

**Trends in the use of animals for research at the University of Nigeria,
2019 – 2023**

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Abstract

The use of animals for research is a basic necessity in the biomedical and agricultural sciences, but trends in their use have not been evaluated in the University of Nigeria Nsukka (UNN). This study evaluated trends in the use of animals for research at the UNN across a five-year period (2019 – 2023). The design of the study was a retrospective cohort type that utilized information on all the animal use protocols submitted to the Institutional Animal Care and Use Committee of the Faculty of Veterinary Medicine UNN for consideration, from January 01, 2019 to December 31, 2023. A total of 172 protocols were evaluated for the study. Experiments constituted a higher proportion of all the protocols (82.0%), with surveys contributing 18.0%. Seventeen animal species were used for research during the study period, and the most frequently used animal was the albino rat (*Rattus norvegicus*), with an overall frequency of 43.6%. The mean number of albino rats used per group for experiments was 5.36 ± 0.32 and the overall modal number of rats used per group for experiments was 5. There were significant ($p < 0.05$) variations in the overall frequency of use of animals for research across the five-year period. Out of the six faculties engaged in the use of animals for research, the highest proportion of animal studies was domiciled in the Faculty of Veterinary Medicine (74.4%). The most frequent pain/distress category for the studies involving animals was USDA-C (75.6%). The frequency of re-use and return to source of animals used for research was high, and it increased significantly ($p < 0.05$) across the study period. It was concluded that the use of animals for research in UNN between 2019 and 2023 was predominantly for experiments, and that albino rats were the most frequently used animals, with a modal number per group of 5. Researches with animals were majorly domiciled in the Faculty of Veterinary Medicine, and the frequency of re-use/return to source of animals was high, and significantly increased across the study period.

Keywords: Animal use; Research; University of Nigeria; Retrospective study; Trends; 2019 – 2023.

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Introduction

The use of animals for research is an indispensable and vital necessity in the biomedical and agricultural sciences, for the good of both humans and animals. Studies with animals have enhanced our knowledge and understanding of the basic mechanisms and function of the body, and have thus facilitated the development of new treatments and vaccines, as well as surgical and organ transplantation procedures that constitute the basis for modern advances in human and veterinary medical practice (Botting and Morrison, 1997; Greaves *et al.*, 2004; Pound *et al.*, 2004; Ginnakou and Vyrides, 2021). Using animals for research makes it possible to experimentally manipulate environmental and genetic factors which are not feasible and practicable in humans (Lemon and Dunnet, 2005; Garattini and Grignaschi, 2017). It has earlier been posited that without preliminary experimental animal studies, it would be unacceptable and unethical to directly test promising therapies and surgical interventions on humans, and additionally, it would be considered a waste of valuable limited resources if new and unproven therapies that showed potential relevance and possible usefulness are directly tested on humans without a pre-clinical testing on animals (Hackam, 2007, Garattini and Grignaschi, 2017; Giannakou and Vyrides, 2021).

Studies with animals cannot be completely replaced with computer models, microorganisms, tissue and cell cultures, as these non-animal alternatives only serve as adjuncts that can provide limited information about parts of the organism and not the whole organism, when compared to whole animals (CULABBR, 1988; Institute of Medicine, 1991). Studies with computer models, microorganisms, tissues and cell cultures can only provide data that is limited in its application, and which does not comparatively translate as effectively as results from animal

experiments (CULABBR, 1988; Institute of Medicine, 1991; Arora *et al.*, 2011; Barre-Sinoussi and Montagutelli, 2015).

As needful as the use of animals is in research, the welfare of animals used for research has been an issue of global concern. There had been calls, policies and institutional actions towards the replacement, reduction and refinement (3Rs) of animal use in experiments (NC3Rs, undated; Fenwick *et al.*, 2009; Lee *et al.*, 2020). Institutional animal care, use and ethical review committees have been put in place in most institutions worldwide to ensure that studies with animals are designed and executed with utmost regard for the welfare of animals, and also to reassure the public as such (Bertout *et al.*, 2021; Institute of Medicine, 2009). Methods that will possibly avoid or replace the use of animals are being developed and utilized, the number of animals used for experiments are being minimized, and ways of handling and treatment of animals that minimize distress, pain and suffering of animals used in research are being advocated and implemented. Progress in the implementation of the replacement, reduction and refinement policies in the use of animals for research can only be assessed based on documentation of the trend of use of animals for research in institutional and possibly national levels (Rodrigues, 2015). There are no reports in available literature on the trend in the use of animals for research in Nigeria, and in the University of Nigeria specifically. The present study evaluated and documented trends in the use of animals for research at the University of Nigeria, between January 2019 and December 2023.

Materials and Methods

The study adopted a retrospective cohort design. Permission to use information/data in the database of the Institutional Animal care and Use Committee (IACUC) of the University of Nigeria was sought for and obtained from

the IACUC, Faculty of Veterinary Medicine, University of Nigeria, Nsukka. All Animal Use Protocols submitted to the IACUC from January 01, 2019 to December 31, 2023 were evaluated in the study.

For each Animal Use Protocol, information collected included: year of submission of the protocol, whether the animal study was an experiment or a survey, the specific animal(s) used for the study, the number of animals used per group for experiments, the faculty in which the study was domiciled, the distress/pain category that the animals used for the study were subjected to, and the fate of the animals after the study. The number of animals used per group in experiments was considered a better and more reliable marker of compliance with reduction in number of animals used, than the total number used for a specific study, as studies vary in scope and capacity. The USDA categorization of pain/distress in animals used in research was used to categorize pain/distress into Categories B, C, D and E (USDA, 2023). Animals being bred, conditioned or held for use in research were in Category B, while animals used for research in which tests were conducted that involved no pain, distress or use of pain relieving drugs were in Category C. Animals used in studies involving pain/distress to the animals and for which appropriate anaesthetics, analgesic and tranquilizing drugs were used was placed under Category D, while studies in which animal use involved pain/distress that could not be relieved because relieving the pain will adversely affect the results and interpretation of outcome was placed under Category E (USDA, 2023). The fate of animals used for research was categorized into three: i. Euthanasia of all animals used; ii. Euthanasia of some of the animals used and re-use of some (especially Controls); and iii. Re-use or return to source of all animals used.

Quantitative data obtained were subjected to descriptive statistics. Chi square was used to

test for association between variables across the study period. IBM SPSS statistical software was used for the data analyses. Results were presented in form of tables of frequencies and bar charts.

Results

The total number of studies involving the use of animals in the University of Nigeria from January 2019 to December 2023, as documented in the IACUC database was 172, and the annual distribution ranged from the lowest in 2022 (16 studies; 9.3%) to the highest frequency in 2023 (54 studies; 31.4%) [Figure 1]. One hundred and forty-one out of the 172 studies (82.0%) were experiments, while 31 (18.0%) were surveys (Table 1). All through the period studied (2019 – 2023), experiments dominated, with a frequency percentage range of 68.8 – 95.2% of the total number of studies, as against 4.8 – 27.6% frequency range for surveys (Table 1). There were no significant differences ($p > 0.05$) in the frequency of experimental studies across the years 2019 – 2023.

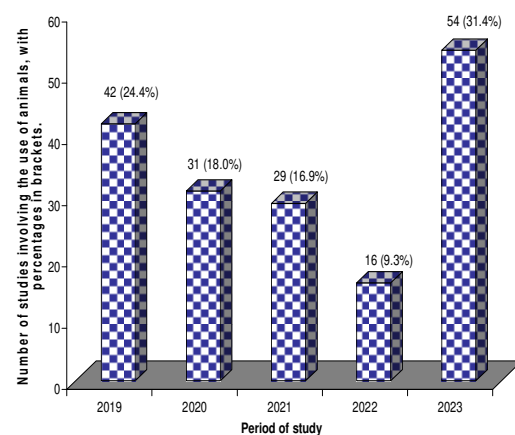


Figure 1. The annual number of studies involving the use of animals at the University of Nigeria, from 2019 to 2023 (with percentage frequency in brackets).

Table 1. The category of studies involving the use of animals (Experiments or Surveys) at the University of Nigeria, from 2019 to 2023.

Years	Number of studies that were experiments or surveys, with percentage in brackets.		Totals
	Experiments	Surveys	
2019	40 (95.2%)	2 (4.8%)	42
2020	25 (80.6%)	6 (19.4%)	31
2021	21 (72.4%)	8 (27.6%)	29
2022	11 (68.8%)	5 (31.3%)	16
2023	44 (81.5%)	10 (18.5%)	54
Total	141 (82.0%)	31 (18.0%)	172

Seventeen animal species were used for studies within the studied period, with albino rats having the highest frequency of use (43.6%), followed by chickens (11.6%), dogs (10.5%), and others that were individually below 10% in frequency. The lowest frequency of 0.6% each was recorded for the use of African giant rats, earthworms, grass cutters and turkeys (Table 2). Animal species with a frequency of use below 10% and above 1%, in descending order are: goats (7.6%), mice (5.2%), bats and sheep (4.1% each), pigs (2.9%), cattle and fish (2.3% each), rabbits (1.7%) and horses (1.2%) [Table 2]. There was a significant increase ($p < 0.05$) in the frequency of use of albino rats across the years studied from the lowest (29.0%) recorded in 2020 to the highest (59.3%) recorded in 2023 (Figure 2). The frequency of use of chickens however significantly ($p < 0.05$) decreased across the studied period from 25.8% in 2020 to 1.9% in 2023 (Table 2). There were no significant differences ($p > 0.05$) in the frequency of use of dogs, goats, mice and other animals across the period studied (Table 2).

Studies involving the use of animals in the University of Nigeria as documented in the IACUC database were majorly domiciled in the Faculty of Veterinary Medicine (74.4%), followed by the Faculties of Agriculture (9.3%),

Biological Sciences (8.1%), Pharmaceutical Sciences (5.8%), Health Sciences (1.7%), with the lowest (0.6%) recorded for the Faculty of Physical Sciences (Figure 3, Table 3). The frequency of studies that involved the use of animals domiciled in the Faculty of Veterinary Medicine did not significantly vary ($p > 0.05$) across the years studied; it ranged from a minimum of 70.4% recorded in 2023 to a maximum of 78.6% recorded in 2019 (Table 3).

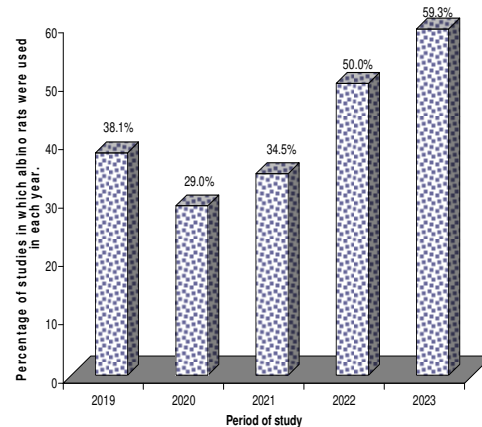


Figure 2. The annual percentage frequency of animal studies in which albino rats were used at the University of Nigeria, from 2019 to 2023.

The category of pain/distress to which animals used for studies between 2019 and 2023 were subjected to was predominantly USDA Category C (75.6%), followed far off by USDA Category D (15.7%), USDA Category B (5.2%) and USDA Category E (3.5%) [Figure 4]. The annual frequency of studies in which animals were subjected to USDA Category C pain/distress (which was the predominant category) did not significantly vary ($p > 0.05$) across the five-year study period, and it ranged from 62.1% recorded in 2021 to a maximum of 83.3% recorded in 2019 (Table 4).

The number of animals used per group for experiments involving albino rats, chicken and dogs (which were the predominantly used animals for the studies) is presented in Table 5. The mean number of albino rats used per group in experiments across the years was 5.36 ± 0.32 , with a mode of 5, while the mean number of chickens used for studies was 18.38 ± 6.47 , with a mode of 10 (Table 5). For dogs, the overall mean number used per group in experiments was 4.30 ± 0.41 , with a modal number of 4 (Table 5).

Table 2. Animals used for studies at the University of Nigeria, from 2019 to 2023, arranged in descending order of frequency of use.

Animals	Number of studies in which specific animals were used, with percentage in brackets					Totals
	2019	2020	2021	2022	2023	
Albino rats	16 (38.1%)	9 (29.0%)	10 (34.5%)	8 (50.0%)	32 (59.3%)	75 (43.6%)
Chicken	5 (11.9%)	8 (25.8%)	5 (17.2%)	1 (6.3%)	1 (1.9%)	20 (11.6%)
Dogs	7 (16.7%)	3 (9.7%)	3 (10.3%)	1 (6.3%)	4 (7.4%)	18 (10.5%)
Goats	1 (2.4%)	3 (9.7%)	3 (10.3%)	2 (12.5%)	4 (7.4%)	13 (7.6%)
Mice	2 (4.8%)	1 (3.2%)	1 (3.4%)	1 (6.3%)	4 (7.4%)	9 (5.2%)
Bats	4 (9.5%)	2 (6.5%)	0	0	1 (1.9%)	7 (4.1%)
Sheep	1 (2.4%)	2 (6.5%)	1 (3.4%)	0	3 (5.6%)	7 (4.1%)
Pigs	2 (4.8%)	1 (3.2%)	1 (3.4%)	1 (6.3%)	0	5 (2.9%)
Cattle	0	2 (6.5%)	1 (3.4%)	1 (6.3%)	0	4 (2.3%)
Fish	2 (4.8%)	0	1 (3.4%)	1 (6.3%)	0	4 (2.3%)
Rabbits	0	0	2 (6.9%)	0	1 (1.9%)	3 (1.7%)
Horses	0	0	1 (3.4%)	0	1 (1.9%)	2 (1.2%)
African giant rats	0	0	0	0	1 (1.9%)	1 (0.6%)
Cats	0	0	0	0	1 (1.9%)	1 (0.6%)
Earthworms	1 (2.4%)	0	0	0	0	1 (0.6%)
Grass cutters	1 (2.4%)	0	0	0	0	1 (0.6%)
Turkeys	0	0	0	0	1 (1.9%)	1 (0.6%)
Total	42	31	29	16	54	172

Table 3. Distribution of faculties where studies involving the use of animals were domiciled at the University of Nigeria, from 2019 to 2023, arranged in descending order of frequency of use.

Faculties	Number of studies, with percentage in brackets					Totals
	2019	2020	2021	2022	2023	
Veterinary Medicine	33 (78.6%)	23 (74.2%)	22 (75.9%)	12 (75.0%)	38 (70.4%)	128 (74.4%)
Agriculture	1 (2.4%)	3 (9.7%)	2 (6.9%)	2 (12.5%)	8 (14.8%)	16 (9.3%)
Biological Sciences	4 (9.5%)	2 (6.5%)	2 (6.9%)	0	6 (11.1%)	14 (8.1%)
Pharmaceutical Sciences	4 (9.5%)	2 (6.5%)	1 (3.4%)	2 (12.5%)	1 (1.9%)	10 (5.8%)
Health Sciences	0	1 (3.2%)	2 (6.9%)	0	0	3 (1.7%)
Physical Sciences	0	0	0	0	1 (1.9%)	1 (0.6%)
Total	42	31	29	16	54	172

Table 4. Pain/distress categories (USDA Pain Categories) of studies involving the use of animals at the University of Nigeria, from 2019 to 2023, arranged in descending order of frequency of use.

Distress/Pain Categories	Number of studies, with percentage in brackets					Totals
	2019	2020	2021	2022	2023	
USDA Category B	0	2 (6.5%)	4 (13.8%)	0	3 (5.6%)	9 (5.2%)
USDA Category C	35 (83.3%)	23 (74.2%)	18 (62.1%)	13 (81.3%)	41 (75.9%)	130 (75.6%)
USDA Category D	7 (16.7%)	6 (19.4%)	5 (17.2%)	1 (6.3%)	8 (14.8%)	27 (15.7%)
USDA Category E	0	0	2 (6.9%)	2 (12.5%)	2 (3.7%)	6 (3.5%)
Total	42	31	29	16	54	172

Table 5. The number of animals used per group for experimental studies involving albino rats, chickens and dogs at the University of Nigeria, from 2019 to 2023.

Years	Albino rats		Chicken		Dogs	
	Mean ± SD	Mode	Mean ± SD	Mode	Mean ± SD	Mode
2019	5.3 ± 1.39	5	-	-	4.2 ± 0.98	4
2020	5.0 ± 0.50	5	19.4 ± 8.5	10	5.0 ± 1.0	5
2021	5.88 ± 1.05	6	25.8 ± 3.8	25	4.0 ± 1.0	4
2022	5.50 ± 1.50	5	-	-	-	-
2023	5.08 ± 1.24	5	10	10	4	4
Total	5.36 ± 0.32	5	18.38 ± 6.47	10	4.30 ± 0.41	4

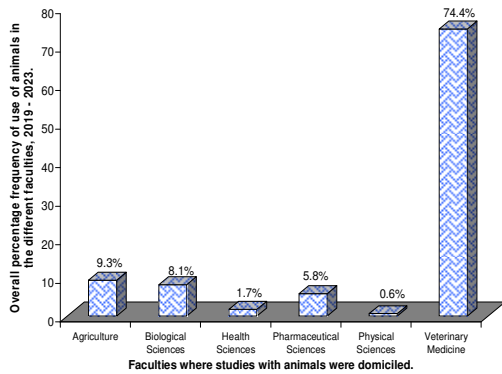


Figure 3. The percentage frequency distribution of faculties in which studies involving the use of animals was domiciled at the University of Nigeria, from 2019 to 2023.

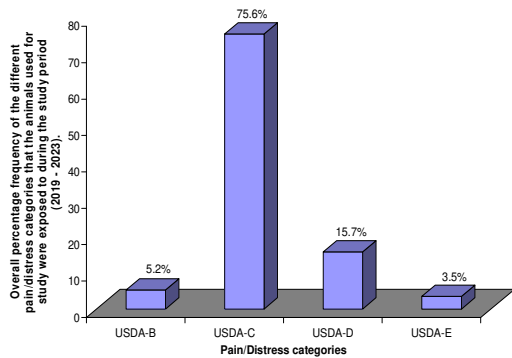


Figure 4. The percentage frequency distribution of USDA-Pain/Distress categories to which animals used for studies were subjected at the University of Nigeria, from 2019 to 2023.

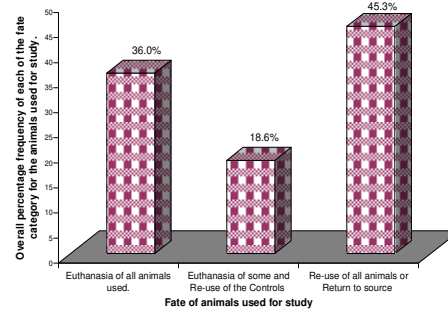


Figure 5. The percentage frequency distribution of the fate of animals used for studies at the University of Nigeria, from 2019 to 2023.

Overall, in 36% of the studies, all the animals used for study were euthanized, while in 45.3% of the studies, the animals used were re-used/returned to source (Figure 5). Studies in which some animals used were euthanized while others (especially the Controls) were re-used accounted for 18.6% of the total number of studies (Figure 5). The annual trend of frequency of the fate of animals used for study is presented in Table 6. There was a decrease in the frequency of ‘euthanasia of all animals used’ across the years studied from 42.9% maximum recorded in 2019 to 31.0% minimum recorded in 2021, while the frequency of ‘re-use/return to source’ increased across the years from 30.3% minimum recorded in 2019 to 52.2% maximum recorded in 2021 (Table 6).

Table 6. The fate of animals used for experimental studies at the University of Nigeria, from 2019 to 2023.

Years	Number of studies, with percentage in brackets			Totals
	Euthanasia of all animals used	Euthanasia + Re-use of Controls	Re-use of all animals or Return to Source	
2019	18 (42.9%)	10 (23.8%)	14 (30.3%)	42
2020	8 (25.8%)	7 (22.6%)	16 (51.6%)	31
2021	9 (31.0%)	4 (13.8%)	16 (52.2%)	29
2022	6 (37.5%)	2 (12.5%)	8 (49.1%)	16
2023	21 (38.9%)	9 (16.7%)	24 (44.5%)	54
Totals	62 (36.0%)	32 (18.6%)	78 (45.3%)	172

Discussion and Conclusion

The recorded annual distribution of studies involving the use of animals showed a relatively lower number of studies using animals in 2020 and 2021, and far less numbers in 2022; these lower annual frequency of use of animals for studies coincided with the 2020 – 2021 COVID-19 pandemic lockdown period and the 2022 eight-month long industrial action embarked upon by Academic Staff Union of Universities (ASUU) in Nigeria. The adverse effects of the COVID-19 pandemic lockdown and the ASUU industrial action on academic and research activities in Nigerian universities have been reported (Onyeaka *et al.*, 2021; Koomson *et al.*, 2023; Usman, 2023). These two events (COVID-19 pandemic lockdown and ASUU industrial action) nearly grounded academic and research activities during the periods stated. The relatively higher frequency of studies using animals in 2023 concurs with the fact that this was a year without any industrial action or disruptive lockdown in the Nigerian university system (Usman, 2023).

The predominance of experiments over surveys all through the studied period is worthy of note, and may be attributed to the earlier documented advantages that experiments have over surveys in terms of accuracy of results due to a firmer control over variables and greater possibility of linking cause with effects (Siedler and Sonnenberg, 2010; Ross and Morrison, 2014). In addition, most survey studies encountered were on owned animals. However, while the laws and standards for human and animal experiments is clear, that for owned animals is not well defined (Bertout *et al.*, 2021). Moreover, survey research in owned animal requires informed consent because participation must be voluntary and consent must be freely given (Institute of Medicine, 2009). However, in most developing countries, due to traditions and economy, the issue of institutionalized animal welfare is not fully appreciated (Upjohn

and Wells, 2016), therefore the use of ethical approval in survey studies seem to be at low level. Hence, some survey study researchers may not seek for ethical approval.

The variety of animals that were used for studies as recorded in the present study is thrilling, ranging from uncommonly used earthworms to the most commonly used albino rats. These varieties of animals nearly concur with the species earlier reported by Rodrigues (2015) in use for studies in Europe. The high frequency of use of albino rats and its significantly increasing frequency of use across the study period is in agreement with earlier reports on the albino rat being the most widely used animal model in the biomedical sciences (Ihedioha *et al.*, 2004; Iannaccone and Jacob, 2009; Homberg *et al.*, 2017). The higher frequency of use of albino rats in research has been attributed to several factors, including: the amazing physiological, anatomical and genetic similarities between the albino rat and humans which makes for greater possibility to successfully translate results of rat studies to human applications, the ease with which albino rats can be handled, kept and fed, and their ability to reproduce rapidly (their short reproduction cycle), which makes them readily available at all times (Bryda, 2013; Smith *et al.*, 2019; Szpirer, 2020; Benz, 2022; Mukherjee *et al.*, 2022). In contrast to the findings in this present study, however, Rodrigues (2015) reported that mice were the most commonly used rodent animal model in Europe.

The finding in the present study that majority of the studies involving use of animals in the University of Nigeria were domiciled in the Faculty of Veterinary Medicine may be attributed to the vital role that veterinarians play in the care, welfare and appropriate use of animals for research and learning (Bain *et al.*, 2011; Berry, 2014; Islam, 2015). The Veterinary Faculty is thus the focal point of all studies involving the use of animals, because, by virtue of their training and professional

calling, veterinarians are in the best position to handle, care and use animals appropriately for studies and learning. In addition, the Faculty of Veterinary Medicine also hosts most of the experimental animal houses and animal handling facilities available for research in the university.

The fact that in majority of the studies (75.6%), the animals used were subjected to USDA Category C pain/distress is laudable, as this implies that minimal pain/distress is inflicted on majority of animals used for studies (USDA, 2023). The very small percentage of studies under USDA Category E (3.5%) is relatively insignificant compared to the remaining 96.5% in which minimal pain/distress is inflicted or the pain inflicted is relieved using pain relievers.

The number of animals used per group in an experiment depends on several factors, and researchers are mindful that in a study, the use of too few animals may lack the statistical power to detect biologically significant effect (Beynen *et al.*, 1993) and using too many animals will be a waste of both animals and resources, and may lead to statistically significant results that are of no practical importance (Erb, 1990, Mann *et al.*, 1991). The finding in this study that the mean and modal number of albino rats used for studies were approximately 5 is in line with the concept of reduction in the number of animals used for studies within limits that will be statistically viable. The near consistency of 5 as modal number of rats all through the years studied is noteworthy. In contrast, the higher mean (18.38 ± 6.47) and modal (10) number of chickens used per group in experiments as recorded in this study is also worthy of note; this may be as a result of the peculiarity of studies in poultry and the common methods of grouping and creating sub-group replicates in most studies with poultry/chickens (Demetrio *et al.*, 2013; Gupta *et al.*, 2015; Akubueze and Aronu, 2023). The relatively lower mean (4.30 ± 0.41) and modal number

(4) of dogs used in studies is thought to be reflective of the bigger physical size, higher cost and greater difficulty in caring for and maintaining higher numbers of dogs.

It is heartwarming that a greater percentage of animals used for studies were re-used or returned to source; that is, laboratory animals were thus not wasted, and that the frequency of 're-use/return to source' increased across the study period, while the frequency of 'euthanasia of all animals used' decreased. These findings are in line with the calls to minimize the overall number of animals used/wasted in research (CCAC, 1998; Hendrickson and Morton, 1998; Stokes, 2002).

Based on the results of the study, it was concluded that a variety of animals were used for research in the University of Nigeria during the study period (2019 – 2023), with albino rats being the most frequently used. Experiments dominated over surveys and studies involving use of animals were majorly domiciled in the Faculty of Veterinary Medicine. Mean and modal numbers of albino rats and dogs used for study were approximately 5 and 4, respectively. Pain/Distress category for majority of studies were USDA Category C and a high proportion of animals used for studies were re-used/returned to source. As animal models play crucial roles in biomedical research, consistent monitoring and evaluation of their use in research is essential.

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which information on use of animals for studies from 2019 – 2023 was drawn.

Conflict of interests

The authors declare no conflict of interests.

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