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A Systematic Review on Feline Internal Medicine Articles of Indonesian Veterinary Journals

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Abstract

This systematic review assesses the diversity of research approaches and methodologies in feline internal medicine articles published by Indonesian veterinary journals between 2012 and 2024. Content analysis was conducted on 20 veterinary journals from veterinary schools across Indonesia, with 17 journals (85%) featuring a total of 123 articles on feline internal medicine. A notable increase in articles was observed from 2017, peaking in 2023 with 35 articles (28.46%). Quantitative methods were the most commonly used in 48 articles (39.02%), followed by mixed methods in 44 articles (35.77%) and qualitative approaches in 31 articles (25.20%). Case reports were the predominant research design, found in 65 articles (52.85%), followed by cross-sectional studies (21.14%) and surveys (14.63%). Other designs included RCTs, laboratory studies, case-control, reviews, and cohort studies. Data collection techniques primarily involved testing (82.11%), with additional methods like document analysis, observation, and testing combined with interviews. Descriptive analysis was employed in 106 articles (86.18%), followed by Chi-square (5.69%) and t-test (2.44%). Infectious diseases were the focus of 67 articles (54.47%), while 44 articles (35.77%) addressed non-infectious diseases, and 12 articles (9.76%) covered other topics. The findings indicate a growing interest and methodological diversity in feline internal medicine research within Indonesia.

Keywords

Approaches, Assess, Diversity, Methodology, Research

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Introduction

Globally, cats are the most popular type of pet kept by humans (Biezus *et al*., 2018; McDonald *et al*., 2023). Cats are one of the many pets with a very high level of ownership, not determined by a person's social or economic factors (Carvelli, 2016). There is an indication that small animal practice in Indonesia has shown rapid growth and development in recent years, and cats are the species that dominate patient visits. An international online survey conducted in 2021 also showed that Indonesia is the country with the highest cat ownership in Asia.

With the cat population continuing to increase throughout the world (Kennedy *et al*., 2020), the field of feline internal medicine has gained more attention as it evolves beyond traditional medical models that have largely centered on dogs. Numerous studies demonstrate the need for specialized research, emphasizing areas where feline medicine demands greater focus and new strategies. For instance, Additional research is needed in areas like hypertrophic cardiomyopathy (HCM) in cats, where newly discovered microRNAs indicate a possible role in the disease's development (Garcia-Revilla *et al*., 2024). To date, research related to feline internal medicine in Indonesia is still relatively small compared to the rapid growth of the small animal healthcare industry. This condition can be seen in veterinary journals in Indonesia where articles discussing feline internal medicine are very limited and difficult to find. Moreover, targeted studies on conditions such as feline infectious peritonitis (FIP) and the efficacy of drug delivery methods highlight the importance of continued research to create more effective, species-specific treatments (Zaciq *et al*., 2017).

The importance of this study lies in its potential to contribute to improving the quality of feline medical practice services in Indonesia. The purpose of this systematic review is to assess and explore aspects of feline internal medicine research published in veterinary journals in Indonesia. As such, this review will not only serve as a resource for veterinarians and researchers but also inform educational initiatives aimed at enhancing the development of feline internal medicine studies. Ultimately, this study will contribute to a better understanding of cat health in Indonesia, promoting evidence-based practices that can lead to improved welfare of these animals.

Materials and Methods

This study followed the principles of content analysis, drawing on findings from multiple studies published in Indonesian veterinary journals owned by veterinary schools across Indonesia. The research approach was similar to that used by Fauzi and Pradipta (2018). Data were collected from 17 of 20 journals that can be accessed online, both accredited and non-accredited, from 2012 to 2024. The research instrument (Table 1) consisted of some aspects adopted from Susetyarini and Fauzi (2020) and categories according to Sumiarto and Budiharta (2021). Each article was categorized into a specific group according to certain criteria that matched the defined category. The classification was made based on information provided by the authors in the abstract, methodology, and discussion sections. Additionally, the collected data were displayed as a bar chart.

Table 1. Aspects and categories used for content analysis in the study

Aspects	Categories
Research approach	Quantitative, qualitative, mixed
Research design	a. Descriptive: case report, case series, survey, review b. Analytical a) Observational: case-control, cross-sectional, cohort b) Experimental: laboratory, randomized clinical trial (RCT)
Data collection technique	Test, test + interview, observation, document
Data analysis	Chi-square, t-test, descriptive, ANOVA, ANOVA + Tukey, regression analysis, correlation test, odds ratio, Duncan's test, Cohen's Kappa
General studied subjects	Infectious disease, non-infectious disease, others

Results and Discussion

The search for veterinary journals published by veterinary schools across Indonesia revealed a total of 20 online-accessible journals. Of these, 13 journals (65%) have obtained national accreditation through SINTA (1, 2, 3, and 4), while only one journal has achieved international accreditation. A comprehensive review of the journals identified 123 articles related to feline internal medicine, spanning 17 distinct publications. These articles were published between 2012 and 2024 (per September) and consisted of original research, case reports, and reviews.

The volume of published articles (Figure 1, bar chart A) on feline internal medicine remained minimal during the 2012-2016 period, accounting for just four publications (3.25%). However, a positive trend emerged between 2017 and 2021, with 30 articles (24.39%) published. This upward trajectory accelerated significantly from 2022 to 2024, with 89 articles (72.36%) contributing to a marked increase in scholarly output. Meanwhile, in feline internal medicine research, the predominant methodology (Figure 1, bar chart B) is quantitative, accounting for 48 studies (39.02%). However, mixed-method approaches are nearly as common, with 44 studies (35.77%). In contrast, qualitative approaches are the least frequently employed.

The dramatic rise in published feline internal medicine articles—from just four between 2012-2016 to 89 between 2022-2024—reflects a notable surge in interest and resources devoted to this area. This trend indicates an expanding awareness of feline health issues within the veterinary sector, alongside a growing need for advanced knowledge in feline medical care. Such growth may be influenced by a heightened public concern for feline health in Indonesia. In recent years, Ukraine has experienced a notable rise in cat ownership, which has consequently been associated with a higher incidence of feline diseases (Radzikhovskyi *et al*., 2022). Identifying the factors driving this trend can help maintain and focus research efforts on key priority areas. In 2022, articles on internal medicine topics accounted for 52.4% of the total publications in the journal Gaceta Médica Estudiantil, with a notable portion focusing on developments in feline internal medicine, underscoring a growing trend in research within this area (Espinosa Goire *et al*., 2023). Quantitatively, feline-focused research may still be insufficient. Banchi *et al*. (2022) conducted a bibliometric analysis of small animal

reproduction studies and found that canine research substantially outnumbers feline research. Clinical areas, such as feline neonatology, remain notably underrepresented and require further investigation. Research on gut health in cats is also still rare compared to other species (Colombino *et al*., 2021). Future research in small animal nutrition would greatly benefit from studies focused on feline metabolism incorporating molecular-level testing methods (Deng *et al*., 2015).

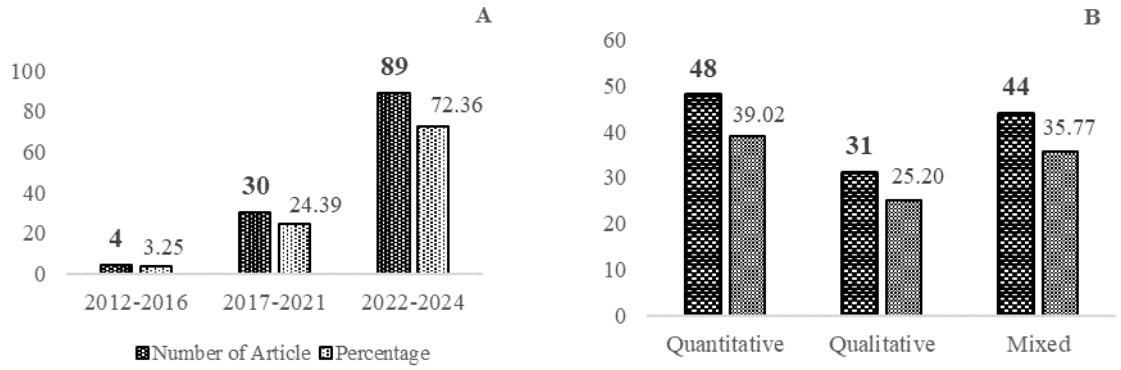

Figure 1. Number and percentage of published articles per each year group (A) and types of research approach found in the feline internal medicine articles (B).

Furthermore, quantitative methods are the most widely used as the research approach, seen in 48 articles (39.02%), followed by mixed (quantitative + qualitative) and qualitative methods. For instance, Tsunekawa *et al*. (2024) used quantitative methods to conduct research on the management of feline chronic kidney disease. Quantitative research offers significant strengths, particularly its capacity to generate statistically rigorous findings that are essential for generalizing results, a crucial aspect in clinical research contexts (Arrigo *et al*., 2023). In conducting quantitative research, Barroga *et al*. (2023) stated that scientists are required to articulate established theories, formulate hypotheses based on these theories, rigorously test the hypotheses through new studies, and subsequently reassess the initial theories. Following this process, a deductive approach is employed to structure and present experimental evaluations of the established theoretical frameworks.

Mixed-method approaches constitute a substantial segment of the research (44 articles, approximately 36%), indicating an increasing recognition of the value in integrating quantitative precision with qualitative depth. Mixed-methods appear to be used quite extensively in many research projects, as applied by Jayanti *et al*. (2023) in conducting a case report on hemoplasmosis in a cat. The incorporation of a mixed-methods approach is also recommended in health research to combine and present both quantitative and qualitative analyses, while highlighting their significance (Guetterman *et al*., 2015). Mixed methods are particularly effective for addressing complex cases where quantitative data may not provide a complete understanding. Promoting and expanding

mixed-methods research could enhance the comprehension of intricate health conditions in feline patients while also encouraging Indonesian veterinary journals to adopt and publish studies that integrate diverse, multi-dimensional perspectives.

On the other hand, qualitative research methodologies have been increasingly employed across diverse fields, including healthcare research (Im *et al*., 2023), and may hold valuable applications within feline internal medicine. A contrasting perspective suggests that qualitative research in medicine and healthcare remains relatively limited (Pyo *et al*., 2023). While not yet prevalent in feline medicine, there is a growing body of qualitative research in ruminant medicine, especially within the domain of dairy science (Ritter *et al*., 2023). Effective use of qualitative methods can enable veterinary economists and epidemiologists to create policy recommendations and interventions that are well-suited to the sociocultural and political contexts in which they will be applied (Degeling and Rock, 2020). This approach could also be relevant for research in feline internal medicine.

Among the eight research designs identified (Figure 2, bar chart A) in feline internal medicine studies, the case report emerged as the most frequently utilized, accounting for 65 articles (52.85%). The cross-sectional design was the second most prevalent, appearing in 26 articles (21.14%), followed by the survey design, which was employed in 18 articles (14.63%). Notably, randomized clinical trials (RCTs) and laboratory-based studies were less common, each featured in only four articles (3.25%). Furthermore, several research designs were rarely used, such as case-control, review, and cohort.

Figure 2 (bar chart B) illustrates that the predominant data collection method in studies on feline internal medicine is diagnostic testing, utilized in 101 articles (82.11%). In contrast, the use of medical records or documentation, as well as observational techniques, is infrequent, appearing in only 10 articles each (8.13%). The least common approach is the integration of testing and interviews, which is seldom employed by researchers.

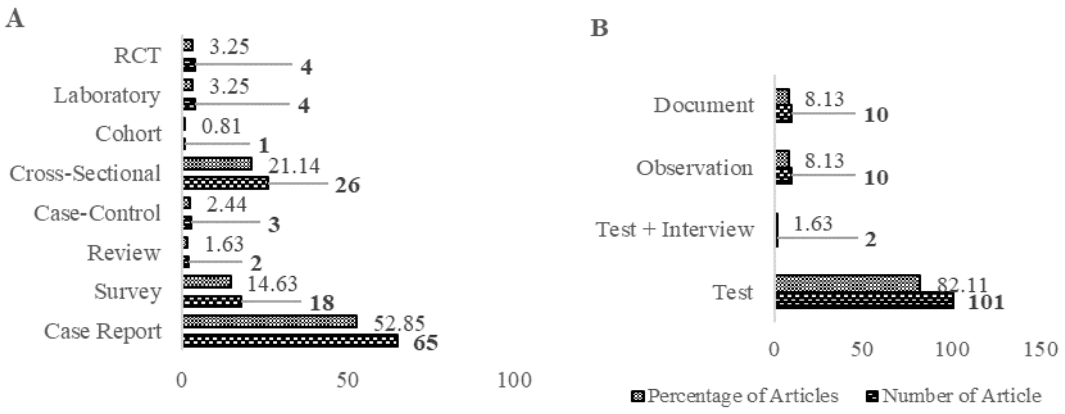

Figure 2. Number and percentage of research design used (A) and types of data collection technique found in the feline internal medicine articles (B).

Case report design was the most widely used by feline internal medicine researchers. A case report is a research design, describing important scientific observations found in a clinical setting to expand a knowledge base and creating a case report is methodologically much easier than conducting other elaborative research designs (Alsaywid and Abdulhaq, 2019). As reported by Samuel *et al*. (2023), as many as 43% of the 15,512 articles on veterinary interventional radiology and endoscopy were research with a case report design. It may be that the low level of methodological difficulty is the reason why many researchers choose case reports in clinical scientific writing. Case reports provide detailed accounts of atypical disease manifestations, diagnostic obstacles, and remarkable treatment achievements. However, while some journals have phased out case report publications, a number of new journals dedicated specifically to case reports have emerged in recent years (Bouchara and Chaturvedi, 2018). Case reports were also found to be one of six categorizations in research on trends in veterinary radiation oncology articles from 1976-2015 (Nagata, 2019).

In this review, cross-sectional studies ranked as the third most frequently utilized design, appearing in 26 articles. Cross-sectional research with binary outcomes is among the most prevalent observational study designs in veterinary medicine (Martinez *et al*., 2017). A systematic review of articles containing risk factors for transmission of Mycobacterium avium subsp. paratuberculosis, published in 12 journals from 11 different countries, also found that 16 of the 23 articles used a cross-sectional design (Doré *et al*., 2012).

Randomized clinical trials (RCTs) are regarded as the highest standard of evidence for evaluating the effectiveness of treatments (Wareham *et al*., 2017). However, RCTs are found to be very rarely conducted by researchers in the field of feline internal medicine in Indonesia. This still remains a question as to whether it is related to the opinion that numerous factors can affect their reliability, such as the quality of the methodology, the accuracy of reporting, and the source of funding (Wareham *et al*., 2017). Randomized controlled trials are structured experiments that include participants who are ill or at risk, with the purpose of assessing a specific intervention. Key elements of an RCT involve having one or more comparison (or control) groups and allowing researchers to manage how the intervention is assigned (Sargeant *et al*., 2014). Winkel *et al*. (2019) conducted a study on case study projects by students for the development of professional skills of veterinary students while a survey conducted by Di Girolamo and Reynsders (2016) showed that, compared to RCTs in human medicine, RCTs in veterinary medicine were smaller and less likely to involve real patients.

A key phase in a research study is data collection, which allows the researcher to obtain answers to the study's questions (Taherdoost, 2021). There is a finding that the testing method is the most widely used technique for data collection in feline internal medicine research. According to Thrusfield *et al*. (2018), data can be gathered through three primary methods: observation, completing questionnaires, and utilizing documentary sources. Observation plays a key role in clinical veterinary medicine and is also significant in

many epidemiological studies. The number of studies that utilize documents, such as medical records, as a data source is much smaller in feline internal medicine articles. As stated by Lopez Pineda *et al*. (2020), veterinary medical records represent an underutilized source of data that holds potential to improve patient care, yet few methods currently exist to harness this information effectively. However, Jones-Diette *et al*. (2016) reported an increase in patient data extraction from electronic patient management systems for veterinary research purposes.

A notable disparity is observed in the frequency of data analysis techniques employed (Figure 3, bar chart A). Descriptive analysis is the most prevalent approach in feline internal medicine research, appearing in 106 articles (86.18%). Chi-square analysis is utilized in seven articles (5.69%), while the t-test is applied in three articles (2.44%). Other statistical methods are used sparingly, each appearing in only one article (0.81%). In the context of general research subjects (Figure 3, bar chart B), infectious diseases represent the most extensively studied category, accounting for 67 articles (54.47%). Non-infectious diseases also constitute a significant portion, appearing in 44 articles (35.77%), while the remaining studies focus on topics outside of these two primary categories.

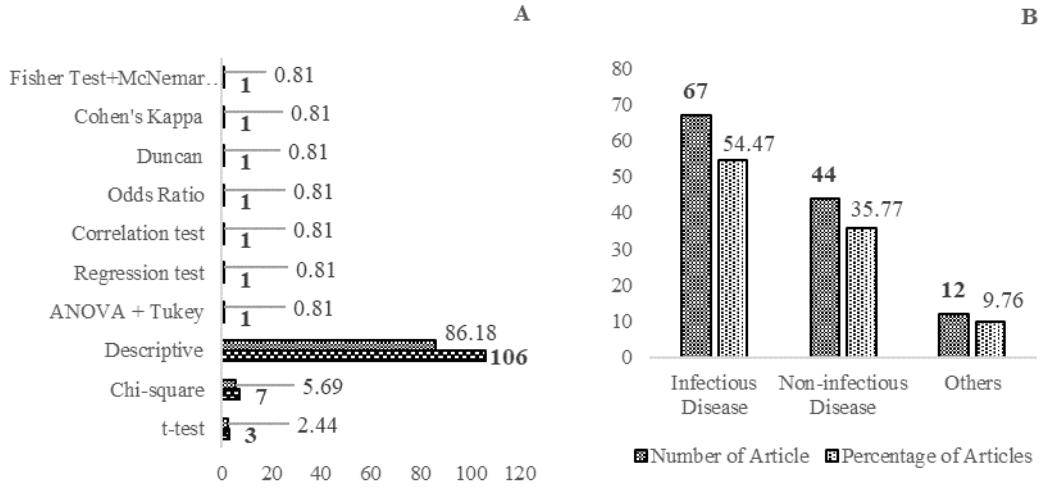

Figure 3. Number and percentage of data analysis technique used (A) and general subject studied found in the feline internal medicine articles (B).

With regard to data analysis techniques, descriptive statistics has proven to be the most widely used tool by feline internal medicine researchers. This high use of descriptive statistics seems to be in accordance with the high use of case report designs in feline internal medicine studies in Indonesia. This is relevant to the statement that descriptive statistics offer an overview of the sample being examined without relying on conclusions derived from probability theory (Kaliyadan and Kulkarni, 2019). Even though the primary focus of a

study is often on inferential statistics, descriptive statistics are still employed to give a basic summary. In the era of complex big data, descriptive statistics have become valuable tools for scientists because they can accurately depict underlying information (Lušņičenko *et al*., 2024). In biomedical research, descriptive statistics are an important aspect used to describe the basic features of the data in the study, as well as providing a simple summary of the samples and measurements (Mishra *et al*., 2019). Although the primary aim of a study is to perform inferential statistics, descriptive statistics are also applied to offer an overall summary (Kaliyadan and Kulkarni, 2019). Descriptive statistics provide a straightforward way to summarize data and play a crucial and insightful role in statistical analysis and serve as a foundation for more advanced analysis (Dong, 2023).

Chi-Square analysis appears to be frequently found in feline internal medicine articles in Indonesia (seven articles). This analysis evaluates the strength of the association between dependent and independent variables (Sogunle and Sogunle, 2018) and could, therefore, be essential for various studies in feline internal medicine. For example, Chi-Square analysis was carried out by Siswandi (2023) to prove that there was no relationship between sex and age on the prevalence of gastrointestinal parasite infestation in cats hospitalized in veterinary clinics. Plumeriastuti *et al*. (2023) also used Chi-Square analysis to determine the risk factors for the incidence of Feline Lower Urinary Tract Disease in a veterinary clinic.

Although only three feline internal medicine studies were found to use the t-test for statistical analysis, this small number may serve as a catalyst for future studies to use clinical designs. The Student's t-test is a statistical method employed to test hypotheses by comparing the means of different groups (Mishra *et al*., 2019). This test is suitable for making statistical inferences when the data follow a normal distribution or approximately do so as the sample size increases (Zhao *et al*., 2021). Gostelow *et al*. (2016) used a paired t-test to analyze the efficacy of human-recombinant protamine zinc insulin in cats with diabetes mellitus. Similarly, Do *et al*. (2022) performed a t-test to assess the palatability and overall gastrointestinal digestibility of macronutrients in a diet incorporating black soldier fly larvae, along with its impact on the fecal traits of cats that consumed this diet.

No less interesting, the topic of infectious diseases is widely studied by researchers (found in 67 articles). This is in accordance with Stull *et al*. (2019) that the occurrence and distribution of feline infectious diseases are continually changing. Infectious diseases such as feline leukemia virus (FeLV) still have the highest prevalence compared to several other internal diseases as reported by Choi *et al*. (2023). Furthermore, feline infectious diseases are distributed as follows: viruses account for 60%, bacteria for 20%, fungi for 15%, and protozoa for 5%, and among these, the most frequently diagnosed infectious agent is FeLV (Biezus *et al*., 2018).

Studies on feline non-infectious diseases were found in 44 articles, a fairly high number. Degenerative disease is one of them, and osteoarthritis is the most common degenerative disease in pets, including cats (Barbeau-Grégoire *et al*., 2022), and is strongly associated with pain (Enomoto *et al*., 2020). Degenerative joint disease (DJD) has been documented in cats globally (Kimura *et al*., 2020), with factors like obesity, outdoor access, and past injuries

potentially increasing the likelihood of owner-observed mobility issues related to the condition. Interestingly, neutering cats before six months of age may help lower this risk (Maniaki, 2021).

Ultimately, it can be deduced that the number of feline internal medicine articles published by veterinary journals throughout Indonesia is generally still very limited. This shows that the enthusiasm of academics, researchers and practitioners is not yet high enough to conduct research and publish scientific articles related to feline internal medicine. Research designs in the field of feline internal medicine using RCTs are also very few, on the other hand RCTs are the gold standard in clinical research.

Conclusion

The results of this systematic review reveal a dynamic progression in feline internal medicine research within Indonesia, marked by a notable increase in publications and a growing variety of methodologies. The dominance of case reports and studies focusing on infectious diseases indicates a strong focus on clinical documentation and addressing significant health challenges in feline populations. The increased adoption of mixed-methods approaches and advanced statistical techniques reflects a maturation of research practices. Nevertheless, the underrepresentation of robust study designs, such as randomized controlled trials and cohort studies, highlights the potential for enhancing research rigor and advancing evidence-based veterinary practices. This review provides a critical reference point for future research, underscoring the importance of sustained inquiry and methodological innovation to meet the diverse health requirements of cats and foster progress in veterinary science in Indonesia.

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Author's Contribution

The authors contributed significantly to the development of this article. JH: Responsible for conceptualizing the study, conducting the research, and writing the initial draft. ADP: Contributed to data analysis, interpretation of results, and revising the manuscript. HBP and SRPWS: Collected all the Indonesian veterinary journals and selected feline internal medicine articles. All authors have read and approved the final version of the article.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

Data Availability Statement

All data used in this research are openly available and can be accessed by readers. For detailed instructions on how to access the data, please refer to the supplementary materials.

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