ijlpr 2022; doi 10.22376/ijpbs/lpr.2022.12.6.P54-60

International Journal of Life science and Pharma Research

ISSN 2250-0480

Research Article

Pharmacology For Drug Discovery

Evaluating Pharm.D Students' Views and Perceptions Regarding Practicing Experimental Pharmacology and Animal Handling: A Single-Site Study

Alanood S. Algarni

Assistant Professor, Pharmacology and Toxicology Department, Pharmacy College, Umm Al-Qura University

Abstract: Animal experimentation is vital to the study of pharmacology during undergraduate studies. Regulations and most commonly, students' preferences are all factors that influence the procurement of and performance of animal experiments. In the higher educational level student's perceptions and preferences contribute significantly to their education. Various studies indicate that using 3D models could reduce and refine animal experimentation in pharmacology teaching. Some researchers illustrate that an existing gender difference in practical classes with laboratory animals exists, indicating that a particular group may be vulnerable to lower grades if a unilateral teaching method is applied. This study seeks to determine the views and perceptions of pharmacology students to determine if a hybrid study method is better suited to help students to gain good grades and understand medical concepts associated with their field. This study aims to gauge the efficacy of such a system for use in UQU, Saudi Arabia. It illustrates the variation between male and female students regarding preference and learning capability in virtual and practical lessons. This research seeks also to determine whether a significant change in grade exists if students have an option to choose between these learning methods. Data were collected through an online questionnaire survey conducted to 121 third-year undergraduate pharmacology students from Umm Al-Qura University (UQU) college of pharmacy in Makkah, Saudi Arabia in October 2021. Undergraduate Pharm.D pharmacology students in Makkah, Saudi Arabia, have positive views and perceptions regarding handling of live animals in experimental pharmacology regardless of their gender.

Keywords: Experimental Pharmacology, Animal Handling, Pharm.D, Pharmacology and Pharmacy Students

***Corresponding Author**

Dr Alanood S. Algarni , Assistant Professor,
Pharmacology and Toxicology Department,
Pharmacy College, Umm Al-Qura University

Received On 29 June 2022
Revised On 30 August 2022
Accepted On 06 September 2022
Published On 01 October 2022

Funding This research did not receive any specific grant from any funding agencies in the public, commercial or not for profit sectors.

Citation Alanood S. Algarni , Evaluating Pharm.D Students' Views and Perceptions Regarding Practicing Experimental Pharmacology and Animal Handling: A Single-Site Study.(2022).Int. J. Life Sci. Pharma Res.12(6), P54-60
http://dx.doi.org/10.22376/ijpbs/lpr.2022.12.6.P54-60

1. INTRODUCTION

Animals such as mice, rats, guinea pigs, and rabbits have been used for years in educational institutions to teach skills to the students that are needed to perform certain activities.[1,2] One of the fields where animals have been used widely to provide students with skills needed to perform certain activities is experimental pharmacology. Experimental pharmacology is the study of pharmacology of unknown substances and pharmaceutical products in controlled situations through experiments involving humans or animals.[3,4] In experimental pharmacology, learning and practicing using animals which is extremely useful for both undergraduate and postgraduate students.[5] According to Badyal ey al., use of animals in experimental pharmacology is also the one that has made possible for most of the current drugs to be discovered.[5] Each of these experiments tests has their strengths and limits. However, several techniques were used in experimental pharmacology teaching including computer-assisted learning, toxicological studies, and various behavioral tests.[6,7] This article is for research conducted for evaluating views and perceptions of Pharm.D students' regarding use of animals in pharmacology laboratories for learning experimental pharmacology. Views and perceptions of students regarding use of live animals when conducting pharmacology experiments have been investigated with respect to various different settings. In India, Jalgaonkar et al., identified that, views and perceptions of postgraduate pharmacology students regarding use of live animals when conducting pharmacology experiments were not bad.[8] Only, seven out of 31 postgraduate pharmacology students who took part in the study agreed that live animal experiments should be replaced with computer-simulated methods in postgraduate teaching of experimental pharmacology.[8] In the same country, it has been identified that, views and perceptions on the use of live animals when conducting pharmacology experiments were also not bad among undergraduate pharmacology students.[9] As many as 66.7% of the students investigated agreed that, animals were essential for learning and understanding biological processes investigated when conducting experimental pharmacology experiments.[8] In India, the students 'views and perceptions regarding use of live animals when conducting experimental pharmacology are not different between student's gender and age.[10] Undergraduate and postgraduate pharmacology students in several other countries have also been identified to have positive views and perceptions regarding use of animals when conducting experimental pharmacology experiments. In Brazil, for instance, undergraduate pharmacology students agreed that, use of animals in experimental pharmacology experiment was important for learning and indicated that, their discomfort when animals were used in the experiments was at most average.[11] However, noted that cases of students refusing to stay in such practical classes were not rare among undergraduate pharmacology students in the country.[11] In another study, as many as 49.5% of the Jordanian pharmacology students investigated refused to handle animals when conducting pharmacology experiment citing phobia as the main reason for refusal.[12] The remaining 50.5% of the Jordanian pharmacology students investigated indicated that animal handling was essential for understanding the effect of drugs on animals.[12] However there were no indications, whether views and perceptions of students regarding animal handling when conducting pharmacology experiment was different depending on age and gender of the student.[12] Recent evidence suggests that using animals in practical pharmacology laboratory classes without considering gender may be detrimental to pharmacology class. Females have a greater tendency to favor virtual learning over practical laboratory lessons. They would potentially have lower grades, if they did not have an alternative to laboratory classes. These individuals are less inclined to animal studies and would gain less knowledge than their male counterparts, with lower resistance to animal experimentation classes. Subsequently, it is prudent to assume that, more female students would leave some practical classes, failing to gain knowledge from these experiments. Virtual learning techniques would eliminate this gap and allow them to attend lessons similar to practical ones. These students are likelier to score higher grades in class as they would not miss essential lessons than their counterparts would learn in practical lessons involving animal experimentation. Views and perceptions of Pharm.D students in Saudi Arabia regarding use of animals in pharmacology laboratories for learning experimental pharmacology continues not to be clearly evident, because of lack of empirical research on the issue. The aim of this particular research was to identify how pharmacology students in Umm Al-Qura University college of pharmacy in Makkah, Saudi Arabia, view and perceive usage of animals when conducting pharmacology experiments. It is expected that, such students with these new experiences would have views and perception that are not highly negative regarding use of animals when conducting pharmacology experiments just like their counterparts worldwide . It was, however, expected that views and perceptions regarding use of animals in experimental pharmacology experiments would be different for male and female individuals given the way women are expected to behave relative to men in the world.

2. MATERIALS AND METHODS

Approval for this particular research study was obtained from the Research Ethics Committee of Umm Al-Qura University in Makkah, Saudi Arabia. Participants in the study were 121 students studying third-year Pharmacology I course of Umm Al-Qura University. Collection of required data was through an online cross-sectional survey involving such individuals conducted on October 2021. A self-administered questionnaire developed and administered using the online platform (Google form) was used for conducting the survey. Questions included in the questionnaire were those on views and perception of pharmacology students regarding practicing experimental pharmacology, animal handling and questions on demographic characteristics of the students. Overall, there were 13 items in the survey and organized into two sections, a section on general information (3 questions) and a section on views and perceptions of the students (10 statements requiring responses about the level of agreement). Questions included in the questionnaire had been sourced from the study by Durand et al., (2019) and adapted accordingly for the pharmacology course[13]. Collected data was analyzed using both descriptive and inferential statistics. Descriptive statistics used for analyzing the data were either univariate or bivariate. Univariate descriptive statistics used included mean and standard deviation or median and quartile deviation for continuous variables depending on whether the variable is approximately normally distributed or not and frequencies and relative frequencies for categorical variables. Bivariate descriptive statistic included such mean and standard deviation computed separately for male and female students. Inferential statistics used included only independent samples t-test. Descriptive statistics were used for assessing views and perceptions of the students regarding the use of animals in

experimental pharmacology experiments based on their responses to the questions asked in the survey and how these views differed between male and female students. Inferential statistics, on the other hand, were used to assess whether differences in views and perceptions regarding use of animals in experimental pharmacology experiments between male and female students were large enough to be significant statistically. Furthermore, the study included the analysis of a peer-reviewed research study positing the advantages of using a virtual learning method for pharmacology students. The researcher sought information from peer-reviewed sources to avoid using unsubstantiated information to support the findings and the conclusion. Furthermore, the researcher sought relevant information based on studies conducted within the past five years. This ensures the study and entails updated information, eliminating outdated data from previous researchers. In this instance, the researcher sought documents that provide information on the impact of students walking out of class on their test scores. The study aims to avoid any form of bias and seeks to dispel adverse information on using virtual teaching methods in practical pharmacology education using relevant and robust findings and conclusions provided by reputable researchers. It entails exclusion criteria based on relevance (peer-reviewed) and timeliness (only documents written from 2017 onwards). Subsequently, the researcher will dispel erroneous information critically to ascertain whether virtual learning methods could potentially aid in boosting students' grades.

3. STATISTICAL ANALYSIS

All statistical tests were 2-sided and conducted using SPSS version 26 (IBM Statistics Institute, Chicago, OH) with findings being considered significant statistically if p-value obtained was less than the 5% level of significance (α = 0.05).

4. RESULTS

Table 1. Demographic characteristics for survey respondents

	N (%)
Total	**121**
Age	
Mean	20.4
Median	20
Range	(18–22)
Gender	
Male	71 (58.7)
Female	50 (41.3)
First time dealing with Laboratory animals?	
Yes	114 (94.2)
No	7 (5.8)

Table 1 contains results obtained for the demographic characteristics of the study participants. Out of total 121 respondents, 71 (58.7%) were females and 50 (41.3%) males. Study participants were aged between 18 and 22 years (M = 20.4, SD = 1.21) with students that were dealing with laboratory animals for the first time being as many as 94.2%among the study participants (n = 114).

Table 2. Response frequency of the respondents

Statements	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
	N (%) [1]	N (%)	N (%)	N (%)	N (%)
The pharmacological phenomena and graphical structures I learned about in my theoretical classes were much easier to visualize and retain after participating in the hands-on lab exercises with animals.	60 (49.6)	45 (37.2)	11 (9.1)	2 (1.7)	3 (2.5)
Practical classes with laboratory animals benefited by scene visualization and animal photos.	62 (51.2)	39 (32.2)	12 (9.9)	2 (1.7)	6 (5.0)
The practical courses with laboratory animals encouraged my drive to study the subject matter.	54 (44.6)	35 (28.9)	25 (20.7)	2 (1.7)	5 (4.1)
The practical courses with laboratory animals contributed to the module's instructional goals.	45 (37.2)	48 (39.7)	21 (17.4)	2 (1.7)	5 (4.1)
As valuable as the academic sessions are for understanding the topic at hand, the practical ones with laboratory animals are.	49 (40.5)	43 (35.5)	18 (14.9)	3 (2.5)	8 (6.6)
My education has been enriched by hands-on experience with laboratory animals.	67 (55.4)	34 (28.1)	14 (11.6)	3 (2.5)	3 (2.5)
From what I've seen in practical courses, using and manipulating animals is crucial.	47 (38.8)	35 (28.9)	29 (24.0)	6 (5.0)	4 (3.3)
Without employing animals in pharmacology labs, students may get the same level of professional preparation.	16 (13.2)	14 (11.6)	30 (24.8)	39 (32.2)	22 (18.2)

The challenge of working with animals hindered my ability to achieve the course goal for that practical lesson.	16 (13.2)	29 (24.0)	34 (28.1)	31 (25.6)	11 (9.1)
Classes with laboratory animals prompted me to rethink the teaching style and look for alternatives.	34 (28.1)	43 (35.5)	25 (20.7)	11 (9.1)	8 (6.6)

Table 2, contains frequencies and relative frequencies as well as mean and standard deviation obtained for questionnaire items on views and perceptions of the students. Students that had at least agreed to the statement were 86.8% (*n* = 105) for practical classes with laboratory animals helping one to understand and remember the structures visualized and the pharmacology phenomenon discussed in the theoretical classes, 83.4% (*n* = 101) for scene visualization and animal images in the practical classes with laboratory animals having a positive impact on ones learning, 73.5% (*n* = 89) for ones motive for studying the discipline related to the practical classes with laboratory animals being stimulated and 76.9% (*n* = 93) for practical animals with laboratory animals assisting in the tutorial objectives in the related module. Moreover, students that, atleast agreed to statements were 76.0% (*n* = 92) for practical classes with laboratory animals having the same importance for learning the theme discussed in the theoretical class and 83.5% (*n* = 101) for new skills useful for one's academic development being acquired during practical classes with laboratory animals.

Table 3. Likert scale score for each survey question

Statements	Overall	Female students	Male students	
	M (SD)	M (SD)	M (SD)	P
The pharmacological phenomena and graphical structures I learned about in my theoretical classes were much easier to visualize and retain after participating in the hands-on lab exercises with animals.	4.3 (0.89)	4.23 (1.00)	4.40 (0.70)	.290
Practical classes with laboratory animals benefited by scene visualization and animal photos.	4.2 (1.04)	4.11 (1.09)	4.40 (0.95)	.135
The practical courses with laboratory animals encouraged my drive to study the subject matter.	4.1 (1.05)	3.96 (1.14)	4.26 (0.88)	.118
The practical courses with laboratory animals contributed to the module's instructional goals.	4.0 (1.00)	3.99 (1.05)	4.12 (0.92)	.468
As valuable as the academic sessions are for understanding the topic at hand, the practical ones with laboratory animals are.	4.0 (1.12)	3.97 (1.17)	4.06 (1.06)	.672
My education has been enriched by hands-on experience with laboratory animals.	4.3 (0.95)	4.28 (0.97)	4.36 (0.92)	.657
From what I've seen in practical courses, using and manipulating animals is crucial.	4.0 (1.06)	3.85 (1.10)	4.10 (1.00)	.195
Without employing animals in pharmacology labs, students may get the same level of professional preparation.	2.7 (1.27)	2.80 (1.20)	2.54 (1.36)	.264
The challenge of working with animals hindered my ability to achieve the course goal for that practical lesson.	3.1 (1.18)	3.25 (1.14)	2.80 (1.20)	.037
Classes with laboratory animals prompted me to rethink the teaching style and look for alternatives.	3.7 (1.17)	3.87 (1.01)	3.44 (1.33)	.055
Converting the total raw score to Likert scale per question (sum of total raw score / number of respondents)				

However, for the view "From what I've seen in practical courses, using and manipulating animals is crucial" were only 67.7% (*n* = 82) students were agreed and 63.6% (*n* = 77) for the view "Classes with laboratory animals prompted me to rethink the teaching style and look for alternatives". Students that at least agreed to the statements were also only 24.8% (*n* = 30) for pharmacy students being professionally well prepared without using animals in practical classes in pharmacology and 37.2% (*n* = 45) for difficulty in handling animals impairing one's learning of the respective practical classes. The mean obtained was less than 4.0 for pharmacy students being professionally well prepared without using animals in practical classes in pharmacology (*M* = 2.7, *SD* = 1.27), difficulty in handling animals impairing one's learning of objective of the respective practical class (*M* = 3.1, *SD* = 1.18), and practical classes with laboratory animals inspiring one to question the methodology and seek alternative methods equally effective in teaching (*M* = 3.7, *SD* = 1.17). The mean obtained was significantly different between male and female students for difficulty in handling animals impairing ones learning of the objective of the respective practical class (*t* (119) = 2.109, *p* = .037) (Table 3). Only the difficulty in handling animals, impairing ones learning of the objective of the respective practical class, the average score was significantly higher for female students (*M* = 3.25, *SD* = 1.143) than that for male students (*M* = 2.80, *SD* = 1.195) (Table 3).

5. DISCUSSION

Over years, pharmacology experiments in UQU were based on computer simulation, video demonstration and other models. Initiation of animal use in few substantial pharmacology experiments was highly recommended by pharmacology academic affairs to assure educational efficacy. Ultimately, this study is intended to support pharmacology academic affairs to takes the right decision to improve the learning quality. Particularly, this research aimed to identify how pharmacology students in Umm Al-Qura University college of pharmacy in Makkah, Saudi Arabia, view and

perceive usage of animals when conducting experimental pharmacology experiments. Although as many as 94.21% of the study participants were dealing with laboratory animals for the first time, more than two-thirds of the students were positive about manipulating animals in practical classes being fundamental and having one's motive for studying the discipline related to practical classes with laboratory animals being stimulated. Students that were positive, were more than three-quarters of the study participants for practical classes with laboratory animals helping one to understand and remember the structures visualized and pharmacology phenomenon discussed in theoretical classes and scene visualization and animal images in practical classes with laboratory animals having a positive impact on one's learning. This particular finding by the present study is consistent with those of previous studied identified that, pharmacology students do not have a view or perception that is highly negative toward use of animals in experimental pharmacology experiments.[8,9] According to Jalgaonkar et al., live animals need not be replaced with computer-simulated methods as viewed and perceived by postgraduate pharmacology students, which is an indication that such students have a positive view and perception regarding the use of animals in experimental pharmacology experiments.[8] On other study, identified that undergraduate pharmacology students have a positive view and perception regarding the use of animals in experimental pharmacology experiments as indicated by agreeing that animals are essential for learning and understanding of biological processes investigated when conducting experimental pharmacology experiments.[9] In contrast, previous study found that, students disagreed with animal experiments due to concerns over the effectiveness and mortality of animal experiments.[14] This was also the case for practical animals with laboratory animals assisting in the tutorial objectives of the module, practical classing with laboratory animals having the same importance for learning the theme discussed in theoretical class and new skill useful for one's academic development being acquired during practical classes with laboratory animals. Each of these student's views and perceptions regarding use of animals in experimental pharmacology experiment also had the average obtained being greater than or equal to four, which is an indication that most of the students were positive about the statements. Previous studies have indicated that the view and perception of animal handling being essential for understanding theoretical concepts learned in pharmacology classes are evident.[6] Just like postgraduate and undergraduate students in countries such as India, Brazil, and Jordan, third-year undergraduate students in Makkah, Saudi Arabia cannot be said to have a negative view and perception regarding using of animals in experimental pharmacology experiments. Students who were positive, however, only about a quarter of the study participants for pharmacy students being professionally well prepared without using animals in practical classes and only slightly more than a third of the study participants for difficulty in handling animals impairing one's learning of the respective practical classes. Average scores obtained for these two items on student's views and perceptions regarding use of animals in experimental pharmacology experiments were also less than four, which is an indication that, majority of the students had failed to agree with the statements. The other student's view and perception having an average score less than four indicating that, many students failed to agree with the statement practical classes with laboratory animals, inspiring one to question the methodology and seek alternative methods equally effective in teaching. It could be noted that students that at least agreed with this particular statement were less than two-thirds of the study participants. Results were in agreement to previous study.[15] Previous studies, however, indicated that some undergraduate students are not comfortable with handling of animals when conducting experimental pharmacology experiments.[11,12,16] According to Rochelle et al., cases of students refusing to stay in practical classes involving handling of animals are not rare among undergraduate students in Brazil.[11] Cases of students refusing to stay in practical pharmacology classes involving handling of live animals are also not rare among undergraduate pharmacology students in Jordan.[12] Such findings from previous studies are consistent with the findings obtained from this particular research study. Almost a quarter of the study participants viewed and perceived that, pharmacy students can be professionally well prepared without using animals in practical pharmacology classes. Students viewing and perceiving that, difficulty in handling animals impaired their learning of the objective of the respective practical class. Such students could refuse to stay in practical pharmacology classes involving handling of live animals because they do not perceive them to be important. Al Khaja and his colleagues conducted a study in 2019 to determine academic performance and attendance. The researchers sought to discern the relationship between test achievements by students in a large-group setting in problem-based learning (PBL). They gauged the relationship between resource sessions entailing PBL and test scores in pharmacology classes to determine whether test scores are connected to a student's gender. The study included a sizeable sample population entailing 1404 medical students, where the researchers analyzed their MCQ test scores and pharmacology resource sessions class attendance. There was a significant drop in students attending PBL sessions, explaining a weak but positive correlation between achievement and attendance in pharmacology. Individuals that attended more than 50% of the sessions had a higher mean score than their counterparts with less than 50% attendance rates.[17] However; the study does not entail information on practical pharmacology laboratory lessons. The researchers indicate that, lower attendance positively correlates with reduced test scores.[17] Al Khaja and his colleagues provide an accurate analysis of the possibility of a student getting lower grades if a student does not attend classes. A PBL curriculum resulted in reduced student classroom attendance, illustrating a positive correlation between academic achievement and attendance based on MCQ test scores. While the researchers' study does not indicate any effect on a student's grades based on gender, it is prudent to note that females are less likely to attend practical animal experimentation lessons.[17] Therefore, one could infer that females are affected to a greater extent than their male counterparts. As the study notes that, virtual learning methods are an option in pharmacology courses. Students with an adverse perception of using animals in practical pharmacology sessions may get lower test scores. In this way, a hybrid teaching design that includes virtual sessions would mitigate these adverse effects and provide an equal opportunity for students to gain information that those with an affinity to practical lessons have. Shehnaz research group identified that views and perceptions of students regarding the use of live animals in pharmacology experiments are not different depending on age and gender of the students.[10] Given that, the students investigated in this particular study did not differ widely in terms of age, effect of age on views and perceptions regarding the use of live animals in experimental pharmacology experiments could not be assessed. With respect to gender, the finding obtained from this particular

study failed to agree with those of Shehnaz to some extent.[10] Based on the findings obtained from this particular research, male and female students appeared to differ significantly in terms of the view and perception of difficulty in animal handling impairing one's learning of the objective of the respective practical class. A larger average score obtained for this particular view and perception regarding use of animals in pharmacology experiment among female individuals than among male individuals is an indication that, there were more female students than male students agreeing to the statement. This could be due to female students being more likely to encounter difficulty in animal handling when conducting pharmacology experiments when compared to male students. Although female students and male students were likely to be also different in terms of their other views and perceptions regarding use of animals in experimental pharmacology experiments, their differences were not large enough to be significant.

6. CONCLUSION

In Makkah, Saudi Arabia, pharmacology students have been studying pharmacology theoretically for years, but they are to start using live animals when conducting experimental pharmacology experiments. This particular research investigated how undergraduate pharmacology students in Makkah, Saudi Arabia, view and perceive handing of live animals when conducting pharmacology experiments. Results obtained indicated that, the students do not have a negative view and perception toward handling of live animals when conducting pharmacology experiments in general, but there are some students that do not view it as necessary. Results obtained also indicated that female students view difficulty in animal handling impaired their learning of the objective of respective practical class more than the male students. The study, therefore, concludes that, views and perceptions of undergraduate students in Makkah, Saudi Arabia regarding handling of live animals when conducting pharmacology experiments are positive in general, but some students are not very comfortable with it. Handling of live animals when conducting pharmacology experiment is, therefore, likely to be highly accepted by the undergraduate pharmacology students in Makkah, Saudi Arabia, but cases of students walking out of such practical classes because of being uncomfortable with it or finding it challenging could be expected, especially among female students. Therefore, this research proposes developing a hybrid teaching system that integrates practical and virtual learning methods. Using 3D models and practical lessons could help mitigate the potential for students walking out at UQU College of pharmacy. Female students have indicated the possibility of lower grades due to difficulties linked to animal experimentation. Virtual teaching sessions for this group posits a likely compromise that does not harm the students and teachers. Students with a lower tolerance for animal experimentation would gain similar skills to their counterparts that opt for practical lessons. Considering this system's efficacy is prudent as reduced classroom attendance is positively correlated with declining test performance. The UQU College of pharmacy could consider a hybrid system that would ensure fairness in its pharmacology class, enabling students to compete on an equal criterion.

7. ETHICAL APPROVAL

The study was approved by the bioethics and medical research committee Umm Al-Qura University (Reference/ ITKQ110921).

8. AUTHOR CONTRIBUTION STATEMENT

Alanood S. Algarni contributed to study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

9. CONFLICT OF INTEREST

Conflicts of interest declared none.

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