Making the most of research 2: is it good quality research?

There is a convention to the format of research papers. This article discusses the typical structure of a published research paper and explains its purpose. However, just because a paper has followed this format does not mean that the research is good. A range of considerations are presented to help the reader critically assess the quality of a given study.

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The recently published paper by Owen and Lamon (2021) 'Are cats good? An important study' is a wonderful parody of a published paper (Figure 1).[1] Egg and spoon races are obviously not a trustworthy way to achieve scientific consensus! The more serious message is that despite publishing in a peer-reviewed journal and adding to the scientific literature, a study may have limitations and possibly contain flaws.[2] This means that papers should be critically appraised when evaluating the strength of evidence presented for clinical decision-making.

Many papers and entire books have been written on how to critically appraise the quality of research.[2] In this article, we introduce some key concepts and offer some direction for further reading.

Navigating a typical research paper

The main body of a paper typically follows the standard **IMRaD** structure:[3]

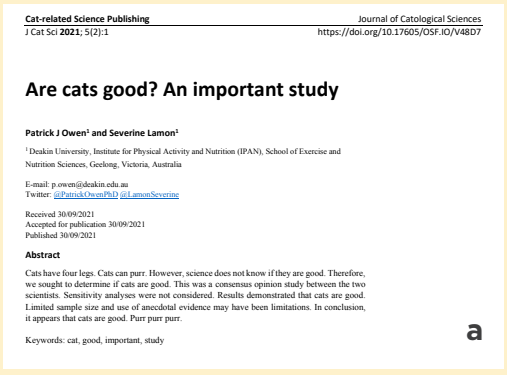
- **I**ntroduction;
- **M**aterials and methods;
- **R**esults; **a**nd
- **D**iscussion/conclusions.

Each of these sections is described in more detail below. Before the main body of the paper an abstract provides a stand-alone snapshot that succinctly summarises each of these main sections.[3]

This article is the second in a three-part series. See **Making the most of research 1: is the research relevant?** *Feline Focus* 2022; 8(2): 25–28. The final part will look at putting research into practice.

Introduction

The introduction should enable the reader to understand why the authors came up with their study. It usually summarises key points from the existing literature on the topic. It should start with a broad context and lead the reader, in a linear and logical way, to the



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Are cats good? An important study

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Abstract

Cats have four legs. Cats can purr. However, science does not know if they are good. Therefore, we sought to determine if cats are good. This was a consensus opinion study between the two scientists. Sensitivity analyses were not considered. Results demonstrated that cats are good. Limited sample size and use of anecdotal evidence may have been limitations. In conclusion, it appears that cats are good. Purr purr purr.

Keywords: cat, good, important, study

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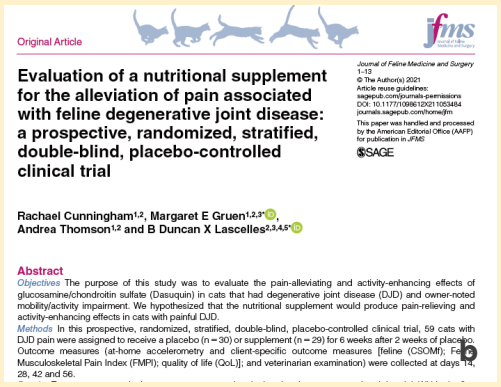

Original Article

Evaluation of a nutritional supplement for the alleviation of pain associated with feline degenerative joint disease: a prospective, randomized, stratified, double-blind, placebo-controlled clinical trial

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SAGE

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Abstract

Objectives The purpose of this study was to evaluate the pain-alleviating and activity-enhancing effects of glucosamine/chondroitin sulfate (Dasuquin) in cats that had degenerative joint disease (DJD) and owner-noted mobility/activity impairment. We hypothesized that the nutritional supplement would produce pain-relieving and activity-enhancing effects in cats with painful DJD.

Methods In this prospective, randomized, stratified, double-blind, placebo-controlled clinical trial, 59 cats with DJD pain were assigned to receive a placebo (n = 30) or supplement (n = 29) for 6 weeks after 2 weeks of placebo. Outcome measures (at-home accelerometry and client-specific outcome measures [feline CSOM]; Feline Musculoskeletal Pain Index (FMPI); quality of life (QoL)]; and veterinarian examination) were collected at days 14, 28, 42 and 56.

b

Figure 1: Looks can be deceiving. (a) A parody paper (full paper can be found at https://osf.io/ytb8). (b) An example of good quality research published in a peer reviewed journal

author's specific point of interest.[4] The introduction typically highlights unresolved issues and/or gaps in knowledge, often positioned as opportunities for research, and thereby provides the rationale for the specific study that was undertaken. This should be expressed at the end of the section as the research aim, with the hypothesis the authors set out to test, their testable prediction, and why the outcome is important in terms of real-world implications.[2,5]

If the paper is a systematic review, the reader should examine the inclusion and exclusion criteria, which should be clearly documented. These criteria can be a source of subjectivity of which the reader should be aware. Likewise, if a narrative review is presented, it is likely and justifiably written from the authors' perspective, which may be subjective. Where potentially relevant themes have not been covered, the author should acknowledge their relevance and signpost where the interested reader should go for more information.[4]

Methods

The methods section documents exactly how the research was conducted and is often divided into subsections for clarity.[4] The authors should outline every step taken to reduce or limit bias. This enables the reader to evaluate the quality of evidence presented and critically assess its place in the hierarchy of available evidence on the topic. The steps taken to reduce bias will differ depending on the type of study undertaken. For a comprehensive set of checklists, specific to the type of study, see Greenhalgh.[2] As a general starting point, consider the points in the box below.

Points to consider when assessing research methods

Patients/participants

- Which subjects/participants were recruited, and which inclusion and exclusion criteria were used? Criteria might include demographic (eg, cat age and gender), environmental (eg, indoor vs outdoor-living), behavioural (eg, spraying indoors) or pathological specifications (eg, urinary infection ruled out). They should be clearly defined and justified in the context of the research question.[2]
- How were the subjects recruited? For example, recruiting via Facebook to a survey on inappropriate elimination in cats is likely to attract owners for whom it is a problem. This method of self-

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selection would be inappropriate to measure the incidence of the problem in the cat-owning population, but might be more acceptable, were the aim to explore where owners sought information and help. For more information on sample selection see Ruxton and Colegrave.[5]

- Were sufficient numbers recruited? The number should be sufficient to draw reliable conclusions from statistical analysis but, where interventions are concerned, ethical guidelines suggest it should be no more than necessary.[6] The relevant calculation of the sample size is called a power analysis and should be documented. For further reading on sample size and power, see Ruxton and Colegrave.[5]
- Was the study reviewed and approved by an independent ethics committee, especially where animals have been used?[2]

Intervention

- If an intervention has been studied, is it clearly defined and replicable, for example, in terms of dosage rates and period of treatment?[2]
- Was the experimental design appropriate? For further reading on experimental design see Ruxton and Colegrave.[5]

Comparison

- Are the test and control groups (where relevant) appropriately defined? They should be as near identical as possible in all aspects other than that which is being studied (eg, the intervention).[2] If not, the authors should note how they have accounted for differences (eg, in statistical analysis) else note if they consider the differences to be a limitation of the research.
- In a randomised controlled trial, has the allocation of subjects to the control or test groups been truly random?[5]
- If the trial is masked, have the subjects and the researchers remained 'blind' to which group the subjects have been allocated?

Outcomes

- Have reliable outcome measures been chosen? Reliable means they measure the variable of interest precisely with minimal random error and consistently.[7] For example, a digital scale might be more reliable than an analogue scale for measuring a cat's weight. The variable should be sufficiently sensitive to small changes in the true variable being studied. For example, the scale might measure kilograms to three decimal places, essential for tiny kittens. Repeated measures of the same thing should produce the same results, whether by the same researcher or between different researchers. If relevant, the authors should document their tests of inter-rater and intra-rater reliability. For further reading, see Ruxton and Colegrave.[5]
- Are the measures valid? Valid means they truly measure what the researcher set out to measure.[7] They should be accurate (free from systematic error). Using the weight example again, a digital scale may be reliable and consistent but could be calibrated incorrectly and systematically over- or underestimate the true weight. They should be specific and measure the variable of interest and nothing else. They should be scientifically valid (appropriate to the over-arching research question).
- Were the subjects followed-up for long enough for clinical outcomes to be observed?[2,8] For example, in a study looking at treatment with fluoxetine for urine marking, Hart et al found that, in some cats, the improvement temporarily declined during the course of treatment and only at 32 weeks of treatment did all cats reach a level of improvement of at least 90%.[9]
- Have the authors noted what statistical analysis was undertaken?[4]

Results
Results should state what was found, without interpretation.[4]

The results often start with descriptive statistics that summarise and describe the data set. For example, distribution frequencies and mean values may describe sample demographics and baseline measures of interest.[10] These may be presented as graphs or tables or written as prose. Here you can check, for example, whether groups were comparable across potentially confounding variables. For example, in a study that tests an intervention to reduce spraying, were factors believed to influence spraying, such as gender, neuter status and presence of environmental stressors, suitably matched between groups?

Inferential statistics are used to test a hypothesis — was there a difference in results between the test and control groups? A named test statistic is calculated, the choice of which will depend on the type of data, the size and nature of the groups being compared and the type of comparison being made. For further reading on test statistics, see Dytham.[10] The test statistics are then compared with the relevant distribution that they are known to follow. The aim is to estimate the probability of obtaining the result found had there been no real-world difference between the groups (the 'null hypothesis'). This is measured by the *P* value associated with the test statistic. The smaller the *P* value, the lower the probability that the difference measured could be obtained by chance. It is standard practice to report *P* values of less than 0.05 as statistically significant.[10]

For further reading on how to interpret the results of interventions and other types of studies, see Holmes and Cockcroft.[8]

Discussion
The discussion should summarise what was found vs the original hypothesis and the implications — the 'so what?' of a paper. The authors should acknowledge any limitations in their study, which may not necessarily be weaknesses, but may reveal opportunities for further research.[11]

Conclusions

These guidelines offer some initial considerations with which to critically appraise a research paper. Returning to Owen and Lamon's question, 'Are cats good?' the reader might be inclined to agree, though possibly not because of the evidence they present!

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