The reporting quality of the interventional animal experiments in Chinese journals-based on the evaluated results of the Animals in Research: Reporting In Vivo Experiments (ARRIVE) guidelines

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Abstract

Objective

To evaluate retrospectively the reporting quality of animal experiments published in Chinese journals adhering to the Animals in Research: Reporting In Vivo Experiments (ARRIVE) guidelines.

Methods

We searched databases including CNKI, WanFang, VIP and CBM by July, 2018. Two well-trained reviewers screened and extracted articles independently. The ARRIVE guidelines were used to assess the quality of animal experiment reports. The compliance rate of every item was analyzed according to different published time.

Results

4342 studies were included finally, of which 73.03% had been cited ≤ 5 times, only 29.04% (1261/4342) were published in journals of Chinese Science Citation Database. The assessment results showed that the compliance rate of more than half of sub-items (51.28%, 20/39) was less than 50% and 65.00% (13/20) of sub-items was less than 10%.

Conclusion

The reporting quality of animal experiments in Chinese journals is generally lower than moderate level. Along with the publication of the ARRIVE guidelines in 2010, the compliance rate of most items in the ARRIVE guidelines has been improved to some extent. However, some specific items of methods, results and discussion were not still reported sufficiently and integrally. Therefore, it is necessary to popularize the ARRIVE guidelines, advocate researchers to adhere to the ARRIVE guidelines in the future and especially to promote the use of the ARRIVE guidelines in specialized journals, so as to promote the design, implementation and reporting of animal experiments, and ultimately improve their quality.

Introduction

The animal experiment is the scientific research by using of animals in experiments to acquire new knowledge about biology and medicine or solve specific problems in laboratories [1], which is one of the basic measures of biomedical researches. The animal experiment is an important part of preclinical research. As a bridge between basic research and clinical trials, the quality of animal experiments affects the achievements and level of researches in many fields [2, 3].

In recent years, the number of animal experiments published in biomedical journals has increased dramatically. But more and more studies showed that [4-7], even in animal experiments published in top journals, the quality of their reports is still not satisfactory. Studies by The National Centre for the Replacement, Refinement and Reduction of Animals in Research, NC3Rs [8] showed: many animal

experiments with funding had inadequate reports on important information such as study design, implementation and analysis. In 271 included animal experiments, 41% of them did not state the hypothesis or objective of the study and the number and basic characteristics of the animals used in experiments, 30% of them did not describe the statistical methods and not present the results with correct statistical indicators. The inadequacy and incompleteness of the quality of articles and poor quality of reports have seriously hindered the utilization of the scientific and practical value of animal experiments. Therefore, in order to improve the quality of animal experimental reports, based on the COSORT Statement [9], NC3Rs developed the ARRIVE guidelines (Animal Research Reporting: In Vivo Experiments Guidelines), which were published in 2010. The guideline consists of six parts: title, abstract, introduction, methods, results and discussion, with 20 items and sub-items [10]. Since 2010, scholars outside China have studied the quality of animal experiment reports published in foreign journals based on the ARRVE guidelines [11, 12], whereas in China, the similar research only can be found from Liu et al. [13]. Moreover, their research is limited to specific diseases. In addition, there is no study to explore whether the publication of the ARRIVE guidelines has improved the quality of animal experiment reports or not.

Therefore, this study collected comprehensively animal experiments published in China, reviewed and analyzed the quality of animal experimental reports and existing problems based on the ARRVE guidelines, so as to provide a reference for promoting the quality of animal experimental reports in China.

Methods And Materials

Patient and Public Involvement

There are not patients and or public involved the study.

Inclusion and Exclusion criteria

Inclusion criteria Intervention animal experiments, no restriction/limitation for animal species and the type of intervention.

Exclusion criteria Republished studies; Non-medical animal experiments; Vitro experiments based on animal tissues, organs or cells; Experiments involving both animals and humans; Relevant journals in the Hong Kong, Macao, and Taiwan districts, which were limited by authority.

Search strategy

Chinese Journal Full Text Database (CNKI), Chinese Academic Journal Database (Wanfang), Chines Science and Technology Journal Database (VIP) and Chinese Biomedical Literature Database (CBM) were searched. The date was up to July 2018. The search terms include: rats, rabbits, dogs, pigs, sheep, apes, frogs, orangutans, monkeys, animal experiments, etc. A detailed search strategy for each database is shown in the S1 File.

Screened literature and extracted data

Two well-trained reviewers (BZ, and YBJ) independently screened, extracted and cross-checked studies strictly based on the inclusion and exclusion criteria, and the third party (BM) made the final decision in case of disagreement. According to the formulated full-text data extraction table in advance, the extraction contents include: basic characteristics of included studies: number of authors, the author's units, time, journals, animal species, sample size, intervention measures, etc.; Information about all items from ARRIVE guideline.

Quality assessment of the included studies

Two well-trained reviewers (BZ and YBJ) assessed the quality of the included studies based on 39 sub-items of 20 items included in the ARRIVE guidelines. The evaluation results for each sub-item in the studies were "high risk" or "low risk", in which "low risk" means the studies to be evaluated reports all or part, or at least one of the information involved in the sub-items in detail. On the contrary, it was "high risk". Finally, the compliance rate of "low risk" for 39 sub-items was calculated, i.e. the total number of studies with "low risk" accounted for the percentage of the total number of included studies.

Subgroup analysis

Based on the published years (2010) of the ARRIVE guidelines, the included papers were comparatively analyzed (animal experiments published before () 2010 vs. animal experiments published in and after (≥) 2010). The "low risk" compliance rate of 39 sub-items of animal experiments published 2010 and ≥2010 was calculated respectively, i.e. the number of papers, of which each sub-item was assessed as "low risk", accounted for the percentage of the total number of animal experiments published 2010 and ≥ 2010 respectively.

Statistical analysis

Data were analyzed using SPSS (v21.0, SPSS, Chicago, IL). Categorical data were represented by frequency (n) and percentage (%). Chi-square test was performed to compare percentage between groups and P-value 0.05 was considered to be statistically significant.

Results

Selecting process and results

21713 potentially relevant studies were selected initially. After excluding duplicates and those that is not fulfil the inclusion criteria, 4342 studies were included finally, in which there were 4925 animal experiments (some included multiple animal experiments). The selecting process and results are shown in Figure 1.

Epidemiological Characteristics

Frequency of citation of each inclusive study ranged from 0 to 12; more than 70% (73.03%, 3171/4342) had been cited lower than 5 times, of which nearly 50% (47.62%, 1510/3171) had not been cited. Only 29.04% (1261/4342) were published in journals of Chinese Science Citation Database. The highest proportion of the first authors were clinicians (45.07%, 1957/4342). (Table 1)

Table 1 Basic information of inclusive studies

Category	Feature	Total N (%)
Citation	0	1510 (34.78)
	1—5	1661 (38.25)
	≥5	1171 (26.97)
Categories of journals	Professional journals	1991 (45.86)
	Comprehensive journals	1654 (38.09)
	Others	697 (16.05)
Identities of the first author	Clinical doctors	1957 (45.07)
	Postgraduate students	740 (17.04)
	Researchers	1645 (37.89)

In 4925 inclusive animal experiments, the top three in the choice of animals are: rats (81.26%, 4002/4925), rabbits (15.07%, 742/4925), and dogs (1.91%, 94/4925). In the type of interventions, the top three are: drugs (82.23%, 4050/4925), surgery (7.39%, 364/4925) and acupuncture (3.70%, 182/4925). (Figure 2) In coverage and classification of related diseases, the top three are: circulatory diseases (10.92%, 538/4925), digestive diseases (10.64%, 524/4925), and tumors (9.66%, 476/4925).

Reporting quality of inclusive studies (Table 2)

Table 2 Assessment of reporting quality of inclusive studies

Contact and Subject	Item	Description	Total		2010 year		≥2010 year		χ^2 value	P value
			"Low risk" items		"Low risk" items		"Low risk" items			
			N	%	N	%	N	%		
TITLE										
	1	Provide as accurate and concise a description of the content of the article as possible.	4241	97.67	2196	97.13	2045	98.27	6.25	0.012
ABSTRACT										
	2	Provide an accurate summary of the background, research objectives (including details of the species or strain of animal used), key methods, principal findings, and conclusions of the study	4117	94.82	2084	92.17	2033	97.69	67.25	<0.001
INTRODUCTION										
Background	3a	Include sufficient scientific background (including relevant references to previous work) to understand the motivation and context for the study, and explain the experimental approach and rationale.	4071	93.76	2057	90.98	2014	96.78	62.36	<0.001
	3b	Explain how and why the animal species and model being used can address the scientific objectives and, where appropriate, the study's relevance to human biology.	1609	37.06	737	32.60	872	41.90	40.24	<0.001
Objectives	4	Clearly describe the primary and any secondary objectives of the study, or specific hypotheses being tested.	4248	97.84	2198	97.21	2050	98.51	8.60	0.003
METHODS										
Ethical statement	5	Indicate the nature of the ethical review permissions, relevant licenses (e.g. Animal [Scientific Procedures] Act 1986), and national or institutional guidelines for the care and use of animals, that cover the research.	286	6.59	125	5.53	161	7.74	8.59	0.003
Study design	6a	For each experiment, give brief details of the study design, including: the number of experimental and control groups.	3741	86.16	1893	83.72	1848	88.80	23.44	<0.001
	6b	For each experiment, give brief details of the study design, including: any steps taken to minimise the effects of subjective bias when allocating animals to treatment (e.g., randomisation procedure) and when assessing results (e.g., if done, describe who was blinded and when).	3961	91.23	2034	89.96	1927	92.60	9.43	0.002
	6c	For each experiment, give brief details of the study design, including: the experimental unit (e.g. a single animal, group, or cage of animals).	4312	99.31	2245	99.26	2067	99.33	0.02	0.890
	6d	For each experiment, give brief details of the study design, including: A time-line diagram or flow chart can be useful to	63	1.45	15	0.66	48	2.31	20.46	<0.001

		illustrate how complex study designs were carried out.								
Experimental procedures	7a	For each experiment and each experimental group, including controls, provide precise details of all procedures carried out. For example: How (e.g., drug formulation and dose, site and route of administration, anaesthesia and analgesia used [including monitoring], surgical procedure, method of euthanasia). Provide details of any specialist equipment used, including supplier(s).	4172	96.08	2165	95.75	2007	96.44	1.37	0.242
	7b	For each experiment and each experimental group, including controls, provide precise details of all procedures carried out. For example: When (e.g., time of day).	269	6.20	214	9.46	55	2.64	86.78	<0.001
	7c	For each experiment and each experimental group, including controls, provide precise details of all procedures carried out. For example: Where (e.g., home cage, laboratory, water maze).	513	11.81	309	13.67	204	9.80	15.53	<0.001
	7d	For each experiment and each experimental group, including controls, provide precise details of all procedures carried out. For example: Why (e.g., rationale for choice of specific anaesthetic, route of administration, drug dose used).	1631	37.56	806	35.65	825	39.64	7.38	0.007
Experimental animals	8a	Provide details of the animals used, including species, strain, sex, developmental stage (e.g., mean or median age plus age range), and weight (e.g., mean or median weight plus weight range).	4162	95.85	2160	95.53	2002	96.20	1.23	0.268
	8b	Provide further relevant information such as the source of animals, international strain nomenclature, genetic modification status (e.g. knock-out or transgenic), genotype, health/immune status, drug- or testnaive, previous procedures, etc.	3785	87.17	1909	84.43	1876	90.15	31.68	<0.001
Housing and husbandry	9a	Housing (e.g., type of facility, specific pathogen free (SPF); type of cage or housing; bedding material; number of cage companions; tank shape and material etc. for fish).	1022	23.54	409	18.09	613	29.46	77.81	<0.001
	9b	Husbandry conditions (e.g., breeding programme, light/dark cycle, temperature, quality of water etc. for fish, type of food, access to food and water, environmental enrichment).	928	21.37	338	14.98	590	28.35	115.83	<0.001
	9c	Welfare-related assessments and interventions that were carried out before, during, or after the experiment.	147	3.39	77	3.41	70	3.36	0.01	0.939
Sample size	10a	Specify the total number of animals used in each experiment	3440	79.23	1728	76.43	1712	82.27	22.47	<0.001

		and the number of animals in each experimental group.								
	10b	Explain how the number of animals was decided. Provide details of any sample size calculation used.	1	0.02	0	0.00	1	0.05	1.09	0.297
	10c	Indicate the number of independent replications of each experiment, if relevant.	6	0.14	4	0.18	2	0.10	0.51	0.474
Allocating animals to experimental groups	11a	Give full details of how animals were allocated to experimental groups, including randomization or matching if done.	522	12.02	208	9.20	314	15.09	35.54	<0.001
	11b	Describe the order in which the animals in the different experimental groups were treated and assessed.	4070	93.74	2100	92.88	1970	94.67	5.89	0.015
Experimental outcomes	12	Clearly define the primary and secondary experimental outcomes assessed (e.g., cell death, molecular markers, behavioral changes).	4071	93.76	2098	92.79	1973	94.81	7.55	0.006
Statistical methods	13a	Provide details of the statistical methods used for each analysis.	3585	82.57	1677	74.17	1908	91.69	230.97	<0.001
	13b	Specify the unit of analysis for each dataset (e.g. single animal, group of animals, single neuron).	2840	65.41	1287	56.92	1553	74.63	150.14	<0.001
	13c	Describe any methods used to assess whether the data met the assumptions of the statistical approach.	662	15.25	284	12.56	378	18.16	26.33	<0.001
RESULTS										
Baseline data	14	For each experimental group, report relevant characteristics and health status of animals (e.g., weight, microbiological status, and drug- or test-naı¨ve) before treatment or testing (this information can often be tabulated).	223	5.14	87	3.85	136	6.54	16.06	<0.001
Numbers analysed	15a	Report the number of animals in each group included in each analysis. Report absolute numbers (e.g.10/20, not 50%)	3023	69.62	1546	68.38	1477	70.98	3.46	0.063
	15b	If any animals or data were not included in the analysis, explain why.	3213	74.00	1661	73.46	1552	74.58	0.70	0.402
Outcomes and estimation	16	Report the results for each analysis carried out, with a measure of precision (e.g, standard error or confidence interval).	3811	87.77	1918	84.83	1893	90.97	38.01	<0.001
Adverse events	17a	Give details of all important adverse events in each experimental group.	64	1.47	21	0.93	43	2.07	9.66	0.002
	17b	Describe any modifications to the experimental protocols made to reduce adverse events.	1	0.02	1	0.04	0	0.00	0.92	0.337
DISCUSSION										
Interpretation /scientific implications	18a	Interpret the results, taking into account the study objectives and hypotheses, current theory, and other relevant studies in the literature.	4157	95.74	2143	94.78	2014	96.78	10.62	0.001
	18b	Comment on the study limitations	228	5.25	103	4.56	125	6.01	4.59	0.032

		including any potential sources of bias, any limitations of the animal model, and the imprecision associated with the results.								
	18c	Describe any implications of your experimental methods or findings for the replacement, refinement, or reduction (the 3Rs) of the use of animals in research.	15	0.35	4	0.18	11	0.53	3.89	0.048
Generalisability/translation	19	Comment on whether, and how, the findings of this study are likely to translate to other species or systems, including any relevance to human biology.	281	6.47	134	5.93	147	7.06	2.32	0.128
Funding	20	List all funding sources (including grant number) and the role of the funder(s) in the study.	47	1.08	15	0.66	32	1.54	7.74	0.005

The ARRIVE guidelines have 6 sections with 20 items and 39 sub-items. In terms of this, the "low risk" compliance rate of more than half of sub-items (51.28%, 20/39) is less than 50%, of which the "low risk" compliance rate of 90% (18/20) is less than 30%., even 65% (13/20) is less than 10%; only 28.21% (11/39) is higher than 90%.

In terms of 2 items (items 1-2) involved in the title and abstract, the "low risk" compliance rate of items 1 and 2 is higher than 90%. The "low risk" compliance rate of items 1 and 2 in studies published after 2010 is higher than that of studies published before 2010, and the difference between two groups in item 1 (P= 0.012) and 2 (P < 0.001) have statistical significance.

In terms of 3 items (items 3a-4) involved in abstract，the "low risk" compliance rate of items 3a and 4 is higher than 90%, and the "low risk" compliance rate of item 3b is only 37.06%. The "low risk" compliance rate of items 3a, 3b and 4 in studies published after 2010 is higher than that of studies published before 2010, and the difference between two groups in items 3a (P< 0.001), 3b (P< 0.001) and 4 (P= 0.003) have statistical significance.

In terms of 28 items (items 5-13c) involved in methods，the "low risk" compliance rate of items 6a, 6b, 6c, 7a, 8a, 8b, 10a, 11b, 12, 13A and 13b is more than 50%, of which the "low risk" compliance rate of items 6b, 6c, 7a, 8a, 11b and 12 is more than 90%; the "low risk" compliance rate of items 5, 6d, 7b, 7c, 7d, 9a, 9b, 9c, 10b，10c，11a and 13c is less than 50%, of which the other items except item 7d is less than 30%, and the "low risk" compliance rate of items 5, 6d, 7b, 9c, 10B and sub-item 10C is even less than 10%. The compliance rate of items 5, 6a, 6b, 6c, 6d, 7a, 7d, 8a, 8b, 9a, 9b, 10a, 10b, 11a, 11b, 12, 13a, 13b and 13C in studies published after 2010 is slightly higher than those before 2010. The difference between two groups in items 5 (P= 0.003), 6a (P< 0.001), 6B (P= 0.002), 6D (P< 0.001), and 6D (P< 0.001). (P< 0.001), 7d (P= 0.007), 8A (P< 0.001), 9a (P< 0.001), 9b (P< 0.001), 10A (P< 0.001), 11a (P< 0.001), 11b (P< 0.015), 12 (P< 0.006), 13a (P< 0.001), 13b (P< 0.001) and 13c (P< 0.001) have statistical significance, but the difference between two groups in 6c(P=0.890), 7a (P=0.242), 8a (P=0.268) and 10b (P=0.297) had none of statistical significance. However, the "low risk" compliance rate of items 7b, 7c, 9c and 10c in studies

published after 2010 is even lower than those published before 2010. The difference between two groups in items 7b (P< 0.001) and 7C (P< 0.001) have statistical significance, but in item 9C (P=0.939) and 10C (P=0.474) have none of statistical significance.

In terms of the 6 items (items 14-17b) involved in results, the "low risk" compliance rate of items 15a, 15b and 16 is more than 50%, while items 14, 17a and 17b is less than 6%. The "low risk" compliance rate of items 14, 15a, 15b, 16 and 17a in studies published after 2010 is all higher than that of studies published after 2010. The differences between two groups in items 14 (P < 0.001), 16 (P < 0.001) and 17a (P = 0.002) have statistical significance, but in items 15a (P = 0.063) and 15b (P = 0.402) have none of statistical significance; whereas, the differences between two groups in item 17b (P = 0.337) have none of statistical significance.

In items of 5 items (items 18a-20) involved in discussion, except for the "low risk" compliance rate of items 18a is more than 90%, the "low risk" compliance rate of the other items is all less than 10%. The "low risk" compliance rate of 5 items in studies published after 2010 is all higher than that of studies published after 2010. The differences between two groups in items 18a (P= 0.001), 18B (P= 0.032), 18C (P= 0.048) and 20 (P= 0.005) have statistical significance, but the differences between two groups in item 19 (P= 0.128) have none of statistical significance.

Discussion

This is the first comprehensive and systematic study on the reporting quality of animal experiments published in Chinese journals based on the ARRIVE guidelines. Overall, with the publication of the ARRIVE guidelines, the compliance rate of most items in the ARRIVE guidelines has been improved to a certain extent in published animal experiments in China. However, there are still inadequacy in reports of some specific items, e.g. study design, procedures, sample size, adverse events and discussion.

Study design: After 2010, although more studies used time-line diagrams or flow charts to illustrate the whole process of study designs and conducting (item 6d), the actual compliance rate was only 2.31%. Some studies have shown that more than half of the preclinical studies are unrepeatable [16], the main reasons of which include deficiencies in study designs, incorrect statistical analysis and inadequate reporting [8, 17, 18]. Therefore, a clear and detailed flow chart can effectively show the whole process of the experiment and improve the transparency of the whole process of the experiment implementation.

Experimental procedures: Of the animal studies published in Chinese journals, only 6.20% and 11.81% studies provided experimental dates (item 7b) and experimental sites (item 7c). A study [19] showed that 76 animal experiment articles (with more than 500 citations) were unable to scientifically evaluate the reliability of the results because of the lack of reports on key methodological information including experimental process and procedures. Therefore, the detailed report of the experimental process and procedures is the key measure to ensure the replication of the results and to improve the utilization and conversion rate of the results.

Housing and husbandry conditions: Although the research published after 2010 showed that the compliance rate of housing (item 9a) and husbandry conditions (item 9b) was effectively improved ($P < 0.001$), the actual compliance rate was only 29.46% and 28.35% respectively. It is well known that type of cage or housing, style of settlement, light/dark cycle, temperature and water quality will have an important impact on the experimental results. In addition, Hooijmans et al. [2, 20, 22] pointed out in their research that there can be a four-fold difference in light intensity between cages at the top or bottom of a rack, and small differences in the light intensity have been associated with animal reproduction and behavior.

Sample size: Of 4342 animal studies published in Chinese journals, only one study reported the algorithm and calculation formula of sample size (item 10b), and six studies indicated the number of independent replications of each experiment (item 10c). NINDS (The National Institute of Neurological Disorders and Stroke) reached a consensus in 2012 on how to improve making animal research reports in the process of submitting articles and using funding, in which NIMDS noted [23]: insufficient sample size may lead to false negative results, and miss some potentially important discoveries. Therefore, it is necessary to report how many animals are used in each group and what statistical methods are used to determine the sample size.

Allocating animals to experimental groups: Although the reporting rate of specific grouping methods for experimental animals published after 2010 (item 11a) was significantly higher than that published before 2010 ($P < 0.001$), the actual coincidence rate was only 12.02%. Some studies have shown [8] that randomization, allocation concealment and blinding are important methods to reduce the risk of the bias in an intervention animal experiment.

Results and discussion

In the ARRIVE Guidelines, the results and discussion sections include "baseline data, numbers analyzed, outcomes and estimation, adverse events, interpretation/scientific implications, generalizability/translation, and funding". Our research shows that:

Adverse event: Most animal experiments published in China (4278/4342, 98.53%) did not report the details of important adverse events in experiments (item 17a). Animal experiments also need to pay attention to adverse events, and analyze their nature, which is very important for judging the pros and cons of an intervention. Therefore, accurate assessment and reporting of adverse events should not be neglected.

Interpretation/scientific implications: Only 5.25% and 0.35% of the 4342 animal experiments published in Chinese journals reported their limitations (item 18b) and the significance of their research methods or findings for the 3R principle (item 18c). The purpose of scientific design is to reduce the bias that may be induced in the process of experiments. However, in the process of specific implementation, such as animal models, any potential source of bias in the experimental process, and any factors affecting the accuracy of the study results will reduce the scientific content of the study [10]. Therefore, it is necessary

for the author to objectively evaluate and explain it in the discussion part of the articles in order to ensure the scientific nature of its valid conclusion and help the users of evidences to grasp and understand its conclusion. In addition, the implementation of animal experiments should follow the 3Rs (replacement, refinement and reduction of animals in research), and the core of which is to protect, use less or use no animals [1, 24]. Scientific experimental design can reduce the number of experimental animals [25, 26]. Refined experimental technology route and optimized research proposal can allay and reduce pain and anxiety of animals in the experimental process [24]. Therefore, it is necessary for the author to interpret the scientific connotation in the discussion section of the paper, which can help readers fully obtain and evaluate the research information, promote the implementation and promotion of the 3R principle, and improve the quality of animal experiments.

There are also some limitations in this study: only based on the evaluation of animal experiments published in Chinese journals. The results may not represent the quality of Chinese scholars' research published in foreign peer-reviewed journals; only included interventional animal experiments. The results can not represent the quality of reports of other types of animal experiments.

In summary, the reporting quality of animal experiments based on ARRIVE guidelines in China is generally low to moderate level. Particularly, insufficient reporting in methods, including ethical statement, study design, experimental procedures, sample size, and allocating animals to experimental groups, makes the evidence users fail to fully understand the whole process of study design and implementation and, to a certain extent, hinder the transformation and utilization of research achievements. Therefore, it is necessary to popularize ARRIVE guidelines and encourage researchers to follow ARRIVE guidelines in the future, especially to promote the introduction of ARRIVE guidelines in specialized journals so as to promote the design, implementation and reporting of animal experiments, and ultimately improve their quality.

Declarations

Data Availability Statement

All relevant data are with in the paper and its Supporting Information files.

Competing interests

The authors all declare that no competing interests exist.

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Author Contributions

B.Z., YB.J., J S.W. K. and B.M. are responsible for the conception and design of the study. B.Z. analysis and interpret the analysis in collaboration with YB.J., T.Z.. ZZ.S., WY. Z., KY.H., F.C., F.M., QQ.G. and L.Z. are responsible for the acquisition of data. B.Z. and YB.J., B.M write the first draft of the article. All authors critically revised the article for important intellectual content and approved the final version of the manuscript.

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Supporting Information

S1 File. The Chinese databases search strategy. (DOC).

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Figures

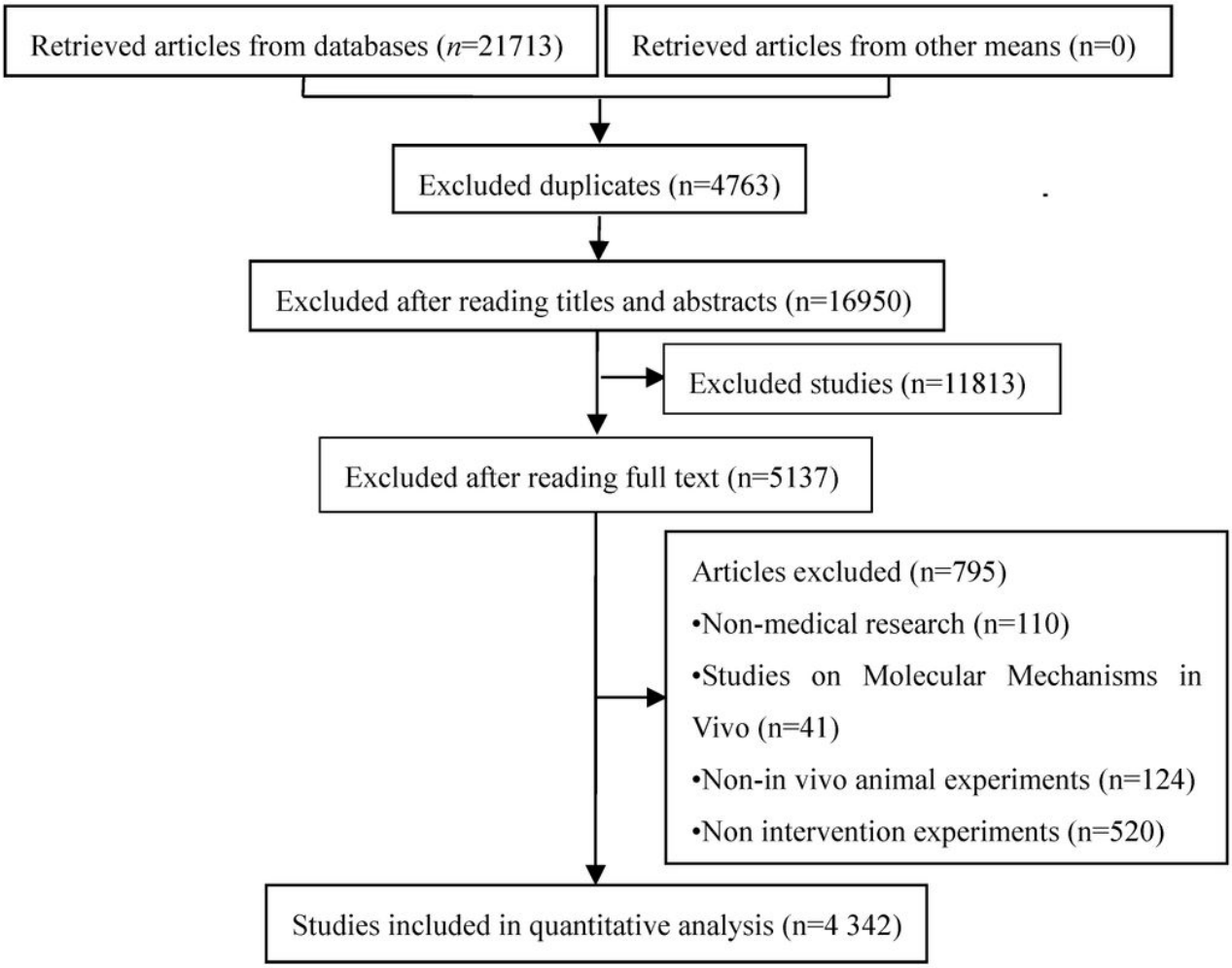

Figure 1 Flowchat for selecting process and results

*Retrieved databases and selected studies as follows: CNKI (n=1 213), Wanfang (n=5 500), VIP (n=1 702), CBM (n=13 298).

Figure 1

Flow chat for selecting process and results *Retrieved databases and selected studies as follows: CNKI (n=1 213), WanFang (n=5 500), VIP (n=1 702), CBM (n=13 298)

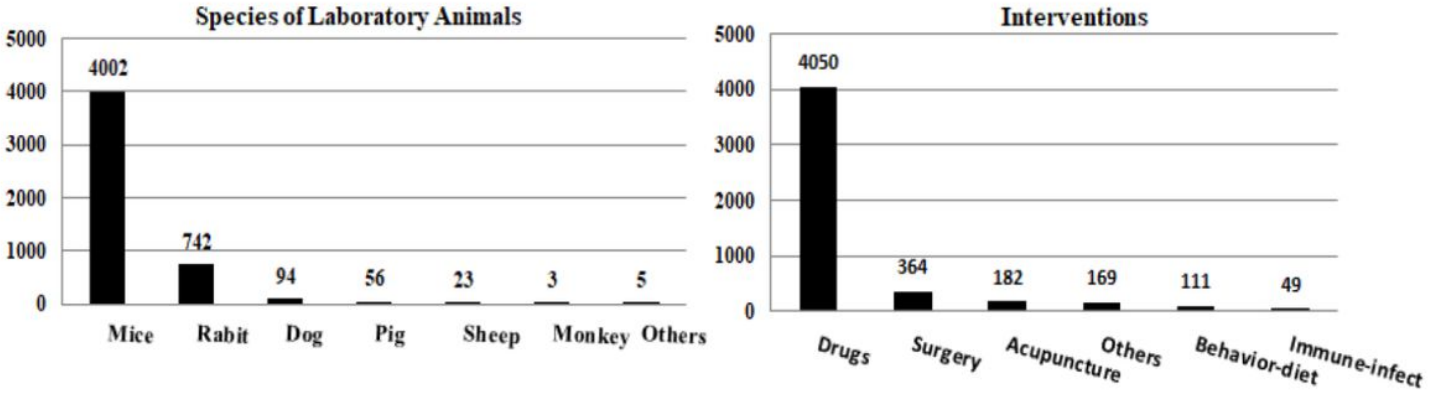

Figure 2: The species laboratory animals and interventions of animal test reports published in Chinese journals

Figure 2

The species laboratory animals and interventions of animal test reports published in Chinese journals.
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