A & B: separate overview questions with answer options (score between brackets) for A: "as good as it could possibly be" (+3), "good" (+2), "fairly good" (+1), "neither good nor bad" (0), "fairly poor" (−1), "poor" (−2), and "as poor as it could possibly be"(−3) and for B: "a great deal better" (−3), "quite a lot better" (−2), "a little better" (−1), "the same" (0), "a little worse" (+1), "quite a lot worse" (+2), and "a great deal worse" (+3).
[a]Maximal range −3 to 3; QoL, quality of life.

the survey-based tool DIAQoL-pet available online through the URL www.rvc.ac.uk/diabetes. To prevent malicious participation, the web-link was purposely not advertised openly on the World Wide Web, and Internet Protocol (IP) addresses of respondents were recorded allowing identification and deletion of duplicate entries by the same IP address. Diabetic dog owners were therefore also only indirectly contacted through their veterinary clinicians and not directly through open-access websites designed for diabetic pet owners. A collaboration was established with the world wide on-line veterinary community "Veterinary Information Network" (VIN[c]; www.vin.com) allowing the survey links to be sent directly to all VIN members (>40,000), as well as the UK-based Vetsurgeon.org online community (approximately 2,500 members), in addition to being advertised through various other electronic and nonelectronic veterinary media outlets, veterinary interest groups, national and international congresses, and continuous education events. Also, over 400 veterinary practices in the United Kingdom, Belgium, and the Netherlands were individually approached via email. Finally, within the United Kingdom, the charity practice chain, the People's Dispensary for Sick Animals (PDSA) was approached and consented to advertising the survey among their hospitals.

Statistical Analysis

Principal components analysis (PCA) was used to validate the DIAQoL-pet for diabetic dogs and their owners by assessing the unidimensionality of the survey (ie, does it measure diabetes-related QoL or does it measure additional latent variables?).[5–9] It also was used to identify critical and noncritical items within the scale, as well as reassessing the meaning of each item or factor in light of its relation with the latent variable. As part of the PCA, extraction communalities were calculated, which indicate the amount of variance in each variable that is accounted for by all other variables or items. Low communalities across the set of items indicate the variables are little related to one other and indicate a poor quality measure.[4,8] A factor matrix also was generated, recording the factor loadings for each variable. The factor loadings represent the correlation between the item and the latent variable. In parallel with extraction communalities, small loading values indicate items that do not correspond well to a latent variable. The value of 0.3 has been suggested as an appropriate cut-off level.[8] As in the diabetic cat study, in this study exclusion decisions were based on a subjective decision advised by a combination of theory behind the item, communalities, loading factors, and reliability analysis.

Cronbach's α, which measures the internal consistency of a psychometric instrument, was determined to indicate how well the set of variables or items measured a single, unidimensional latent construct (ie, QoL). An acceptable minimum alpha is deemed to be 0.7–0.8.[9]

Cronbach's α is defined as:

$$\alpha = \frac{N}{N-1}\left(1 - \frac{\sum_{i=1}^{N} \sigma_{Yi}^2}{\sigma_X^2}\right)$$

with N representing the number of components (items), σ_X^2 the variance of the observed total test scores, and σ_{Yi}^2 the variance of item i. In addition, Cronbach's α was calculated when each item was left out of the scale to identify items that markedly negatively influence the scale's reliability as a whole. In addition, corrected item-total correlations were calculated and correlations were considered acceptable if ≥ 0.2.[4,7]

Correlations between DIAQoL-pet and answers of diabetic dog owners to general and diabetes-related QoL questions (item A and B, Table 2) were assessed by performing a 2-tailed non-parametric Spearman's rho, and correlations were considered to be significant when P value was <.05.

All statistical analyses were performed by the statistical software package SPSS Statistics for Windows 17.0.[d]

Results

Demographic Data

A total of 101 owners of insulin-treated diabetic dogs completed the survey. Respondents originated from the United Kingdom (n = 35), the United States (n = 35), Canada (n = 11), Australia (n = 4), the Netherlands (n = 2), France, Finland, Greece, Spain, Portugal, and Belgium (n = 1 each) or unknown (n = 8). The dog's mean ± standard deviation (SD) age was 10.2 ± 2.6 years (range, 1–15 years), body weight was 19.1 ± 14 kg (range, 4–75 kg), and common breed categories were unknown (n = 47), cross-breed (n = 19), Labrador Retriever (n = 10), West Highland White Terrier (n = 5), Cocker Spaniel (n = 4), Rottweiler (n = 4), and Miniature Schnauzers (n = 4). Mean insulin dosage was 0.80 ± 0.5 IU/kg (range, 0.01–4.0) and 86 (85%) received insulin q12h, the remainder 15 (15%) q24h. Three owners gave a different number of units in the morning than in the evening. Fifty-five were receiving Vetsulin/Caninsulin,[e] 13 Insuvet Lente,[f] 15 Novolin N[g]/Humulin N,[h] 2 Humulin L,[h] 4 Humulin U,[h] 10 "other", 2 "don't know" or blank.

Fifty-two dogs (52%) received a special diabetic diet and 39 owners (39%) reported giving additional medication or supplements to their dog. Fifty-two owners (52%) reported their dogs to suffer from cataracts, 43/101 (43%) reported absence of cataracts, 5/101 (5%) reported "don't know" when asked, 1/101 (1%) left this question blank. Fifty-three owners (52%) reported to "never" check urine glucose concentrations at home, 21 (21%) "occasionally", 12 (12%) "often", 7 (7%) "all the time", and 8 (8%) did not answer this question. Sixty-two owners (61%) reported to "never" check urine ketone concentrations at home, 18 (18%) "occasionally", 5 (5%) "often", 7 (7%) "all the time",

and 9 (9%) did not answer this question or answered "don't know". Sixty-five owners (64%) reported to "never" check blood glucose concentrations at home, 13/101 (13%) "occasionally", 7/101 (7%) "often", 11 (11%) "all the time". Three (3%) did not answer this question and 2 (2%) answered "don't know". Eight dogs (8%) were completely covered by insurance for their disease, whereas 12/101 (12%) were partially insured for this condition and 74/101 (73%) were not insured. Six owners (6%) did not answer this question and 1 (1%) answered "don't know".

Descriptive Statistics

All negative items confirmed negative weighted impact of DM, whereas positive items indicated positive impact of diabetes (Table 1, Fig 2). Areas reported as most negatively impacting QoL (based on IWIS) were: "worry about pet's DM", "friends and family", "worry vision", "boarding kennels", "worry hypo", "social life", "costs", and "future care". The least severe negative impact of diabetes was felt for: "play less", "resent injection", "injection pain", and "hypoglycemia". Diabetes had a positive impact on: "special bond", "play more" and "extra things".

Analysis of answers to the separate overview questions found that although 81% of diabetic dog owners rated their dog's QoL as good, 84% reported a negative impact of the DM on QoL (details in Table 2).

Principal Components Analysis

All items showed high extraction communalities (≥ 0.5), indicating a reasonably strong relationship among the items (Table 3). Factor matrix analysis identified 2 items ("Injection pain" and "Play less") to have loadings below 0.3 (cut-off suggested by Kline;[5] Table 3). However, both factors contributed to overall scale reliability according to Cronbach α (see below
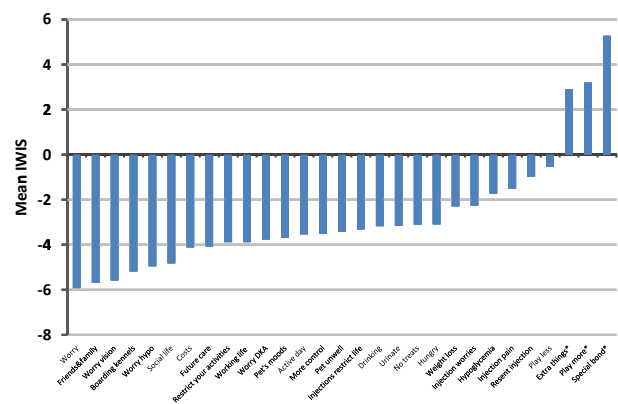

Fig 2. Mean item-weighted-impact-scores of the 29 items of the DIAQoL-pet for diabetic dogs and their owners. * indicates positive items.

Table 3. Principal components analysis (extraction communalities and loadings) and reliability analysis of the DIAQoL-pet.

Item Number	Item Name	Communalities (Extraction)	Factor Matrix (Loading)	Corrected Item-Total Correlation	Cronbach's α if Item Deleted
1.	Worry	0.639	0.715	0.626	0.836
2.	No treats	0.546	0.390	0.369	0.845
3.	Injections restrict life	0.851	0.402	0.388	0.845
4.	Injection pain	0.734	0.199	0.204	0.849
5.	Injection worries	0.649	0.545	0.415	0.844
6.	Resent inject	0.767	0.405	0.330	0.847
7.	Restrict your activities	0.860	0.599	0.601	0.838
8.[a]	Extra things	0.784	−0.518	−0.392	0.864
9.	More control	0.706	0.486	0.373	0.845
10.	Pet's moods	0.605	0.695	0.621	0.838
11.	Pet unwell	0.845	0.685	0.615	0.838
12.	Boarding kennels	0.774	0.595	0.498	0.840
13.	Friends & family	0.776	0.668	0.565	0.838
14.	Hypoglycemia	0.809	0.431	0.415	0.845
15.	Active day	0.731	0.588	0.518	0.840
16.	Drinking	0.892	0.612	0.551	0.840
17.	Hungry	0.634	0.534	0.514	0.841
18.	Urinate	0.863	0.536	0.446	0.843
19.	Weight loss	0.709	0.480	0.400	0.844
20.	Future care	0.574	0.625	0.555	0.838
21.	Worry hypo	0.643	0.666	0.608	0.837
22.	Worry DKA	0.765	0.519	0.508	0.841
23.	Worry vision	0.683	0.525	0.455	0.842
24.	Play less	0.750	0.130	0.129	0.850
25.[a]	Play more	0.707	−0.508	−0.395	0.868
26.	Social life	0.735	0.705	0.637	0.836
27.	Working life	0.777	0.491	0.459	0.842
28.[a]	Special bond	0.638	−0.511	−0.389	0.874
29.	Costs	0.793	0.500	0.450	0.842

[a]Positive item.

and Table 3), indicating that inclusion would not deter significantly from the validity of the DIAQoL-pet for diabetic dogs and their owners.

Internal Consistency Reliability

A Cronbach's α level of 0.85 (n = 101) indicated a high level of internal consistency. All corrected item-total correlations were >0.2, apart from factor 24 ("Play less"), which showed a correlation of 0.129. However, deletion of this factor from the scale did not result in an increase in the α coefficient and the factor was therefore left in the scale. Only deletion of factors 25 ("Play more") and 28 ("Special bond") resulted in a minimal increase in alpha (Table 3). In view of the initial scale's reliability already being sufficient and the apparent significant impact on QoL of these particular items according to IWIS (+3.20 ± 4.0 and +5.28 ± 5.1, respectively), these items were also not excluded.

AWIS

AWIS was −2.74 ± 1.7, consistent with a negative effect of the DM and its treatment on QoL of dog and owner.

Correlation of DIAQoL-pet and General Measures of QoL

Moderate correlations were found between DIAQoL-pet AWIS and the overview item A (general QoL pet; ρ = 0.30, P = .002). The correlation with diabetes-dependent-QoL (B) was higher (diabetes-dependent QoL; ρ = 0.51, P < .001).

Additional Questions

When asked "If your pet had not been insured for the treatment of diabetes, would you have been willing or able to go ahead with treatment?", 0/101 (0%) of respondents answered "no", 9/101 (9%) "don't know", 15/101 (15%) did not answer this question, and 77/101 (76%) answered "yes". When asked "In the unfortunate event that another one of your pets were to get diabetes, would you treat this pet with insulin too?", 21/101 (21%) of respondents answered "probably", 3/101 (3%) "not sure", 0/101 (0%) "definitely not", 6/101 (6%) did not answer, and 71/101 (69%) reported "without a doubt". Finally, when asked "Would you recommend friends and family with pets diagnosed with DM to go ahead with insulin injection treatment on the basis of your experiences with your pet?", 17/

101 (17%) of respondents answered "probably", 4/101 (4%) "not sure", 73/101 (72%) "without a doubt", and 7/101 (6%) did not answer.

Free Comments Section

Sixty-one owners of diabetic dogs provided an entry into the free comments section. Comments mostly related to or emphasized areas already covered by the DIAQoL-pet. Three areas were mentioned by ≥3 respondents and were not directly or completely covered by the DIAQoL-pet. Seven respondents reported that the information given by veterinary clinicians was thought to be insufficient for them to understand and treat DM to the best of their abilities, 6 respondents reported concurrent disease to be causing as much or more troubles than the DM itself, and 3 owners emphasized the burden of the monitoring and stabilization process (time and money investment).

Discussion

The DIAQoL-pet was developed to quantify the perceived impact of DM and its treatment on QoL of both diabetic pets and their owners and previously was validated for use with diabetic cats and their owners. Application of the tool in a population of owners of insulin-treated diabetic dogs proved that it also was robust for use in canine DM, judging by its validity, unidimensionality, and reliability, as demonstrated by PCA, Cronbach α assessment, and large-scale testing. The overall need for a tool to provide a detailed QoL assessment in diabetic dogs was illustrated by the detected discrepancy between the fact that 81% of owners reported a "good" QoL when asked by the simple general QoL question approach, and the fact that 84% of those same owners, nevertheless reported a negative impact on QoL, when asked by the more specific diabetes-related QoL question approach.

Factors 25 ("Play more") and 28 ("Special bond") could have been deleted from the scale on the basis of a small increase in Cronbach's alpha. However, we thought it prudent to leave these factors in the scale because even when leaving both factors in the scale the overall reliability score (according to Cronbach's alpha) remained indicative of a high quality tool. In addition, both items addressed important factors in the lives of diabetic dogs and their owners, based on high (positive) IWIS values. Indeed, owners seem also to experience positive effects by living with a pet with DM, with the item "Special bond" scoring the highest of all positive items. This might not be unique to owners of pets with DM and might also apply to animals with other chronic diseases, although no specific data currently are available to substantiate this hypothesis. Also in the human health-related QoL literature, little data can be found to indicate possible positive effects of chronic disease on the caretaker-patient bond. For instance, reported effects of childhood chronic illness on the mother-child bond tend to overwhelmingly focus on negative impact areas. In a study of mothers of asthmatic children, perceived parenting stress was greater and the quality of the mother-child relationship was more problematic than for mothers with healthy children.[10] Additional studies on the psychological effects on parents of a diagnosis of type 1 DM in their child show potential for long-term psychological symptoms to occur in those parents as a result of the diagnosis, which in turn could result in depressive symptoms in the child, indicating a negative influence on the parent-child or caretaker-patient bond.[11,12]

The systematic use of this tool in this diabetic dog owner population allowed structural identification of a number of short comings of current DM treatment methods from an owner's point of view and therefore provides a number of incentives and ideas toward further optimization of current treatment approaches that specifically address the shortcomings identified by this study. As an example, worry about the diabetic dog's vision appeared to exert a relatively marked negative influence on QoL (IWIS -5.58 ± 4.6). How best to prevent cataract formation in diabetic dogs remains incompletely understood. Although optimal glycemic control and limited fluctuations in blood glucose concentrations might decrease their overall incidence, cataracts still occur in 80% of diabetic dogs within 470 days of DM diagnosis.[13] Therefore, their occurrence possibly involves more than the degree of glycemic control of the individual patient or the speed at which such glycemic control is obtained. Apart from the development of novel treatment methods or protocols that would result in a lower incidence of diabetic cataracts, preemptively informing owners about the success of currently available cataract treatment options, especially in terms of QoL (eg, phacoemulsification with or without lens replacement) might aid at least in reducing the negative impact exerted by the worry surrounding this issue.[14] Also, the QoL of diabetic dogs could be quantified by the DIAQoL-pet before and after onset of cataract formation, as well as before and after phaco-emulsification.

Understandably given the higher incidence of diabetic cataracts in dogs, the "worry vision" item did not have a prominent place on the list of negative impact areas when assessed in a population of diabetic cats and their owners (Table 4).[4] Another notable difference was the different relative position of the item "more control", which featured high on the diabetic cat owner list, yet only occupied 14th place on the list of negative impact areas of diabetic dog owners. This might represent a genuine difference in attitudes and desires between dog and cat owners, or the fact that changes in treatment philosophies and protocols recently have occurred predominantly in the field of feline DM. Indeed, compared with the situation in canine DM, in recent years owner involvement in blood glucose measurement and achievement of diabetic remission in cats might have been more explicitly promoted by veterinary and nonveterinary sources and might have led to a higher proportion of diabetic cat owners desiring and indeed assuming more control over the management of their pet's DM.[4]

Table 4. Comparison of the top 10 items reported as most negatively impacted by DM of diabetic dogs and their owners and diabetic cats and their owners. The IWIS (mean ± SD) is denoted between brackets and the items that do not occur in the top 10 of both species are shown in bold.

	Diabetic Dogs and Owners	Diabetic Cats and Owners
1.	"worry" (−5.92 ± 4.27)	"boarding kennels" (−4.67 ± 5.3)
2.	"friends & family" (−5.68 ± 5.07)	**"more control" (−4.34 ± 4.7)**
3.	**"worry vision"−5.58 ± 4.63)**	"friends & family" (−4.21 ± 4.7)
4.	"boarding kennels" (−5.18 ± 5.21)	"worry" (−4.10 ± 3.9)
5.	"worry hypo" (−4.95 ± 4.26)	"worry hypo" (−3.67 ± 3.5)
6.	"social life" (−4.82 ± 4.41)	"social life" (−3.48 ± 3.9)
7.	"costs" (−4.11 ± 4.74)	"costs" (−3.04 ± 3.8)
8.	**"future care" (−4.07 ± 4.62)**	"working life" (−3.03 ± 3.7)
9.	"working life" (−3.88 ± 4.48)	**"pet's moods" (−2.87 ± 2.88)**
10.	"Restrict your activities" (−3.88 ± 3.85)	"Restrict your activities" (−2.81 ± 3.09)

SD, standard deviation; IWIS, item-weighted-impact-score; DM, diabetes mellitus.

Otherwise, the top 10 items with the most negative impact looked similar for both diabetic dogs and cats, but re-emphasized the importance of recording the impact of treatment on the owner's life, in addition to the animal's QoL (Table 4). Arguably, because less than half of the 29 items of the tool inquired specifically about the pet's QoL, the tool might have been somewhat biased toward recording these owner-specific aspects. Nevertheless, 9 of the 10 items in the feline and all 10 of the canine top 10 negative impacts were associated mostly with the owner's QoL rather than with the pet's QoL. It was previously shown, by looking at owner-perceived QoL of phenobarbital treated epileptic dogs, that many owners are prepared to administer oral medication on a long-term and daily basis to their pet, if this leads to improved QoL of their pet.[15] However, it could have been hypothesized that the situation would have been different in the case of owners having to inject their pet on a daily basis. Interestingly, however, in both the diabetic dog and cat population, items specifically related to injecting insulin did not feature in the top 15 most negatively impacting items. In fact, the first item of this nature for diabetic dogs documented the restriction exerted by insulin injections on the owner's life rather than the actual injection itself, whereas items, such as "injection worries", "injection pain", and "resent injections" featured even lower on the list.

As was the case with the cat study, the current dog-specific data should be interpreted in light of the demographics and characteristics of the studied population, with the majority of dog owners originating from the USA and UK. In addition, most dogs were uninsured and these demographic characteristics likely influenced the results. In any study, the methods of that use an online survey will be influenced by the fact that internet access was a condition for participation, thereby potentially lowering the proportion of elderly or underprivileged owners completing the survey. Nevertheless, internet access availability currently is at an all-time high in all involved countries.[16,17]

The signalment of diabetic dogs proved similar to recent reports.[18] Most animals were middle aged to elderly, and Labrador Retrievers and Terriers were common. Most dogs were treated by twice daily injections, according to current recommendations. For the United Kingdom, this represents a change from the situation recorded in 2005 when once daily injection protocols were reported to be more popular, despite their inferior efficacy.[18]

The assessed diabetic dog population might have included a high number of animals with good glycemic control because all items related to the classical clinical signs of DM ("drink", "hunger", "urinate", and "weight loss") featured outside of the top 10 of most negatively impacting items. This was further substantiated by the fact that the low IWIS values were mainly caused by low frequency ratings for these signs. Perhaps therefore the main study results would have been different for a group of owners of diabetic dogs with inferior glycemic control.

As was the case with the diabetic cat owners, a discrepancy was identified between the perceived high impact of worrying about hypoglycemia ("worry hypo": −4.95 ± 4.3) and the perceived lower impact of hypoglycemia actually occurring ("hypo": −1.72 ± 2.4). It is understandable that owners are concerned about the possible occurrence and consequences of insulin overdosing and hypoglycemia. In addition, 40% of diabetic dog owners reported hypoglycemic episodes to possibly have occurred at least occasionally. A similarly high prevalence was found in the diabetic cat study (35%), and this observation once again emphasizes the need for clinicians to intensify any efforts to decrease the frequency of such episodes, as well as to promote owners' confidence in their early recognition and adequate management to decrease anxiety levels among owners, and increase overall QoL. Home blood glucose monitoring might help with this concern, although it would be prudent to ensure this extra responsibility is not perceived to be a detrimental burden by specific dog owners. Interestingly, a recent study using the DIAQoL-pet in cats could not document that home blood glucose monitoring was associated with an overall decrease in hypoglycemia-associated anxiety of diabetic cat owners, although additional studies are indicated.[a] This would support the logical view that the "average diabetic pet owner" does not exist and that a careful consultation with each individual pet owner about the specifics of DM management is indicated, rather than implementing or imposing a practice- or hospital-wide standard protocol. Using the DIAQoL-pet could form part of this process to individualize diabetic pet care.

The comments made in the free comments section suggest consideration should be made to include items

regarding "support from the veterinary team", "monitoring and stabilization process", and "concurrent disease" into future adaptations of the QoL tool.

In conclusion, in addition to proving valid for use for diabetic cats and their owners, the DIAQoL-pet also proved reliable in quantifying diabetes-dependent QoL of diabetic dogs and their owners. The tool identified specific areas impacted by DM and its treatment and could therefore be used by clinicians and diabetic dog owners to assess and seek to improve QoL and treatment success, alongside clinical signs, BG, and fructosamine measurement. The DIAQoL-pet also may prove useful in clinical trials of new diabetic dog treatment options, alongside measures of biologic effect, as has recently been attempted in diabetic cats and is routinely the case in human DM clinical research.[a,19,20]

Footnotes

[a] Niessen SJ, Powney SJ, Guitian J, et al. Impact of home blood glucose monitoring on quality-of-life of diabetic cats and their owners recorded by the psychometric tool DIAQoL-pet. J Vet Intern Med 2011;25:679 (abstract)
[b] Copyright Questionmark Corporation, London, UK
[c] VIN, Davis, CA
[d] SPPS Inc, Chicago, IL
[e] Intervet/MSD Animal Health, Milton Keynes, UK
[f] Pfizer Animal Health, Wockhardt, UK
[g] Novo Nordisk, Bagsværd, Denmark
[h] Eli Lilly and Company, Indianapolis, IN

Acknowledgment

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