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Literature Review

A Systematic Review of Indonesian Veterinary Research on Abattoir and Animal Slaughtering: Scientific Methods and Approaches

Tinjauan Sistematis Penelitian Veteriner Indonesia tentang Abatoar dan Pemotongan Hewan: Metode dan Pendekatan Ilmiah

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ABSTRACT

Background: Veterinary research on abattoirs and animal slaughter published in Indonesian journals requires comprehensive evaluation due to its close relevance to animal-derived food production and public health. **Purpose:** This systematic review analyzes studies on abattoirs and slaughter practices published from 2014 to 2024 in 20 Indonesian veterinary journals, including 13 SINTA-accredited and 7 non-accredited journals. **Review:** A total of 37 articles were examined to identify research themes, methodological approaches, study designs, analytical techniques, and disciplinary focuses. **Result:** Publication trends over the decade fluctuated, with no significant correlation between publication year and article count ($r = 0.43$; $p > 0.05$). Cattle were the most frequently examined species (13 studies), showing a significant difference in the distribution of research subjects ($\chi^2 = 79.50$; $p = 6.15 \times 10^{-14}$). Quantitative and mixed-method approaches were the most commonly used (17 and 19 studies), and their adoption differed significantly ($\chi^2 = 11.80$; $p = 0.0027$). The descriptive survey design dominated the literature (32 studies), with a significant difference from other designs ($\chi^2 = 21.85$; $p = 0.000018$). Differences in analytical techniques were not significant ($\chi^2 = 94.49$; $p = 1.47 \times 10^{-19}$), although descriptive analysis was most frequently applied. Veterinary public health was the primary disciplinary focus (15 studies), but the overall disciplinary distribution was not significantly different ($\chi^2 = 1.121$; $p = 0.993$). **Conclusion:** This review provides a concise overview of research priorities and methodological patterns in Indonesian veterinary literature on abattoirs and animal slaughter. The findings highlight the dominance of descriptive and mixed-method studies, the strong focus on public health, and the need for more diverse methodological and disciplinary approaches in future research.

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ABSTRAK

Latar Belakang: Penelitian veteriner mengenai abatoar dan pemotongan hewan yang dipublikasikan dalam jurnal-jurnal Indonesia memerlukan evaluasi komprehensif karena berkaitan erat dengan produksi pangan asal hewan dan kesehatan masyarakat. **Tujuan:** Tinjauan sistematis ini menganalisis studi-studi tentang abatoar dan praktik pemotongan hewan yang dipublikasikan pada periode 2014 hingga 2024 di 20 jurnal veteriner Indonesia, terdiri atas 13 jurnal terakreditasi SINTA dan 7 jurnal tidak terakreditasi. **Tinjauan:** Sebanyak 37 artikel ditelaah untuk mengidentifikasi tema penelitian, pendekatan metodologis, desain penelitian, teknik analisis, dan fokus keilmuan. **Hasil:** Tren publikasi selama satu dekade menunjukkan fluktuasi, tanpa korelasi signifikan antara tahun publikasi dan jumlah artikel ($r = 0.43$; $p > 0.05$). Sapi merupakan spesies yang paling banyak diteliti (13 studi), dengan perbedaan signifikan dalam distribusi subjek penelitian ($\chi^2 = 79.50$; $p = 6.15 \times 10^{-14}$). Pendekatan kuantitatif dan metode campuran menjadi yang paling sering digunakan (masing-masing 17 dan 19 studi), dengan perbedaan signifikan dalam penerapannya ($\chi^2 = 11.80$; $p = 0.0027$). Desain survei deskriptif mendominasi literatur (32 studi), dengan perbedaan signifikan dibandingkan desain lainnya ($\chi^2 = 21.85$; $p = 0.000018$). Perbedaan teknik analisis data tidak signifikan ($\chi^2 = 94.49$; $p = 1.47 \times 10^{-19}$), meskipun analisis deskriptif paling sering digunakan. Kesehatan masyarakat veteriner menjadi fokus keilmuan utama (15 studi), namun distribusi disiplin secara keseluruhan tidak berbeda signifikan ($\chi^2 = 1.121$; $p = 0.993$). **Kesimpulan:** Tinjauan ini memberikan gambaran yang jelas mengenai arah penelitian dan kecenderungan metodologis dalam literatur veteriner Indonesia terkait abatoar dan pemotongan hewan. Hasilnya menyoroti dominasi penelitian deskriptif dan metode campuran, kuatnya perhatian pada kesehatan masyarakat, serta perlunya pendekatan yang lebih beragam dan kolaboratif di masa mendatang.

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INTRODUCTION

The process of animal slaughter in Indonesia plays a crucial role in the livestock sector, not only in meeting domestic food demands but also in supporting various economic activities. However, empirical evidence indicates that national beef production remains insufficient to fulfil public consumption needs (Astuti *et al.*, 2023). Slaughtering operations in abattoirs are required to comply with established standards to ensure hygiene, food safety, and animal welfare. In the context of modernizing meat safety systems, maintaining hygiene throughout the slaughter and processing chain is recognized as a critical risk factor in abattoir management (Salines *et al.*, 2023). Despite this, compliance with regulatory standards varies widely among Indonesian abattoirs, affecting both meat quality and animal welfare. Additionally, ethical concerns regarding animal welfare particularly those related to slaughter practices are receiving increasing public attention, which has led to a rise in studies addressing this issue (Wigham *et al.*, 2018).

Veterinary research on abattoirs and slaughtering practices in Indonesia remains limited, particularly studies evaluating the scientific principles and techniques applied in these processes. This study aims to address this gap by systematically reviewing veterinary literature on slaughterhouses and animal processing practices published in Indonesian scientific journals. Adherence to proper slaughter protocols is essential, as deviations may heighten public health risks through microbial contamination of meat. Persistent issues related to abattoir hygiene, meat safety, and packaging have also been identified, especially when assessed using the Hazard Analysis and Critical Control Point (HACCP) framework (Mail *et al.*, 2021). With the growing demand for meat production, slaughterhouses play an increasingly important role in ensuring meat quality and halal compliance (Gaznur *et al.*, 2017). Inadequate slaughtering techniques and poor animal welfare practices not only compromise meat quality but also violate ethical and welfare standards. Therefore, a comprehensive assessment of the methodologies and scientific approaches used in veterinary research on this topic is expected to provide valuable insights for improving slaughterhouse practices in Indonesia. While global research trends continue to emphasize animal welfare (Bekuma and Tadesse, 2024; Schneidewind *et al.*, 2024), food safety (Li *et al.*, 2024), and zoonosis control (Nwankwo *et al.*, 2023; Pal *et al.*, 2024), the Indonesian context faces similar challenges yet shows evident gaps in methodological rigor and publication volume. This literature study offers a significant contribution through its comprehensive analysis of scientific aspects related to animal slaughter, providing a foundation for policy development and best practices in Indonesia. The study focuses on identifying, evaluating, and advancing scientific methodologies in veterinary research concerning slaughterhouses and slaughtering procedures. A systematic review of existing literature and empirical findings is undertaken to obtain a detailed understanding of current trends, methodological approaches, and the overall diversity of veterinary research related to animal slaughter in Indonesia.

REVIEW

Several inclusion criteria were applied in this study. Eligible articles were required to be written in either Indonesian or English and to primarily address topics related to slaughterhouses or animal slaughter. The sources consisted of veterinary journals published by Indonesian veterinary schools, irrespective of their accreditation status. Only articles published between 2014 and 2024 were included. Short communications, review articles, and meta-analyses were excluded from the analysis. The study adopted the content analysis method described by Fauzi and Pradipta (2018), focusing on research findings pertaining to abattoirs and animal slaughter. Data were obtained from veterinary journals published by higher education institutions in Indonesia, including journals indexed in the national database (<https://sinta.kemdiktisaintek.go.id/>) as well as non-indexed journals. As of 2024, a total of 20 veterinary journals had been identified across various institutions. Articles were accessed directly through the respective journal websites. From the overall pool of publications, 37 articles met the eligibility criteria and were included in the review.

The analytical framework employed in this study was adapted from Susetyarini and Fauzi (2020). The framework encompassed several components, including the annual distribution of publications, research subjects, methodological approaches (quantitative, qualitative, or mixed methods), data analysis techniques (e.g., statistical procedures, interviews, observations, and document analysis), and associated scientific disciplines. Research design classifications followed the guidelines of Sumiarto and Budiharta (2021), which broadly distinguish between descriptive and analytical designs. Content analysis was carried out on all eligible articles to identify their methodological characteristics (Susetyarini and Fauzi, 2020). Data extracted from each analytical component were synthesized and presented using tables and graphical visualizations. Pearson's correlation coefficient was used to assess publication trends and determine their statistical significance (Zhao *et al.*, 2021), while Chi-square tests were performed to evaluate the degree of variation among categories (Sumiarto and Budiharta, 2021). A comprehensive search of Indonesian veterinary journal websites covering the 2014–2024 period identified 37 articles related to abattoirs and animal slaughter. The annual publication trends are presented in Figure 1, while the methodological characteristics including research subjects, methodological approaches, research designs, analytical techniques, and disciplinary focuses are summarized in Table 1.

The findings indicate that this research theme has not yet gained substantive attention within veterinary scholarship or aligned scientific fields. Although publication counts fluctuated over the 11-year period, the temporary rise in 2018–2019 did not translate into sustained growth. The weak to moderate correlation between publication year and article volume ($r=0.43$) was statistically insignificant ($p>0.05$), underscoring the absence of a meaningful upward trend. This suggests that the field lacks consistent academic momentum



Figure 1. Trends in the number of scientific articles related to abattoir and animal slaughter published by Indonesian veterinary journals in the period 2014-2024.

and remains underexplored. Significant variation was observed in the distribution of research subjects ($\chi^2 = 79.50$; $p = 6.15 \times 10^{-14}$), reflecting heterogeneity rather than a coordinated research direction. Mixed-methods approaches dominated, surpassing purely quantitative and qualitative designs. The significant imbalance ($\chi^2 = 11.80$; $p = 0.0027$) implies that methodological choices may be driven more by convenience or tradition than by epistemological rigor.

The predominance of survey-based descriptive research appearing in 22 publications further illustrates a methodological limitation. In contrast, more robust designs such as cross-sectional analytical studies (three publications) and randomized controlled trials (two publications) were rarely employed. The significant skew toward descriptive surveys ($\chi^2 = 21.85$; $p = 0.000018$) suggests an overreliance on low-inference designs, which may constrain the depth and applicability of findings in abattoir and animal-slaughter research. Analytical techniques also showed substantial imbalance. Descriptive analysis dominated 83.78% of studies, while inferential methods were minimally represented. The Chi-Square test ($\chi^2=94.49$; $p = 1.47 \times 10^{-19}$) confirmed a statistically significant disparity, indicating a tendency toward superficial interpretation, with limited efforts to generate predictive or causal insights. Although veterinary public health appeared most frequently (15 articles), followed by animal welfare and parasitology, the distribution across disciplines was statistically uniform ($\chi^2 = 1.121$; $p = 0.993$). This apparent balance, however, may reflect the generally low research intensity rather than true interdisciplinarity. Taken together, the findings highlight a field characterized by fragmented efforts, heavy reliance on descriptive approaches, and limited methodological rigor underscoring the need for more analytical, evidence-driven, and experimentally robust investigations in future research.

DISCUSSION

Abattoirs play a critical role in the meat supply chain (Ekpunobi *et al.*, 2024), ensuring that meat products remain halal, safe (Arifin *et al.*, 2021), wholesome, and free from adulteration. They also serve as important facilities for the surveillance and monitoring of animal diseases (Aminah *et al.*, 2022). In Indonesia, however, the number of halal-certi-

Table 1. Quantity and Percentage of Each category of Analyzed Aspects Identified in Research Articles Related to Abattoirs and Animal Slaughter

Aspects Analyzed	Quantity	Percentage (%)
Subjects		
Cattle	13	35.14 ^a
Goat	4	10.81 ^c
Sheep	1	2.70 ^c
Pig	7	18.92 ^b
Poultry	1	2.70 ^c
Sacrificial Animals	2	5.41 ^d
Meat	4	10.81 ^c
Abattoir	1	2.70 ^c
Employee	4	10.81 ^c
Approaches		
Quantitative	17	45.95 ^b
Qualitative	1	2.70 ^c
Mixed	19	51.35 ^a
Designs		
Descriptive Survey	32	86.49 ^a
Analytical Survey	3	8.11 ^b
RCTs	2	5.41 ^c
Data Analysis		
Covarians	1	2.70 ^c
Descriptive	31	83.78 ^a
Analysis of Variance	1	2.70 ^c
Chi-Square Test	3	8.11 ^b
t-test	1	2.70 ^c
Disciplines		
Parasitology	7	18.92
Pathology	1	2.70
Veterinary	1	2.70
Reproduction	1	2.70
Histology	2	5.41
Pharmacology	1	2.70
Halal Food	15	40.54
Veterinary Public Health	9	24.32
Animal Welfare		

Note: Numbers followed by the same superscript letter in the same column of each aspect analyzed are not significantly different based on Chi-Square analysis ($\alpha=5\%$).

fied abattoirs remains limited (Sumiati *et al.*, 2019), even though halal food is a fundamental requirement for the majority of the population. Moreover, micro-, small-, and medium-scale slaughter enterprises have not yet fully achieved halal certification (Mustahal, 2022). All procedures conducted within slaughterhouses are closely linked to food safety and zoonotic risk; inadequate hygiene and sanitation can substantially increase the proliferation of pathogenic microorganisms (Ovuru *et al.*, 2024). Given the diverse challenges associated with slaughterhouse operations, research is urgently needed to develop innovative and evidence-based solutions. This field holds considerable potential for scientific advancement and would benefit greatly from interdisciplinary collaboration. As key veterinary facilities, slaughterhouses are also expected to contribute more fully to epidemiological investigations through integrative collaboration with diagnostic laboratories (Dini *et al.*, 2022). Content analysis of research articles on abattoirs and animal slaughter indicates that cattle are the most frequently studied species. This predominance may reflect the increasing

demand for beef, despite overall low per capita meat consumption in several countries (Smith *et al.*, 2018). Cattle also constitute the highest proportion of animals slaughtered globally (Oliveres-Ferretti *et al.*, 2022). In Ethiopia, for example, 88% of slaughtered animals are cattle (Getahun *et al.*, 2020). Findings of this review also show that pigs constitute the second most frequently studied species in abattoir-related research. Although pork consumption is limited to certain communities, pigs remain an economically important livestock commodity (Anes *et al.*, 2019; Saputra *et al.*, 2020). Nursida *et al.* (2020) further emphasized the substantial economic potential of pig farming in Indonesia.

Goats appear as another frequently studied species. Bello *et al.*, (2022) reported that goats account for 6.35% of animals slaughtered in abattoirs. Small ruminant husbandry is widely practiced in rural areas, contributing significantly to protein availability (Chama *et al.*, 2019). However, the slaughter of goats is often performed traditionally and outside formal abattoir facilities (Qekwana *et al.*, 2017). Meat, as the primary product of abattoirs, is also a commonly examined subject, reflecting the fundamental function of abattoirs as providers of safe meat for public consumption (Muhami and Haifan, 2019). Slaughterhouse workers have likewise been the focus of several studies, including assessments of hygiene compliance, slaughter procedures, and occupational sanitation (Deswitta *et al.*, 2018; Dayana *et al.*, 2019).

In contrast, studies concerning sacrificial animals particularly sheep and poultry remain scarce. Field observations indicate major concerns regarding animal welfare, health, sanitation, meat hygiene, and slaughter personnel performance during religious slaughter practices. From a veterinary public health perspective, the implementation of proper slaughter procedures for sacrificial animals remains suboptimal (Handoko *et al.*, 2024). When placed within a global context, noticeable gaps become evident. International literature increasingly emphasizes food safety risk categorization (Salines *et al.*, 2023), One Health-based zoonotic surveillance (Fèvre *et al.*, 2023), and welfare monitoring during slaughter (Bekuma and Tadesse, 2024; Browning and Veit, 2020). In contrast, Indonesian publications remain dominated by descriptive surveys addressing basic public health concerns, with limited analytical, experimental, or surveillance-oriented studies. Abattoir-based epidemiological and environmental assessments, widely conducted in Africa and Latin America (Bello, 2023; Wakeyo *et al.*, 2019), remain underrepresented in Indonesia, highlighting the need to align national research with global methodological standards.

Quantitative research provides significant advantages due to its reliance on statistical validation, which is essential for generating generalizable findings (Arrigo *et al.*, 2023). Barroga *et al.*, (2023) emphasized that quantitative studies require theory-based hypothesis development and rigorous empirical testing. Wakeyo *et al.*, (2019) applied quantitative methods in evaluating the environmental implications of abattoir waste management. Mixed-methods research, meanwhile, is partic-

ularly effective for addressing multifaceted issues, integrating quantitative and qualitative data to yield comprehensive insights (Guetterman *et al.*, 2015). For instance, Bello (2023) explored the impact of slaughterhouse location on surrounding communities using a mixed-methods approach, while Maman *et al.*, (2018) used mixed methods to assess halal risk mitigation in the Indonesian–Australian red meat supply chain.

Qualitative research remains relatively uncommon in veterinary studies. Qualitative descriptive approaches, though epistemologically simpler, are often difficult to distinguish from other qualitative methodologies (Bradshaw *et al.*, 2017). Nevertheless, qualitative methods have been applied to examine halal slaughter practices (Nawawi and Peristiwo, 2022) and regulatory aspects of halal certification (Mustahal, 2022). Survey design continues to play an important role in veterinary research (Yang and Laven, 2021). Its importance lies in its influence on sampling, data collection, and the reliability of research outcomes (Christopher and Udoh, 2020). The central role of slaughterhouses in disease surveillance may explain the frequent use of descriptive surveys. This design has been employed in studies of brucellosis seropositivity (Septiningtyas *et al.*, 2018) and animal welfare during sacrificial slaughter (Sambodo *et al.*, 2023).

Cross-sectional studies although widely used in veterinary epidemiology remain limited in abattoir research. These studies assess population characteristics at a specific point in time and are commonly used to estimate disease prevalence or identify risk factors (Wang and Cheng, 2020). Examples include assessments of slaughterhouse profiles (Tolistiawaty *et al.*, 2016) and evaluations of workers' food safety practices (Gebeyehu and Tsegaye, 2022). Experimental designs, especially randomized controlled trials (RCTs), are rarely conducted in slaughterhouse-related studies despite their status as the gold standard for establishing causal inference (Wareham *et al.*, 2017; Sargeant *et al.*, 2014). Nevertheless, RCTs have been used to compare slaughter methods (Pisestyani *et al.*, 2016) and examine cortisol responses in cattle (Sarmin *et al.*, 2014).

The predominance of descriptive analytical techniques reflects the widespread use of survey-based designs in Indonesian slaughterhouse research. Descriptive statistics effectively summarize data and support initial exploratory analysis (Kaliyadan and Kulkarni, 2019; Dong, 2023). They are also essential in biomedical studies for characterizing sample attributes (Mishra *et al.*, 2019). Descriptive analysis has been employed to detect multi-antibiotic-resistant *Escherichia coli* in cattle before slaughter (Mustika *et al.*, 2024) and to evaluate compliance with veterinary public health standards during sacrificial slaughter (Handoko *et al.*, 2024). The importance of veterinary public health in safeguarding human health has been widely acknowledged (Khatun *et al.*, 2019). Improvements in animal production systems have significantly contributed to global public health advances. Strengthening slaughterhouse roles in zoonotic disease

control (Gemesho, 2023) and enforcing meat hygiene regulations (Pakpahan and Anggriawin, 2022; Njoga *et al.*, 2023) are therefore essential. From a One Health perspective, slaughterhouses constitute essential public health infrastructure (Fèvre *et al.*, 2023).

Animal welfare represents another critical and increasingly recognized issue. Welfare concerns arise throughout the pre-slaughter and slaughter process (Browning and Veit, 2020) and directly affect meat quality (Bekuma and Tadesse, 2024). Factors influencing welfare include farm management, transport conditions, and stunning methods (Chulayo and Muchenje, 2016; Saputro, 2021). This review demonstrates that animal welfare remains an important and highly relevant research area in Indonesia. Parasitology also emerges as a frequently studied discipline. Slaughterhouses offer valuable opportunities for parasitic surveillance. Parasitic infestation continues to be a major health challenge with adverse economic impacts (Rizwan *et al.*, 2023). Fascioliasis, for instance, affects both livestock and humans (Alaba *et al.*, 2023). High prevalence of gastrointestinal parasites such as *Oesophagostomum radiatum*, *Trichuris spp.*, trematodes, and cestodes has been reported in various Indonesian slaughterhouses (Haajidah *et al.*, 2020; Kurnia *et al.*, 2019; Lubis *et al.*, 2019). These findings reinforce the role of abattoirs as critical surveillance points for animal diseases (Aminah *et al.*, 2022).

CONCLUSION

This review shows that research on abattoirs and animal slaughter in Indonesia remains limited in scope, methodological rigor, and thematic diversity. Most studies rely on descriptive survey designs and basic descriptive analyses, with few employing analytical or experimental approaches. Research topics are dominated by cattle, pigs, goats, and meat hygiene, while essential areas such as sacrificial animal practices, environmental impacts, welfare innovation, and abattoir-based disease surveillance are underrepresented. Compared with global trends, Indonesian studies have not yet fully integrated advanced methodologies, One Health frameworks, or risk-based food safety assessments. Strengthening interdisciplinary collaboration and adopting more robust research designs are necessary to enhance scientific quality and practical impact. Overall, improving the methodological and thematic breadth of abattoir research will contribute significantly to food safety, animal welfare, and zoonotic disease control in Indonesia.

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CONFLICT of INTEREST

The author declare that they have no competing interests.

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ETHICAL APPROVAL

This study is a literature review and does not involve human or animal subjects; therefore, ethical approval was not required

AUTHORS' CONTRIBUTIONS

Guidance on methodology, data analysis, and manuscript preparation was provided by JH. Article collection, data extraction, and data synthesis were carried out by the other authors (US, AS, AVA, DE, MAA)

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