



ΤΜΗΜΑ ΙΑΤΡΙΚΗΣ
ΣΧΟΛΗ ΕΠΙΣΤΗΜΩΝ ΥΓΕΙΑΣ
ΠΑΝΕΠΙΣΤΗΜΙΟ ΘΕΣΣΑΛΙΑΣ
ΠΡΟΓΡΑΜΜΑ ΜΕΤΑΠΤΥΧΙΑΚΩΝ ΣΠΟΥΔΩΝ
ΥΠΕΡΗΧΟΓΡΑΦΙΚΗ ΛΕΙΤΟΥΡΓΙΚΗ ΑΠΕΙΚΟΝΙΣΗ
ΓΙΑ ΤΗΝ ΠΡΟΛΗΨΗ ΚΑΙ ΔΙΑΓΝΩΣΗ ΤΩΝ ΑΓΓΕΙΑΚΩΝ ΠΑΘΗΣΕΩΝ



Μεταπτυχιακή Διπλωματική Εργασία

***"ΒΙΒΛΙΟΜΕΤΡΙΚΗ ΚΑΙ ΕΠΙΣΤΗΜΟΝΟΜΕΤΡΙΚΗ ΜΕΛΕΤΗ
ΤΗΣ ΑΠΕΙΚΟΝΙΣΗΣ ΤΗΣ ΘΡΟΜΒΩΣΗΣ ΣΕ ΜΗΡΥΚΑΣΤΙΚΑ
ΜΕ ΕΜΦΑΣΗ ΣΤΗ ΘΡΟΜΒΩΣΗ ΣΕ ΑΙΓΕΣ"***

υπό

ΜΑΡΓΑΡΙΤΑΣ Σ. ΤΖΟΥΡΟΥΤΗ

Κτηνιάτρου

Υπεβλήθη για την εκπλήρωση μέρους
των απαιτήσεων για την απόκτηση του
Διπλώματος Μεταπτυχιακών Σπουδών
«Υπερηχογραφική Λειτουργική Απεικόνιση
για την πρόληψη & διάγνωση των αγγειακών παθήσεων»

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Επιβλέπων:

Γ.Χ. Φθενάκης, Καθηγητής, Τμήμα Κτηνιατρικής, Πανεπιστήμιο Θεσσαλίας

Τριμελής Εξεταστική Επιτροπή:

1. *Γ.Χ. Φθενάκης, Καθηγητής, Τμήμα Κτηνιατρικής, Πανεπιστήμιο Θεσσαλίας*
(Επιβλέπων),
- 2.
- 3.

Τίτλος εργασίας στην αγγλική γλώσσα:

***BIBLIOMETRIC AND SCIENTOMETRIC STUDY OF THE IMAGING
OF THROMBOSIS IN RUMINANTS
WITH SPECIAL REFERENCE TO THROMBOSIS IN GOATS***

ΠΕΡΙΕΧΟΜΕΝΑ

ΠΡΟΛΟΓΟΣ	4
ΠΕΡΙΛΗΨΗ	5
ABSTRACT	6
INTRODUCTION	7
OBJECTIVES OF THE STUDY	9
METHODOLOGIES	10
Preliminary search	10
Search procedure	10
Paper evaluation	11
Data management and statistical analysis	11
RESULTS	12
Year of publication	12
Country of origin of the papers	12
Journals in which papers were published	14
Access to published papers	18
Topics of study of the papers	20
Associations between topics of study and the country of origin of the papers	22
Associations between topics of study and journals in which papers were published	23
Citations given to published papers	25
Authors	27
Papers describing use of imaging for the study of thrombosis	29
DISCUSSION	30
REFERENCES	31

ΠΡΟΛΟΓΟΣ

Η παρούσα διπλωματική εργασία σηματοδοτεί την ολοκλήρωση των μεταπτυχιακών σπουδών μου στο Τμήμα Ιατρικής του Πανεπιστημίου Θεσσαλίας.

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ΠΕΡΙΛΗΨΗ

Η μελέτη αποσκοπούσε (α) στην αξιολόγηση δημοσιευμένων άρθρων, τα οποία σχετίζονταν με τη θρόμβωση σε αίγες και (β) στην παρουσίαση ποσοτικών χαρακτηριστικών σχετικά με το επιστημονικό περιεχόμενο και τις βιβλιομετρικές λεπτομέρειες των άρθρων αυτών.

Πραγματοποιήθηκε θεματική αναζήτηση στη βάση δεδομένων Web of Science χρησιμοποιώντας τη συμβολοσειρά ['*thromb**' AND ('*goat**' OR '*caprine*' OR '*Capra hircus*')]. Τέλος, εξετάστηκαν και αξιολογήθηκαν αναλυτικά 135 άρθρα.

Βρέθηκε ότι προοδευτικά υπάρχει αύξηση του σχετικών άρθρων που δημοσιεύονται ετησίως. Οι χώρες από τις οποίες προέρχονται τα περισσότερα άρθρα ήταν η Ιαπωνία, οι Ηνωμένες Πολιτείες της Αμερικής και η Ολλανδία. Τα άρθρα έχουν δημοσιευτεί σε συνολικά 85 περιοδικά. Τα περιοδικά στα οποία είχαν δημοσιευτεί τα περισσότερα άρθρα είναι τα *Artificial Organs*, *Journal of Artificial Organs* και *ASAIO Journal*. Τα περισσότερα άρθρα (78,5%) δημοσιεύτηκαν με συνδρομητική και λιγότερα (21,5%) με ανοιχτή πρόσβαση. Τα περισσότερα άρθρα (69,6%) αναφέρονταν σε συστηματικές μελέτες, στο πλαίσιο των οποίων καταγράφηκε θρόμβωση (δηλαδή, οι μελέτες δεν αποσκοπούσαν καταρχήν στη μελέτη της θρόμβωσης). Λιγότερα άρθρα αναφέρονταν σε πειραματικές μελέτες σχετικά με τη θρόμβωση (16,3%) ή παρουσίαζαν κλινικών περιστατικών σχετικών με θρόμβωση (14,1%). Στις περισσότερες μελέτες σε αυτά τα άρθρα, το όργανο που μελετήθηκε ήταν τα αιμοφόρα αγγεία (> 73,0%). Όσον αφορά στη μεθοδολογική προσέγγιση, χρησιμοποιήθηκε πιο συχνά η εργαστηριακή διαγνωστική (> 40,0%). Η χρήση διαγνωστικής απεικονιστικής αναφέρεται σε μόνον 7 άρθρα. Συνολικά, η διάμεση τιμή του ετήσιου αριθμού αναφορών στα άρθρα ήταν 0,8 (διατεταρτημοριακό εύρος: 1,3). Άρθρα που δημοσιεύθηκαν με ανοικτή πρόσβαση έλαβαν σημαντικά μεγαλύτερο ετήσιο αριθμό αναφορών: 1,6 (1,8) έναντι άρθρων που δημοσιεύθηκαν με συνδρομητική πρόσβαση: 0,5 (1,2). Συγκεντρωτικά στα άρθρα υπήρχαν 710 μεμονωμένοι συγγραφείς και 900 συν-συγγραφείς, δηλαδή κατά μέσο όρο υπήρχαν $6,7 \pm 0,3$ συν-συγγραφείς ανά άρθρο (διάμεση τιμή: 6 (3), ελάχιστη-μέγιστη: 1–18). Τέλος, υπήρχαν 221 μεμονωμένοι συγγραφείς ως πρώτοι ή τελευταίοι συγγραφείς στα άρθρα.

Λέξεις κλειδιά

αίγα, απεικονιστική, επιστημονομετρία, θρόμβωση, μετα-ανάλυση.

ABSTRACT

The objectives of the study were: (a) the evaluation of published papers on the field of thrombosis in goats and (b) the presentation of quantitative characteristics regarding the scientific content and bibliometric details of these papers.

A topic search using the search string [*‘thromb*’* AND (*‘goat*’* OR *‘caprine’* OR *‘Capra hircus’*)] was made in the Web of Science platform. Finally, 135 papers were considered in detail.

There was a significant increase in number of papers published yearly. Countries from which most papers originated were the following: Japan, United States of America and The Netherlands. The papers were published in a total of 85 journals. Papers were published mostly in the following journals: *Artificial Organs*, *Journal of Artificial Organs* and *ASAIO Journal*. Most papers (78.5%) were published with subscription-type access and fewer (21.5%) as open access. Most papers (69.6%) referred to systemic works, in which thrombosis was recorded during the study (i.e., the study in principle did not aim to study thrombosis) Fewer papers referred to experimental work regarding thrombosis (16.3%) or presented clinical case report regarding thrombosis (14.1%). In those papers, the organ studied in papers with either type of work was blood vessels (> 73.0%). With regard to the methodological approach employed, clinical pathology was the one most frequently used (> 40.0%). Imaging was employed in 7 papers only. Overall, the median number of citations per year received by all papers was 0.8 (interquartile range: 1.3). Open-access papers received more citations yearly than those published under subscription access: 1.6 (1.8) *versus* 0.5 (1.2). Cumulatively, in the papers, there were in total 710 individual authors and 900 co-authors, i.e., per paper 6.7 ± 0.3 co-authors on average (median: 6 (3), min.-max.: 1–18). Also, 221 individual authors were first or last in these papers.

Keywords

doe; goat; imaging; meta-research; scientometrics; thrombosis.

INTRODUCTION

Scientometrics refers to the study of analysis and measure of the published scientific literature. It is described as referring to ‘all quantitative aspects of science and scientific research’ [Sengupta 1992] and produces new knowledge by dealing with information regarding articles published previously published.

The various sub-topics within the broad field of scientometrics include the assessment of impact of published papers, the understanding of citations in other scientific publications and the employment of the findings of such assessments in management and policy contexts [Leydesdorff and Milojevic 2013]. There are significant overlaps between scientometrics and other scientific fields, e.g., meta-science. Meta-science is defined as QUOTE *the use of research methods to study and appraise research itself and the areas where improvements can be made; the field deals with reporting, methods, evaluation, reproducibility, and incentives, which are related with communication, performance, evaluation, verification, and rewarding research, respectively* UNQUOTE [Ioannidis et al. 2015].

Scientometrics studies can be used for the assessment of developments and changes in technology and in scientific research, as well as for evaluating output derived from these, through the making of a quantitative evaluation of relevant published papers. Moreover, the approach can be used to identify priorities in research, to allocate budgetary funds and to reward excellence. Scientometrics-based articles are different from review articles: reviews summarise and discuss state of knowledge regarding a topic, without presentation of new data, reports of new results or performing of new analyses [Leydesdorff and Milojevic 2013, Lianou and Fthenakis 2020].

In the international literature on veterinary or animal science, there are only few scientometrics-based papers. A topic search in the Web of Science database by using the terms: [‘(‘*veterinary*’ OR ‘*animal*’) AND *scientometrics*’] retrieved only 15 published articles.

Gupta et al. [2015] evaluated the research output on camels internationally: 3089 papers from 2003 to 2012. Freire and Nicol [2019] showed the modifications in the reporting on animal welfare from 1968 to 2017. Gonzalez and Salgado-Arroyo [2020] presented the veterinary research output from Colombia: 3000 papers from 2010 to 2019. Garg et al [2021] assessed the same type of papers from India: 7056 papers from 2001 to 2020. Vaziri et al. [2022] presented a scientometrics-based history of international publications related to poultry science. Lianou and Fthenakis [2022] assessed the scientific outputs from Greece regarding small ruminants.

Greece has approximately 3,600,000 goats [Hellenic Statistical Authority 2021], which are approximately 22.0% of these animals in Europe [Pulina et al. 2018]. Goat farming is indeed an important animal production sector in Greece [Ministry of Agricultural Development & Food 2018].

OBJECTIVES OF THE STUDY

The objectives of the study were: (a) the evaluation of published papers on the field of thrombosis in goats and (b) the presentation of quantitative characteristics regarding the scientific content and bibliometric details of these papers.

METHODOLOGIES

Preliminary search

Initially, a preliminary search was performed on 14 October 2023 in the Web of Science platform, by using the following three different search strings:

- i. ['*thromb**' AND ('*cattle*' OR '*bovine*' OR '*Bos taurus*')]
- ii. ['*thromb**' AND ('*sheep*' OR '*ovine*' OR '*Ovis aries*')]
- iii. ['*thromb**' AND ('*goat**' OR '*caprine*' OR '*Capra hircus*')]

The records returned were then analysed and the number of articles or review articles was recorded. These were as below:

	Number of records returned	Number of articles or review articles
i. (' <i>cattle</i> ' OR ' <i>bovine</i> ' OR ' <i>Bos taurus</i> ')]	4680	4427
ii. (' <i>sheep</i> ' OR ' <i>ovine</i> ' OR ' <i>Ovis aries</i> ')]	1521	1450
iii. (' <i>goat*</i> ' OR ' <i>caprine</i> ' OR ' <i>Capra hircus</i> ')]	378	373

Based on these, it was decided to focus on goat-related papers, as the scarcity of information available made the topic an area of fruitful research.

Search procedure

The search procedure was based on the description of procedures described by Lianou and Fthenakis [2022]. This is described below.

The Web of Science platform (www.webofknowledge.com; Clarivate Analytics, Philadelphia, USA) was used. The Web of Science Core Collection was employed, through which, the search spanned across multiple disciplines.

The search was made using the term string ['*thromb**' AND ('*goat**' OR '*caprine*' OR '*Capra hircus*')]' as a topic search (the asterisk served as a truncation symbol). That way, records that included the query terms in the title, the abstract or the keywords, were retrieved. The search was made on 4 November 2023 ('freeze date'). The search included records available from 1 January 1971 to 4 November 2023.

The search produced 382 records. The document type of these records was taken into account: only 'articles' and 'review articles' documents were maintained. Thus, a total of 377 records remained for further analysis.

These papers were individually evaluated. Papers not including work related to goats or to thrombosis were excluded. Finally, a total of 135 papers were maintained for the analysis.

Paper evaluation

In each of these 135 records, the following details were recorded.

- Year of publication.
- Country of origin (the country(ies) of the first and last authors were taken into account).
- Journal in which published.
- Accessibility, i.e., whether there was open or subscription-only access to the paper.
- Topic(s) of study in the paper: (i) systemic work, in which thrombosis was recorded during the study (i.e., the study in principle did not aim to study thrombosis), (ii) experimental work regarding thrombosis, (iii) clinical case report regarding thrombosis.
- Total number of citations received (for calculations, the number of citations received by papers were normalised by calculating the average citations per year after publication of each paper).
- Number and names of all co-authors.

Data management and statistical analysis

All data were entered into Microsoft Excel. Descriptive analysis was performed initially. The frequency of the various outcomes was evaluated in tables of cross-categorised frequency data by use of Pearson chi-square test as appropriate. Comparisons of proportions were performed by a two-proportion z-test. Comparisons between continuous data were performed by use of one-way analysis of variance. Pearson's correlations were performed as indicated and significance of the result was evaluated according to the critical values for Pearson's *r*. Linear regression analysis was used to establish associations with the year of publication of each paper.

Statistical significance was defined at $p < 0.05$.

RESULTS

Year of publication

There was a significant increase progressively of the number of papers published yearly: slope of the increase was 0.130 ± 0.020 ($p < 0.0001$) (Figure1).

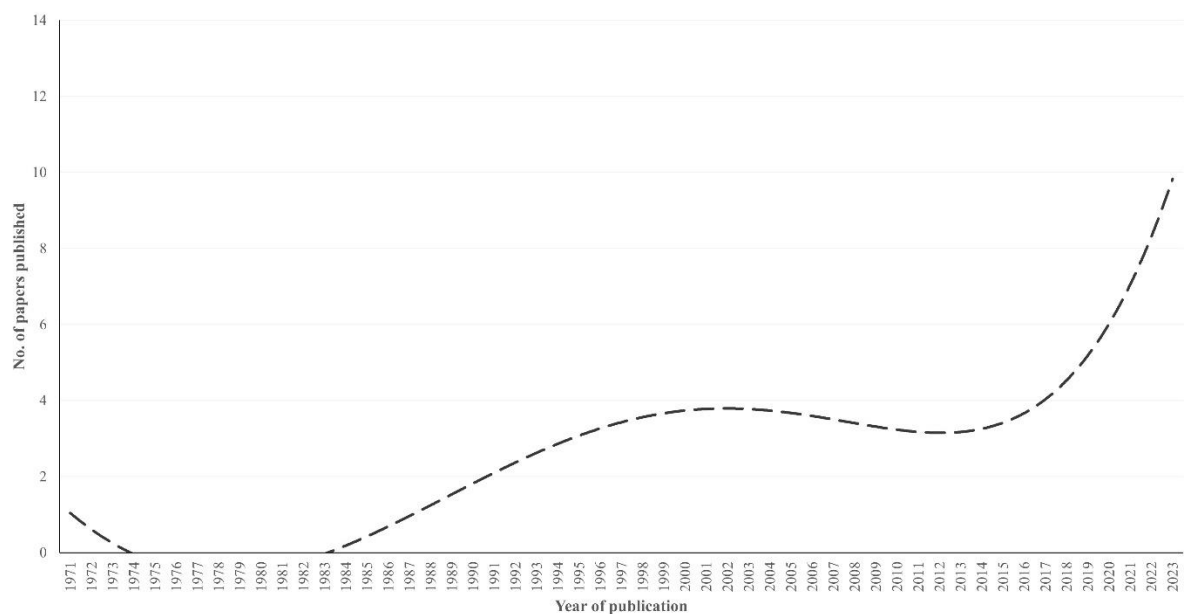


Figure 1. Trendline (dashed line) for number of papers on thrombosis in goats published annually during 1971 to 2023.

Country of origin of the papers

The papers originated from a total of 27 different countries from four continents (no papers published from Oceania). Countries from which most papers originated were the following: Japan ($n = 32$; 23.7%), United States of America ($n = 22$; 16.3%) and The Netherlands ($n = 15$; 11.1%) (Table 1, Figure 2).

Table 1. List of countries from which papers on thrombosis in goats originated and the respective number of papers published from each.

Country name ¹	Number of papers that originated from respective country (n)
Japan	32
United States of America	22
The Netherlands	15
Spain	10
China	9
India	9
United Kingdom of Great Britain and Northern Ireland	6
Italy	5
Austria	3
Belgium	3
Bulgaria	3
Brazil	3
Germany	3
Republic of Korea	3
France	2
Pakistan	2
Poland	2
Sweden	2
Argentina	1
Czechia	1
Denmark	1
Egypt	1
Hungary	1
Islamic Republic of Iran	1
Israel	1
Kenya	1
United Arab Emirates	1

¹ Country names are according to ISO 3166.

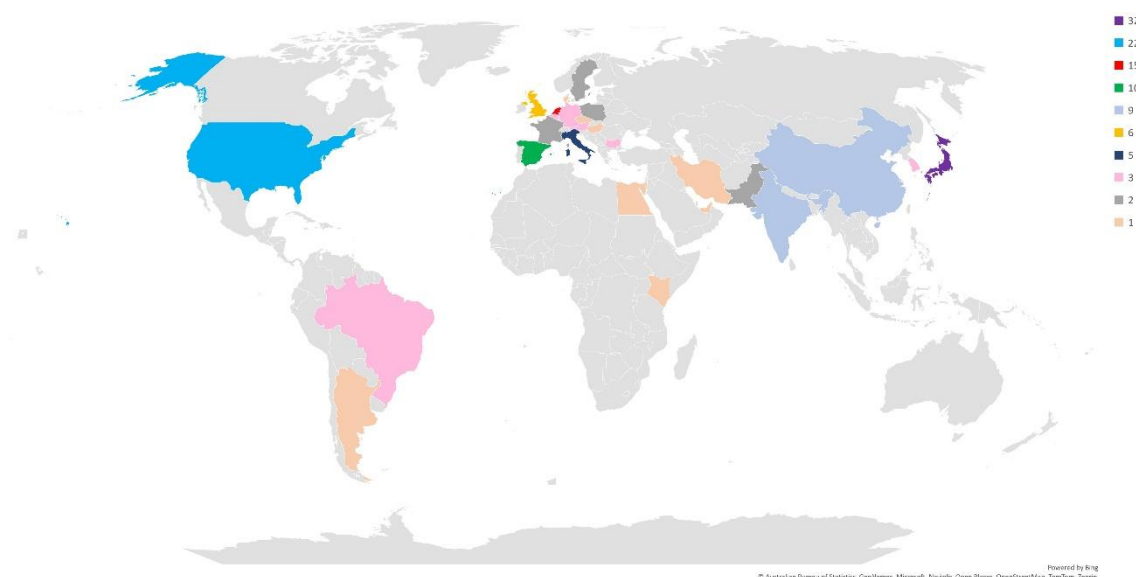


Figure 2. Global map indicating the countries from which papers on thrombosis in goats originated (colour-code of each country corresponds to number of papers from respective country, in accord to the legend in upper right part of the graph).

Journals in which papers were published

The papers were published in a total of 85 journals (Table 2). It is noted that 34.1% of papers are published in 9.4% of journals (Table 2). The journals in which most papers had been published, were the following: *Artificial Organs* ($n = 13$; 9.6%), *Journal of Artificial Organs* ($n = 8$; 5.9%) and *ASAIO Journal* ($n = 7$; 5.2%).

Table 2. List of journals in which papers on thrombosis in goats were published and the respective number of papers published in each.

Journal name	Number of papers that were published in respective journal (n)
<i>Artificial Organs</i>	13
<i>Journal of Artificial Organs</i>	8
<i>ASAIO Journal</i>	7
<i>Small Ruminant Research</i>	5
<i>International Journal of Artificial Organs</i>	4
<i>Animals</i>	3
<i>Journal of Biomedical Materials Research</i>	3
<i>Journal of Veterinary Diagnostic Investigation</i>	3
<i>Agriculture</i>	2
<i>Biomaterials</i>	2
<i>Biotechnology & Biotechnological Equipment</i>	2
<i>Brain Research</i>	2

<i>Comparative Haematology International</i>	2
<i>Journal of Animal and Feed Sciences</i>	2
<i>Journal of Comparative Pathology</i>	2
<i>Journal of Thoracic and Cardiovascular Surgery</i>	2
<i>Journal of Vascular and Interventional Radiology</i>	2
<i>Plos One</i>	2
<i>Research in Veterinary Science</i>	2
<i>Thrombosis Research</i>	2
<i>Agronomy</i>	1
<i>American Journal of Cardiology</i>	1
<i>American Review of Respiratory Disease</i>	1
<i>Analytical Biochemistry</i>	1
<i>Anesthesiology</i>	1
<i>Annals of Thoracic Surgery</i>	1
<i>Arteriosclerosis Thrombosis and Vascular Biology</i>	1
<i>Biomedical Engineering Online</i>	1
<i>Blood Coagulation & Fibrinolysis</i>	1
<i>BMC Veterinary Research</i>	1
<i>Bulgarian Journal of Agricultural Science</i>	1
<i>Cardiovascular and Interventional Radiology</i>	1
<i>Circulation</i>	1
<i>Comparative Biochemistry and Physiology</i>	1
<i>Coronary Artery Disease</i>	1
<i>Domestic Animal Endocrinology</i>	1
<i>Ejves Vascular Forum</i>	1
<i>Europace</i>	1
<i>European Heart Journal</i>	1
<i>European Journal of Cardio-Thoracic Surgery</i>	1
<i>European Journal of Lipid Science and Technology</i>	1
<i>European Journal of Pharmacology</i>	1
<i>European Journal of Vascular and Endovascular Surgery</i>	1
<i>Indian Journal of Animal Sciences</i>	1
<i>Indian Journal of Orthopaedics</i>	1
<i>International Dairy Journal</i>	1
<i>International Journal of Biological Macromolecules</i>	1
<i>International Journal of Dairy Technology</i>	1
<i>International Journal of Molecular Sciences</i>	1
<i>Italian Journal of Animal Science</i>	1
<i>Journal of Animal and Plant Sciences</i>	1
<i>Journal of Applied Animal Research</i>	1
<i>Journal of Applied Physiology</i>	1
<i>Journal of Dairy Science</i>	1
<i>Journal of Food Composition and Analysis</i>	1
<i>Journal of Food Safety and Food Quality</i>	1
<i>Journal of Heart Valve Disease</i>	1
<i>Journal of Molecular and Cellular Cardiology</i>	1
<i>Journal of Orthopaedic Research</i>	1
<i>Journal of Pharmaceutical and Biomedical Analysis</i>	1
<i>Journal of Surgical Research</i>	1
<i>Journal of the American Society of Nephrology</i>	1
<i>Journal of Thrombosis and Haemostasis</i>	1
<i>Journal of Vascular Access</i>	1

<i>Journal of Veterinary Pharmacology and Therapeutics</i>	1
<i>Kidney International</i>	1
<i>Laboratory Animals</i>	1
<i>Lupus</i>	1
<i>Pace-Pacing and Clinical Electrophysiology</i>	1
<i>Pakistan Veterinary Journal</i>	1
<i>Polish Journal of Veterinary Sciences</i>	1
<i>Postgraduate Medicine</i>	1
<i>Praktische Tierarzt</i>	1
<i>Progress in Biophysics & Molecular Biology</i>	1
<i>Research and Practice in Thrombosis and Haemostasis</i>	1
<i>Stroke</i>	1
<i>The Veterinary Record</i>	1
<i>Theranostics</i>	1
<i>Ticks and Tick-Borne Diseases</i>	1
<i>Transplantation</i>	1
<i>Veterinarski Arhiv</i>	1
<i>Veterinary Parasitology - Regional Studies and Reports</i>	1
<i>Veterinary Pathology</i>	1
<i>Viruses</i>	1
<i>Wiener Tierärztliche Monatsschrift</i>	1

These 85 journals were included in 33 categories in the Web of Science platform. The categories which included the journals with most published papers, were the following ‘Engineering, biomedical’ ($n = 38$; 28.1%), ‘Agriculture, Dairy & Animal science’ ($n = 37$; 27.4%) and ‘Veterinary sciences’ ($n = 13$; 9.6%) (Table 3).

Table 3. List of categories in the Web of Science platform, in journals of which papers on thrombosis in goats were published and the respective number of papers published in each.

Category name	Number of papers that were published in journals of respective category in Web of Science (n)
Engineering, biomedical	38
Agriculture, dairy & animal science	15
Cardiac & cardiovascular systems	13
Veterinary sciences	13
Hematology	8
Peripheral vascular disease	5
Biochemistry & molecular biology	4
Agronomy	3
Food science & technology	3
Pathology	3
Biotechnology & applied microbiology	2
Chemistry, applied	2
Multidisciplinary sciences	2
Neurosciences	2
Orthopedics	2
Pharmacology & pharmacy	2
Urology & nephrology	2

Agriculture, multidisciplinary	1
Anesthesiology	1
Biochemical research methods	1
Chemistry, analytical	1
Clinical neurology	1
Environmental sciences	1
Immunology	1
Infectious diseases	1
Medicine, general & internal	1
Medicine, research & experimental	1
Parasitology	1
Physiology	1
Respiratory systems	1
Rheumatology	1
Surgery	1
Virology	1

Among the six countries from which most published papers originated, 38 papers were published in the eight journals with most papers published (Table 4) ($p = 0.004$). Among these six countries, papers that originated from Japan, The Netherlands or United States of America were published mostly in journals in category ‘Engineering, biomedical’, whilst papers that originated from Spain or India were published mainly in journals in category ‘Agriculture, Dairy & Animal Science’ ($p < 0.001$) (Figure 3, Table 5).

Table 4. List of journals with most published papers, in which papers on thrombosis in goats were published with origin from countries with most published papers.

Number of papers that originated from respective country, which were published in respective journal (<i>n</i>)						
Journal name	Country name					
	China	Spain	India	Japan	The Netherlands	United States of America
<i>Animals</i>	0	2	0	0	0	0
<i>Artif. Organs</i>	0	0	0	11	0	1
<i>ASAIJ</i>	0	0	0	5	0	2
<i>Int. J. Artif. Organs</i>	0	0	0	1	0	0
<i>J. Artif. Organs</i>	0	0	0	8	0	0
<i>J. Biomed. Mat. Res.</i>	0	0	0	1	1	1
<i>J. Vet. Diagn. Inv.</i>	0	0	0	0	0	2
<i>Small Rumin. Res.</i>	0	1	2	0	0	0

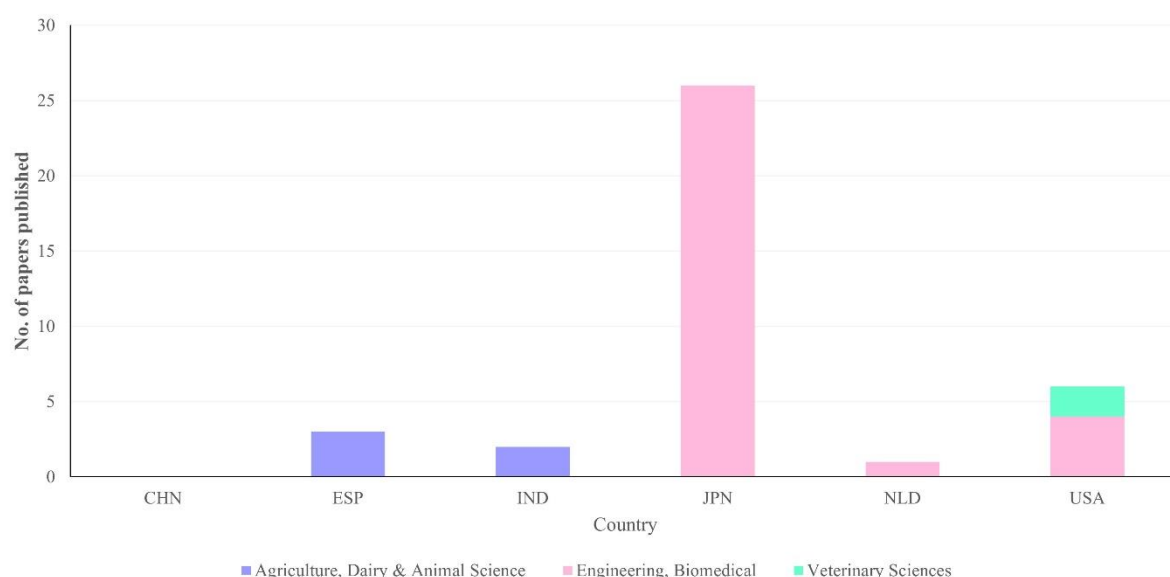


Figure 3. Categories in the Web of Science platform, in journals of which (with most published) papers on thrombosis in goats were published with origin from countries with most published papers (country abbreviations are according to ISO 3166).

Table 5. List of categories in the Web of Science platform, in journals of which (with most published) papers on thrombosis in goats were published with origin from countries with most published papers.

Number of papers that originated from respective country, which were published in respective journal (n)						
Category	Country name					
	China	Spain	India	Japan	The Netherlands	United States of America
Agriculture, dairy & animal science	0	3	2	0	0	0
Engineering, biomedical	0	0	0	26	1	4
Veterinary sciences	0	0	0	0	0	2

Access to published papers

Most papers ($n = 106$; 78.5%) were published with subscription-type access. Median year of publication of these papers was 2005 (interquartile range: 18 years). The other 29 (21.5%) papers were published as open access. Median year of publication of these papers was 2020 (interquartile range: 4 years). The difference in the median year of publication between the two types of papers was significant ($p < 0.0001$) (Figure 4). However, the slope of progressive increase in the number of articles published yearly did not differ significantly between the two access types: 0.052 ± 0.012 versus 0.078 ± 0.018 ($p = 0.23$) (Figure 5).

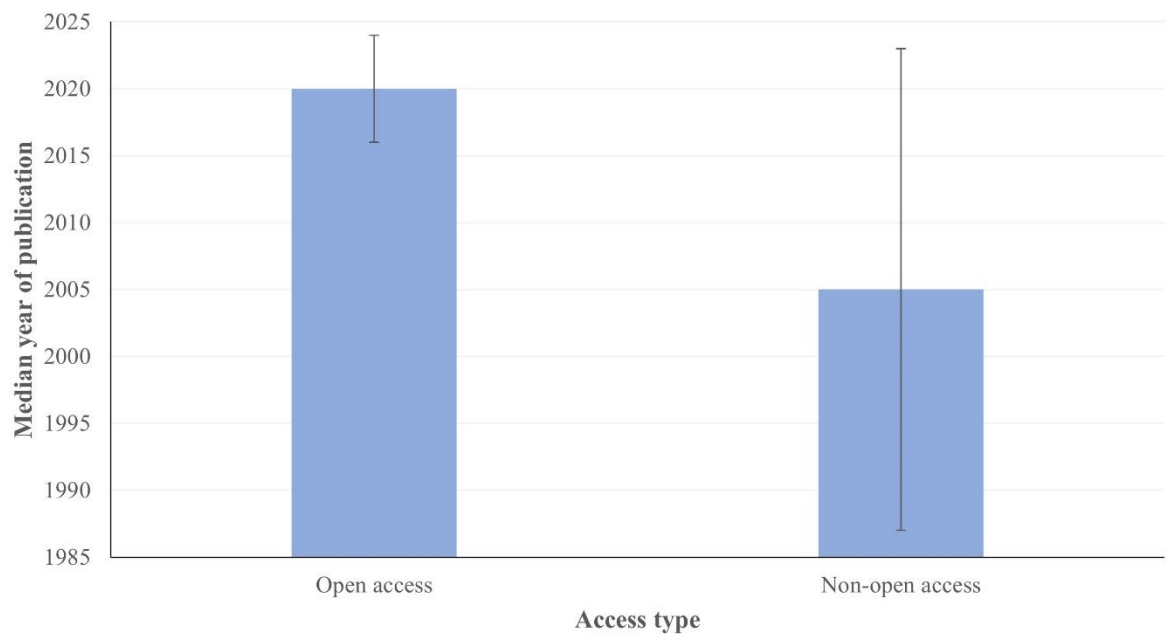


Figure 4. Median year of publication of papers on thrombosis in goats in accord with the type of access to them (error bars indicate interquartile range).

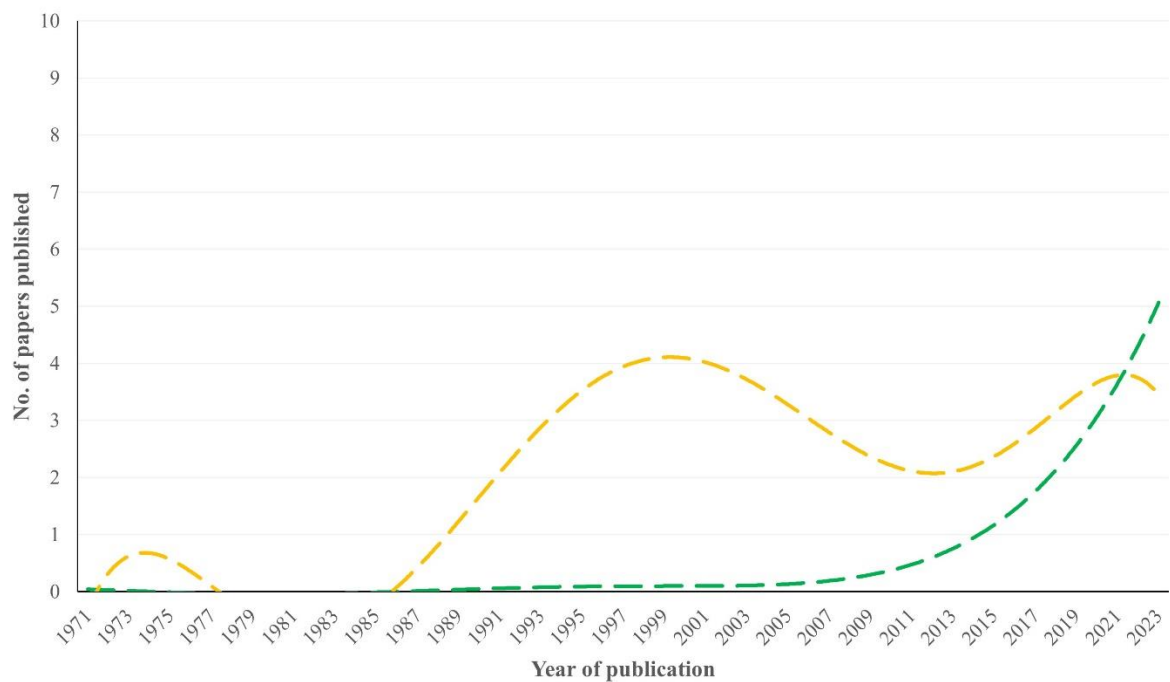


Figure 5. Trendlines for year of publication of papers on thrombosis in goats in accord with the type of access to them (green: open access, orange: non-open access).

Topics of study of the papers

Most papers ($n = 96$; 69.6%) referred to systemic works, in which thrombosis was recorded during the study (i.e., the study in principle did not aim to study thrombosis). Of these, 3 (3.1%) were review papers.

Fewer papers referred to experimental work regarding thrombosis ($n = 22$; 16.3%) or presented clinical case report regarding thrombosis ($n = 19$; 14.1%) (Table 6). In most cases, the organ studied in papers with either type of work was blood vessels ($n = 20$ and 14, respectively; 90.9% and 73.7%, respectively) ($p = 0.32$) (Figure 6). With regard to the methodological approach employed, clinical pathology was the one most frequently used ($n = 9$ and 11, respectively; 40.9% and 57.9%, respectively) ($p = 0.07$) (Figure 7).

Imaging was employed in 7 papers only. These referred to experimental work regarding thrombosis ($p = 0.007$, when comparing the use of imaging in experimental work regarding thrombosis (31.8%) *versus* clinical case reports regarding thrombosis (0.0%)).

Table 6. Number of papers on experimental work (green) or clinical case reports (orange) regarding thrombosis in goats in relation to the organ studied in each work or the diagnostic methodology employed.

Topic of study	Organ studied	Diagnostic methodology employed
experimental work regarding thrombosis ($n = 22$)	blood vessels ($n = 20$)	clinical pathology ($n = 9$)
		imaging ($n = 7$)
	heart ($n = 2$)	gross pathology ($n = 3$)
	lungs ($n = 1$)	histology ($n = 2$) electromagnetic measurements ($n = 1$)
clinical case report regarding thrombosis ($n = 19$)	blood vessels ($n = 14$)	
	heart ($n = 2$)	clinical pathology ($n = 11$)
	kidneys ($n = 2$)	
	brain ($n = 1$)	gross pathology ($n = 5$)
	uterus ($n = 1$)	
	placenta ($n = 1$)	histology ($n = 3$)

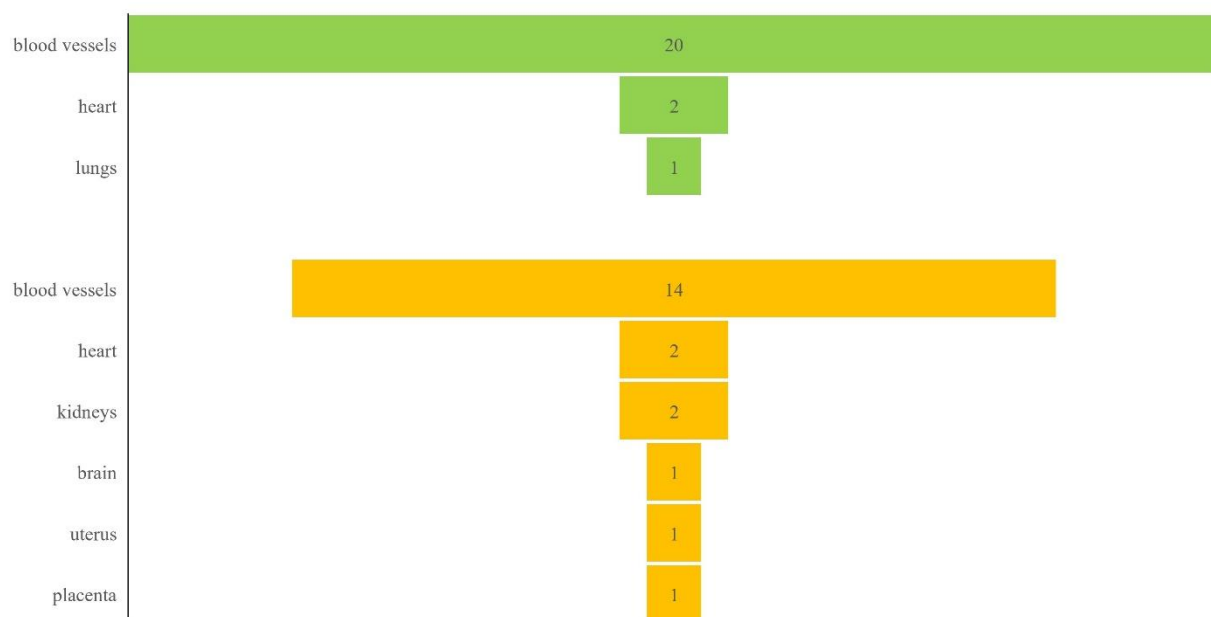


Figure 6. Number of papers on experimental work (green) or clinical case reports (orange) regarding thrombosis in goats in relation to the organ studied in each work.

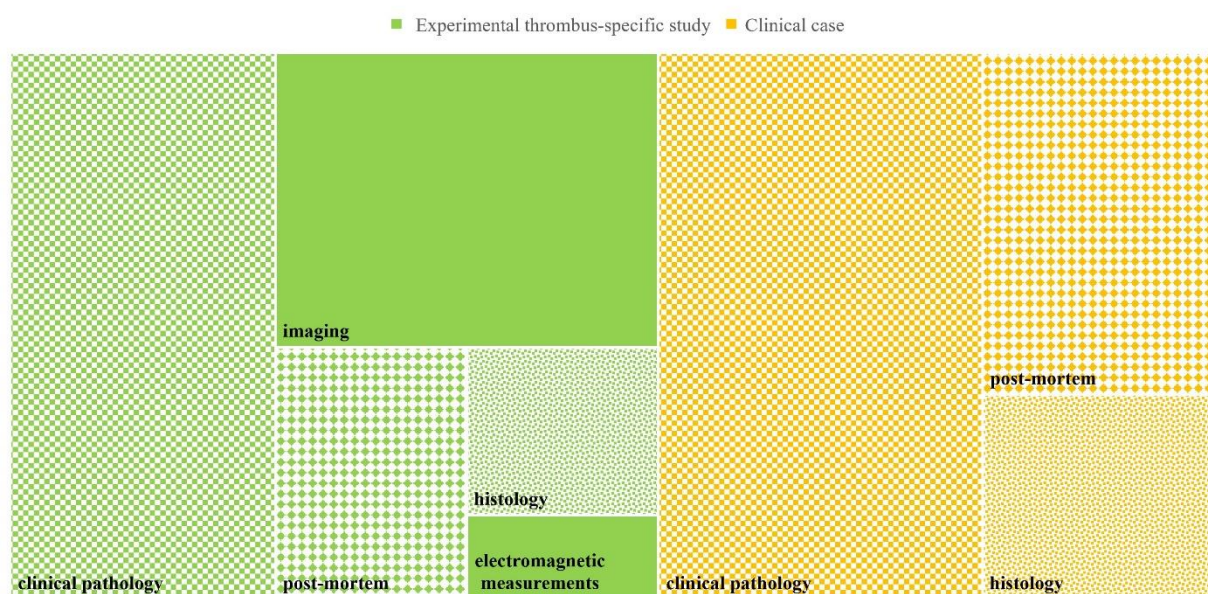


Figure 7. Number of papers on experimental work (green) or clinical case reports (orange) regarding thrombosis in goats in relation to the diagnostic methodology employed.

Associations between topics of study and the country of origin of the papers

There were differences between the various countries in the type of papers which originated from these ($p = 0.012$) (Table 7). Among the six countries from which most published papers, from China, Spain, Japan and the Netherlands originated mainly papers on experimental work, whilst from Indian and United States of America originated mainly clinical case reports (Figure 8).

Table 7. List of countries from which papers on thrombosis in goats originated and the respective number of papers published from each, in accord with the type of paper: papers on experimental work or clinical case reports.

Number of papers that originated from respective country, which presented respective type of work (<i>n</i>)		
Country name ¹	Type of paper	
	Experimental work papers	Clinical case reports
Argentina	0	1
Austria	0	1
China	2	0
France	1	1
Germany	1	1
India	1	4
Islamic Republic of Iran	0	1
Italy	0	1
Japan	2	1
Pakistan	0	2
Republic of Korea	2	0
Spain	3	0
Sweden	0	2
The Netherlands	9	0
United Kingdom of Great Britain and Northern Ireland	0	1
United States of America	1	5

¹ Country names are according to ISO 3166.

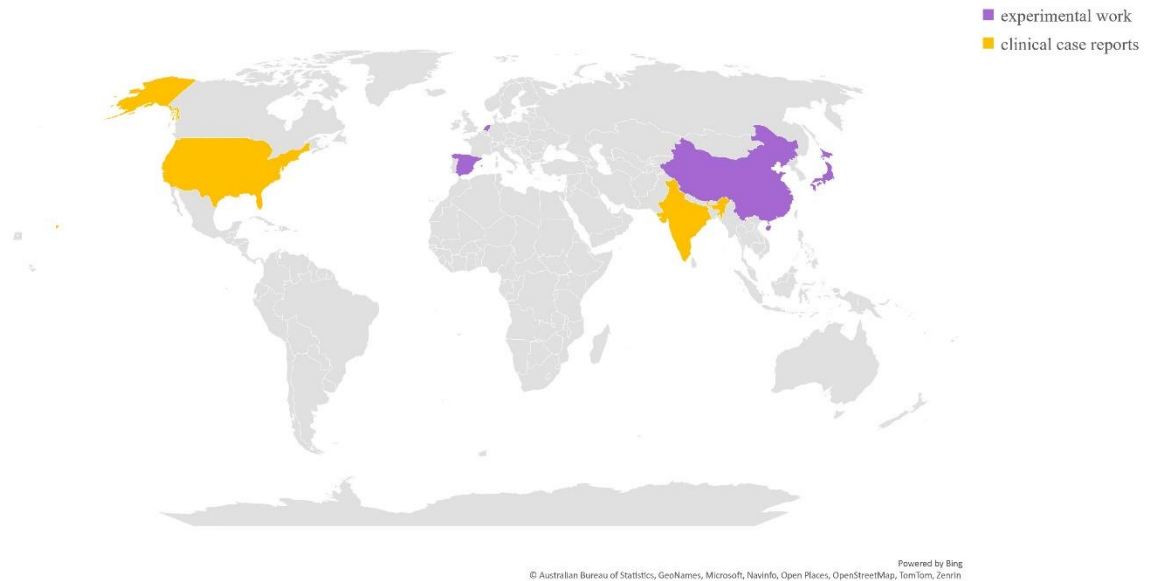


Figure 8. Main type of papers from the six countries from which most published papers originated: papers on experimental work (purple) or clinical case reports (orange) regarding thrombosis in goats.

Associations between topics of study and journals in which papers were published

There were no differences between the various journals in the type of papers which were published in these ($p = 0.17$) (Table 8). However, there were significant differences in the category in which the journals belonged ($p = 0.012$) (Table 9).

Table 8. List of journals in which papers on thrombosis in goats were published and the respective number of papers published from each, in accord with the type of paper: papers on experimental work or clinical case reports.

Number of papers published in respective journal, which presented respective type of work (n)		
Journal name	Type of paper	
	Papers on experimental work	Clinical case reports
<i>American Journal of Cardiology</i>	0	1
<i>Analytical Biochemistry</i>	1	0
<i>Annals of Thoracic Surgery</i>	1	0
<i>Artificial Organs</i>	1	0
<i>Biomedical Engineering Online</i>	1	0
<i>BMC Veterinary Research</i>	0	1
<i>Brain Research</i>	2	0
<i>Cardiovascular and Interventional Radiology</i>	1	0
<i>Circulation</i>	1	0
<i>Europace</i>	1	0
<i>European Journal of Cardio-Thoracic Surgery</i>	1	0

<i>European Journal of Pharmacology</i>	1	0
<i>European Journal of Vascular and Endovascular Surgery</i>	1	0
<i>Indian Journal of Animal Sciences</i>	1	0
<i>International Journal of Artificial Organs</i>	2	1
<i>Journal of Animal and Plant Sciences</i>	0	1
<i>Journal of Biomedical Materials Research</i>	2	0
<i>Journal of Comparative Pathology</i>	0	2
<i>Journal of Molecular and Cellular Cardiology</i>	1	0
<i>Journal of Surgical Research</i>	1	0
<i>Journal of Thoracic and Cardiovascular Surgery</i>	0	1
<i>Journal of Vascular and Interventional Radiology</i>	2	0
<i>Journal of Veterinary Diagnostic Investigation</i>	0	2
<i>Pakistan Veterinary Journal</i>	0	1
<i>Postgraduate Medicine</i>	0	1
<i>Praktische Tierarzt</i>	0	1
<i>Small Ruminant Research</i>	0	3
<i>Stroke</i>	1	0
<i>Veterinarski Arhiv</i>	0	1
<i>Veterinary Parasitology - Regional Studies and Reports</i>	0	1
<i>Viruses</i>	0	1
<i>Wiener Tierärztliche Monatsschrift</i>	0	1

Table 9. List of categories in the Web of Science platform, in journals of which papers on thrombosis in goats were published and the respective number of papers published in each, in accord with the type of paper: papers on experimental work or clinical case reports.

Number of papers published in journal in respective category, which presented respective type of work (n)		
Journal name	Type of paper	
	Papers on experimental work	Clinical case reports
Agriculture, dairy & animal science	1	3
Agriculture, multidisciplinary	0	1
Biochemical research methods	1	0
Cardiac & cardiovascular systems	6	2
Clinical neurology	1	0
Engineering, biomedical	6	1
Medicine, general & internal	0	1
Neurosciences	2	0
Parasitology	0	1
Pathology	0	2
Peripheral vascular disease	3	0
Pharmacology & pharmacy	1	0
Surgery	1	0
Veterinary sciences	0	7
Virology	0	1

Citations given to published papers

Overall, the median number of citations per year received by all papers was 0.8 (interquartile range: 1.3). There were no significant differences between citations received by papers that originated from the various countries ($p = 0.21$) (Table 10).

Table 10. List of citations per year received by papers on thrombosis in goats, in accord with country of origin of the papers.

Country name ¹	Number of papers that originated from respective country (<i>n</i>)
Argentina	3.7 (0.0)
Austria	0.3 (1.0)
Belgium	0.6 (1.3)
Bulgaria	0.8 (0.3)
Brazil	1.3 (1.0)
China	0.9 (1.5)
Czechia	0.1 (0.0)
Denmark	0.4 (0.0)
Egypt	0.0 (0.0)
France	0.6 (0.3)
Germany	0.2 (0.5)
Hungary	2.2 (0.0)
India	1.0 (2.1)
Islamic Republic of Iran	0.3 (0.0)
Israel	0.3 (0.0)
Italy	1.4 (2.2)
Kenya	0.5 (0.0)
Pakistan	0.7 (0.7)
Poland	0.2 (0.1)
Republic of Korea	0.4 (0.1)
Spain	0.4 (1.2)
Sweden	0.2 (0.0)
The Netherlands	1.6 (3.3)
United Arab Emirates	0.0 (0.0)
United Kingdom of Great Britain and Northern Ireland	1.0 (1.2)
United States of America	1.1 (1.4)

¹ Country names are according to ISO 3166.

Papers published under open-access received significantly more citations per year than papers published under non-open access: 1.6 (1.8) *versus* 0.5 (1.2), respectively ($p = 0.0001$) (Figure 9).

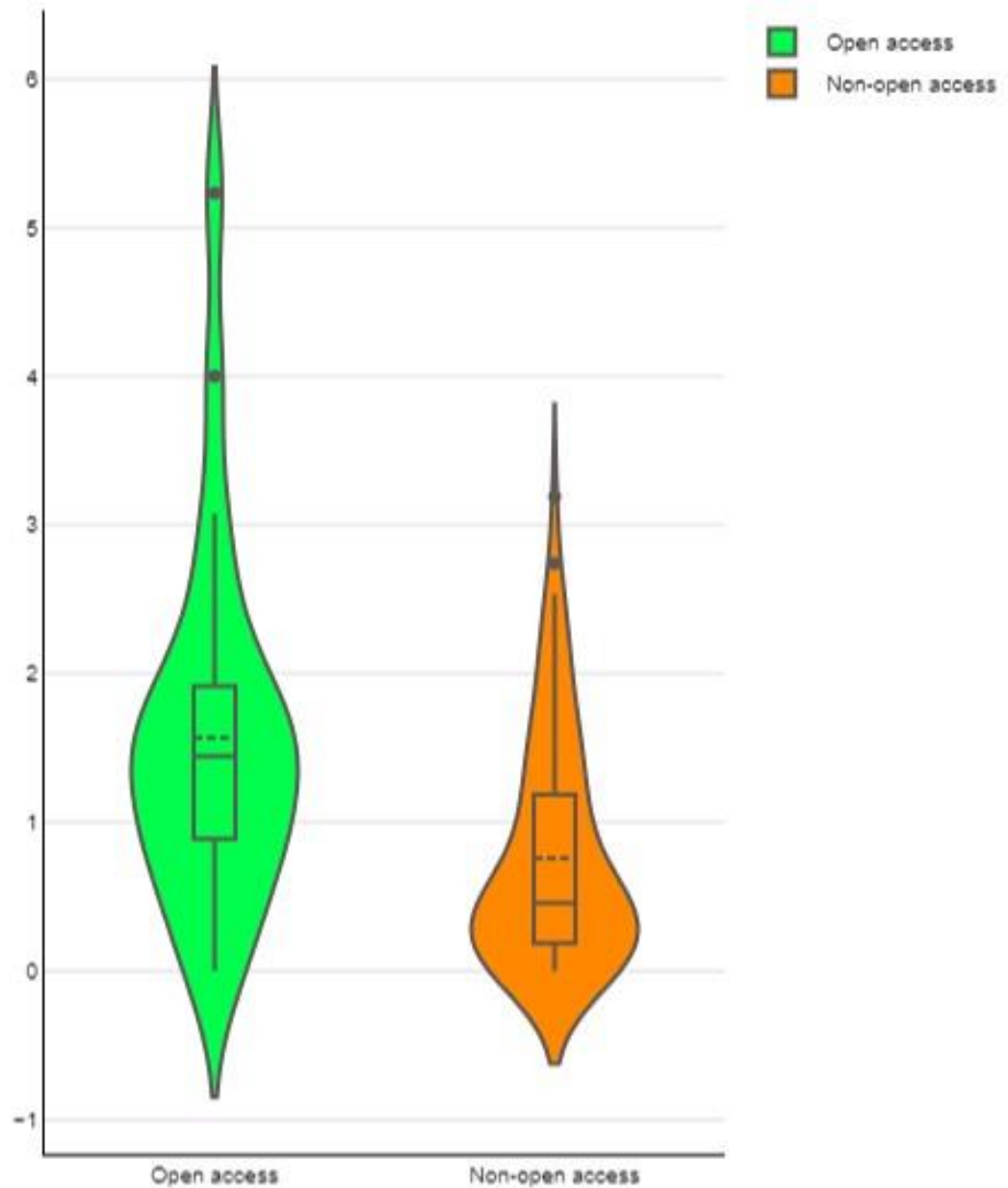


Figure 9. Violin plot ¹ of citations per year received by papers published under open (green) or non-open (orange) access.

¹ Outlying values not included in graph.

There was a tendency for a difference between the citations received per year by the different types of papers ($p = 0.085$). Median number (interquartile range) of citations for papers describing systemic work was higher than that of papers describing experimental work regarding thrombosis, which in turn was also higher than that of clinical case reports regarding thrombosis: 0.8 (1.3), 0.8 (1.3) and 0.3 (1.1), respectively ($p = 0.085$) (Figure 10).

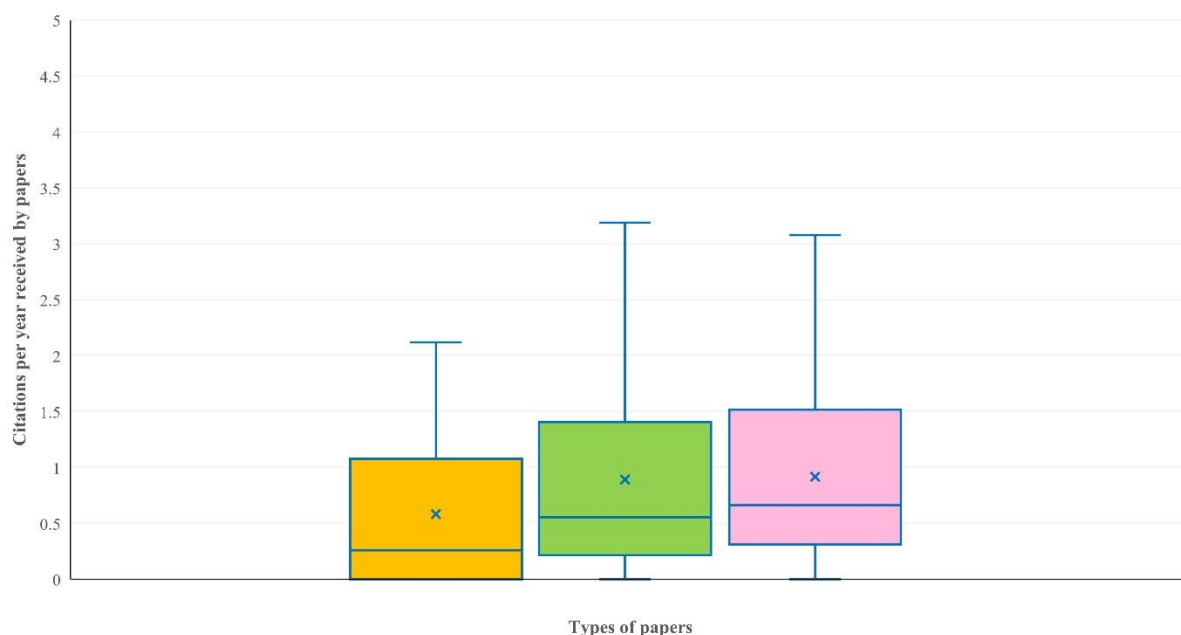


Figure 10. Boxplot and whiskers graph ¹ of citations per year received by papers describing systemic work (pink box), papers describing experimental work regarding thrombosis (green box) and clinical case reports regarding thrombosis (orange box).

¹ Outlying values not included in graph.

Authors

There were in total 710 different authors of the papers. Five of these had co-authored over six papers each (max: 12). In total, in the 135 papers, there were 900 co-authors, i.e., (mean) 6.7 ± 0.3 co-authors per paper (median: 6 (3), min.-max.: 1–18).

Further, there were 221 different authors who were first or last authors in the papers. Four of these were first or last in over two papers each (max.: 5). The above 4 authors were first or last authors in 65.4% of their papers.

These four authors were affiliated with scientific establishments in two of the countries (Japan, The Netherlands) also with most papers published. However, it seemed there was limited collaboration between them. Among them, only two authors were identified with common papers (Figure 11).

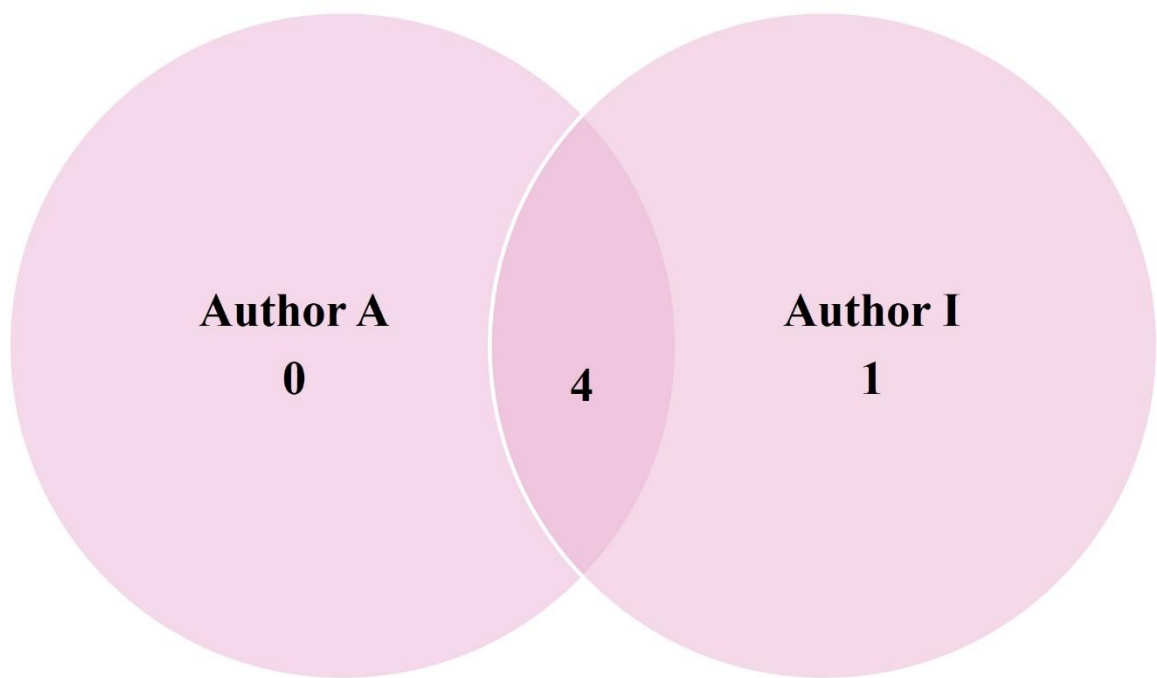


Figure 10. Venn diagram of common papers by two authors among the four with the most papers written as first or last author.

The average number of co-authors per paper increased throughout the years: $r_{sp} = 0.31$, $p = 0.0003$ (Figures 11 and 12). In 4 papers (3.0%), there was only one author.

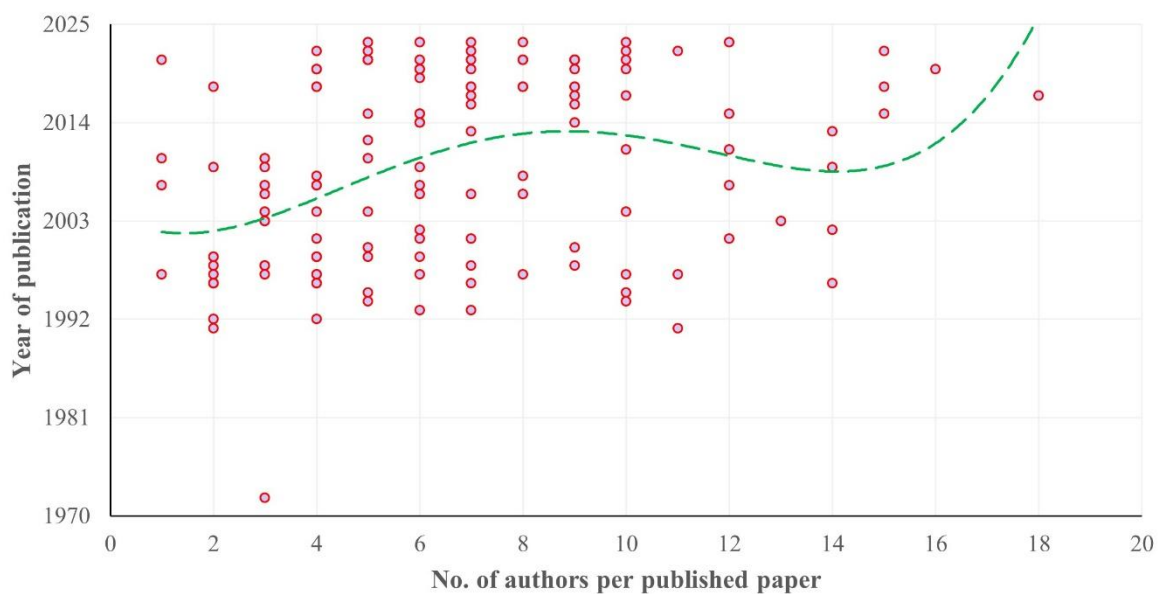


Figure 11. Progressive change of number of co-authors in papers, in accord with the year of publication.

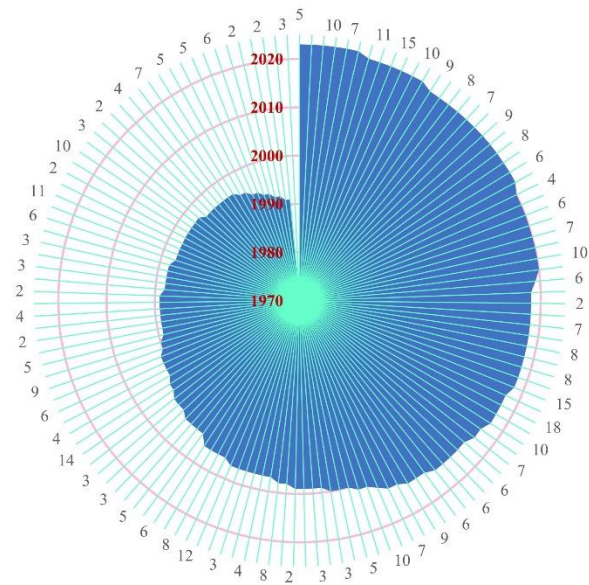


Figure 12. Radar-type graph of the progressive change of number of co-authors in papers, in accord with the year of publication.

Papers describing use of imaging for the study of thrombosis

There were seven papers, in which imaging was used as the diagnostic methodology for studying thrombosis (Table 6). These seven papers are the following: Chachques et al. (1994), Wakisaka et al. (1997), Lemson et al. (1999), Kim et al. (2004, 2006), Nakayama et al. (2015) and Boersma et al. (2017).

DISCUSSION

The study provides for the first time internationally a scientometrics approach for caprine thrombosis.

The results indicate that, in most cases, the studies presented in the relevant papers did not study thrombosis *per se*, but rather recorded that as part of studying systematic diseases, in which thrombosis is a salient disease feature. Such diseases include mainly parasitic (e.g., babesiosis) (Ijaz et al. 2013), bacterial (e.g., anaplasmosis) (Zhang et al. 2017) or viral (e.g., Nairobi disease) (Yang et al. 2019) blood-associated infections. This is corroborated by the facts that in most papers in that category the blood was studied as the target-tissue in the study and moreover clinical pathology techniques were principally employed for the work performed.

Furthermore, other papers studied thrombosis in goats using that species as an animal model for human disorders. Relevant studies include evaluation of pathogenetic pathways (e.g., thromboxane synthesis) (Mitchell et al. 1978), development of techniques (e.g., recanalization of occlusions) (Vicol and Dalichau 1996) and assessment of safety of drugs (e.g., tolifenamic acid) (Sidhu et al. 2006).

In only a very small number of papers, the respective works employed imaging techniques for studying thrombosis. In these studies, tissues other than blood were assessed, e.g., heart valves (Nakayama et al. 2015) or vessel wall (Boertsma et al. 2017). In such cases, imaging allowed a better and more detailed evaluation of the tissues under study than clinical pathology techniques.

In conclusion, there is limited work internationally on the use of imaging for the study of thrombosis in goats. Nevertheless, the various diseases of that species, which cause thrombosis-related lesions in the animals, can be studied better by employing imaging techniques. This will enhance knowledge on the pathogenesis of these disorders. Therefore, there is interest for furthering studies on thrombosis on that species by means of imaging-related techniques.

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