Do Faculty in Southern Indian Medical Colleges Support Animal Use in Postgraduate Education More Than in Undergraduate Education?

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Summary — In India, animal experiments play an integral role in both undergraduate medical education (UGME) and postgraduate medical education (PGME) in the discipline of Pharmacology. Therefore, we aimed to compare the perceptions of pharmacology faculty members in southern India with regard to the use of animal experiments and alternatives in UGME and in PGME. We also determined the association between these perceptions and the socio-demographic characteristics of the participants. Pharmacology faculty members in 15 medical colleges located in southern India answered a 27-statement, 5-domain questionnaire with a total score of 108. The means of the total, domain and statement scores were analysed by the Wilcoxon signed-rank test. The mean total score obtained for faculty members (n = 52) was significantly higher ($p < 0.001$) for PGME (61.2/108) than that for UGME (51.9/108). Significant differences were observed in the mean total and in the domain scores for PGME when compared to UGME in all of the socio-demographic groups, except for male faculty members and those without an MD or doctoral degree. The mean individual statement scores also indicated that there is more support for animal use in PGME. Overall, it was apparent that pharmacology faculty members in southern Indian medical colleges support animal use in PGME more than in UGME. Increased awareness is required among faculty members concerning alternatives to animal experiments in medical education, especially in PGME.

Key words: *animal experimentation, attitudes, medical education*, *medical faculty, pharmacology.*

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Introduction

Animal experiments have conventionally formed an essential component of postgraduate medical education (PGME; 1) and undergraduate medical education (UGME; 2–4) in the discipline of Pharmacology in India. Graduate students in India specialise in pharmacology after the completion of Bachelor of Medicine, Bachelor of Surgery, Bachelor of Pharmacy, Bachelor in Veterinary Science or Master of Science courses. In almost all of these pharmacology-related postgraduate courses (except for the PhD), animal experiments form a vital part of summative assessment. However, the poor clinical and toxicological utility of animal experiments (5, 6), and the finding that many are statistically under-powered (7), contribute to the question of their validity. In addition, the escalating economic burden of animal experiments, problems in obtaining animals, strict regulations limiting their use, ethical objections from animal rights organisations, and misgivings voiced by undergraduate students (2–4, 8–11) and medical interns (12), have created stumbling blocks to the use of animals in medical education. Moreover, the availability of many newer alternatives, such as computer simulations, high-quality videos, ethically-sourced animal cadavers for education/biomedical research (13, 14), innovative opportunities in the pharmaceutical industry and clinical research organisations (15), and other evolving streams, such as pharmacoepidemiology, pharmacovigilance and pharmacoeconomics (1), have raised questions about the use of animals in medical education.

The perceptions of students and faculty members with regard to the use of animals in UGME have been explored in depth (9–12, 16, 17), but, to our knowledge, no studies have compared the perceptions of faculty members on the use of animals in undergraduate and postgraduate education. As the views of the teachers have a strong bearing on the implementation of the curriculum, the results obtained in our study might help to improve the postgraduate and undergraduate curricula that are followed in the medical colleges of India.

The objectives of this study were:

— to compare the perceptions of pharmacology faculty members from southern Indian medical colleges with regard to the use of animals and alternatives in PGME and in UGME; and

— to determine whether an association exists between the perception of faculty members and their socio-demographic characteristics (i.e. age, gender, educational qualifications, postgraduate teaching experience and total teaching experience).

Materials and Methods

The sample

A cross-sectional survey was conducted among pharmacology faculty in medical colleges (selected by the 'convenience sampling' method) in four southern states of India (Tamil Nadu, Karnataka, Kerala and Andhra Pradesh). The study was approved by the Ethics Review Committee of the Gulf Medical University, Ajman, UAE. The objectives of the study were explained at each college involved, and verbal consent was obtained from the heads of the relevant departments of the selected colleges. A self-administered questionnaire was distributed by post to the colleges. The anonymity of the respondents was ensured and participation was voluntary. Explanations of the objectives and the instructions for filling in the questionnaire were detailed in the questionnaire.

The questionnaire

The questionnaire was structured with close-ended statements identified from a review of the literature, taking into consideration the experience of the researchers and various discussions between a focus group of six pharmacologists. The content validity of the questionnaire was obtained through a review process with a medical education expert, a socio-psychologist and two professors of pharmacology. Assessments of the statements were made on the basis of the relevance to the study objectives.

The questionnaire was pre-tested for readability and ease of understanding among a group of five pharmacology faculty members. Modifications to the questionnaire were made following the pilot study, to ensure a better understanding of the questions being asked. To avoid answering bias due to the questionnaire design (respondents tending to answer 'strongly disagree' or 'strongly agree' to all statements), certain statements were negatively worded. The final questionnaire had 27 statements. Participants were also requested to provide their socio-demographic details and the extent of the use of animals for undergraduate and postgraduate training in their institutions.

The questionnaire consisted of 27 positive and negative statements, divided into the following five domains:

1. *Advantages of animal experiments in learning (ADV)*: seven statements; the maximum score was 28. This domain was about the usefulness, relevance and value of animal experiments in learning.

2. *Disadvantages of animal experiments in learning (DIS)*: five statements; the maximum score was 20. This domain was about the drawbacks of animal experiments in education.

3. *Logistics of conducting animal experiments (CON)*: six statements; the maximum score was 24. This domain focused on the time duration, economics and other details about the conduct of animal experiments.

4. *Faculty perceptions of student experiences with animal experiments (PER)*: four statements; the maximum score was 16. This domain was about whether students find these experiments stimulating, have lower exam stress, and are aware of the learning objectives.

5. *Alternatives to existing animal experiments (ALT)*: five statements; the maximum score was 20. This domain assessed knowledge about Government laws and the characteristics of alternatives to existing animal experiments.

The total score for all domains was 108. Each statement was rated on a 0–4 scale with 0 = strongly disagree, 1 = disagree, 2 = unsure, 3 = agree, and 4 = strongly agree. Sixteen statements were positive and eleven were negative statements.

Scoring

A high mean total score was considered as being in favour of the use of animal experiments in medical education. The negative statements were scored inversely, so that the higher the score for these statements, the more the respondents disagreed with the statement. Therefore, this would indicate a positive perception of animal use.

For the analysis of the mean scores of individual statements, mean scores of 3 and above were considered to be positive perceptions, mean scores between 2 and 3 were considered to be neutral perceptions, and mean scores of 2 and below were considered to be negative perceptions.

Statistical analysis

Data was analysed by using the statistical package SPSS 19 (IBM, Chicago, IL, USA). Categorical variables were described by frequencies and percentage. The mean total scores, domain scores and individual statement scores were expressed as the mean ± standard deviation (SD). Comparison of scores between groups (based on socio-demographic characteristics) was performed by using the Wilcoxon signed-rank test. The significance level was set at 0.05.

The sample was categorised into different groups based on socio-demographic characteristics. The junior faculty and the senior faculty were differentiated on the basis of their teaching experience — less than, or more than, eight years. According to the Medical Council of India (MCI) specifications, approximately eight years of teaching experience after specialisation are required before a faculty member can be promoted to Associate Professor.

Results

The content-validated questionnaire was posted in self-addressed envelopes to 70 faculty members in 15 southern Indian medical colleges, of which eight were private medical schools and seven were State Government institutions. Of the 15 colleges in our study, six were not conducting postgraduate courses, but were planning to start to do so in the near future. Overall, 59 faculty members responded, but seven of the questionnaires were incomplete. Hence, responses were analysed from 52 faculty members, who were equally distributed between private and government institutions. The response rate was 84%. The mean age ± SD of the sample was 40.5 ± 9.5 years (ranging from 25 to 62 years). The majority of the faculty members were females, aged less than 40 years, with an MD or doctoral degree, with postgraduate teaching experience, but with fewer than eight years of teaching experience in total. All of the participants were simultaneously involved in teaching different undergraduate courses. Table 1 shows the characteristics of the study sample and the total scores obtained for PGME and UGME.

The mean total scores indicated that faculty members in all categories, except for the male faculty members and faculty members without an MD or a doctoral degree, significantly supported animal use for PGME more than for UGME (see Table 1).

Table 2 presents the domain scores obtained by the different groups of faculty. The mean domain scores of all domains showed statistically significant differences with respect to age and teaching experience. Moreover, the female faculty members, those with MD/PhD degrees, and those with postgraduate teaching experience, supported animal experiments in PGME more than in UGME, as indicated by the significant differences in all the domains. Significant differences ($p < 0.05$) were also observed in individual statement scores between PGME and UGME (see Table 3).

The highest domain score (calculated as a percentage of the maximum domain score) was recorded for domain ADV, and the lowest scores were given to the domains ALT and DIS for perceptions with regard to the use of animals in

Table 1: The socio-demographic characteristics of the study sample

Socio-demographic characteristics		Frequency	Mean total score ± SD (% maximum score) PGME	Mean total score ± SD (% maximum score) UGME
Gender	Female	36 (69.2%)	61.6 ± 14.2 (57%)*	51.1 ± 14 (47.3%)
	Male	16 (30.8%)	60.4 ± 20.6 (55.9%)	53.8 ± 19.7 (49.8%)
Age (years)	≤ 40	32 (61.5%)	60.9 ± 13.9 (56.4%)*	52.5 ± 13 (48.6%)
	> 40	20 (38.5%)	61.7 ± 19.7 (57.1%)*	51.1 ± 19.8 (47.3%)
Teaching experience (years)	Group 1 (≤ 8)	34 (65.4%)	57.6 ± 15.7 (53.3%)*	48.8 ± 14.5 (45.2%)
	Group 2 (> 8)	18 (34.6%)	68.1 ± 15.3 (63.1%)*	57.9 ± 16.8 (53.6%)
MD/PhD?	Yes	42 (80.8%)	62.8 ± 16.6 (58.1%)*	52.5 ± 16.2 (48.6%)
	No	10 (19.2%)	54.5 ± 13.3 (50.5%)	49.4 ± 14.3 (45.7%)
Teaching PGME	Yes[a]	35 (67.3%)	64.2 ± 15 (59.4%)*	53.5 ± 15 (49.5%)
	No[b]	17 (32.7%)	55 ± 17.3 (50.9%)†	48.8 ± 17.4 (45.2%)
Total		52 (100%)	61.2 ± 16.2 (56.7%)*	51.9 ± 15.8 (48.1%)

*Group 1 = Faculty with 8 years of teaching experience or less; Group 2 = Faculty with more than 8 years of teaching experience; PGME = postgraduate medical education; UGME = undergraduate medical education; [a]Yes = Faculty with postgraduate teaching experience; [b]No = Faculty without postgraduate teaching experience. *$p < 0.001$ and †$p < 0.05$ indicate statistically significant differences between PGME and UGME.*

Table 2: The mean domain scores for faculty perceptions regarding animal use in postgraduate and undergraduate medical education

	Mean domain score ± standard deviation (% maximum score)									
	ADV max. score 28		DIS max. score 20		CON max. score 24		PER max. score 16		ALT max. score 20	
	PGME	UGME	PGME	UGME	PGME	UGME	PGME	UGME	PGME	UGME
Female	20.6 ± 3** (73.6%)	16.6 ± 3.9 (59.3%)	9.0 ± 3.6** (45.0%)	7.5 ± 3.2 (37.5%)	13.3 ± 3.9** (55.42%)	11.7 ± 4.7 (48.8%)	9.5 ± 2.7** (59.4%)	7.3 ± 3.0 (45.6%)	9.2 ± 3.2‡ (46%)	8.0 ± 2.3 (40.0%)
Male	18.3 ± 5.7† (65.4%)	15.4 ± 6.2 (55.0%)	10.1 ± 3.6 (50.5%)	9.9 ± 3.9 (49.5%)	12.3 ± 5.2 (51.3%)	10.2 ± 6.2 (42.5%)	9.4 ± 3.9 (58.8%)	9.1 ± 3.8 (56.9%)	10.3 ± 4.5 (51.5%)	9.3 ± 4.4 (46.5%)
≤ 40 years	20.3 ± 3.4** (72.5%)	16.6 ± 4.1 (59.3%)	8.9 ± 3.5† (44.5%)	8.1 ± 3.7 (40.5%)	12.7 ± 4.0† (52.9%)	11.2 ± 4.8 (46.7%)	9.4 ± 2.6‡ (58.8%)	8.0 ± 2.7 (50.0%)	9.6 ± 3.4† (48.0%)	8.6 ± 3.0 (43.0%)
> 40 years	19.2 ± 5.9** (68.6%)	15.6 ± 5.5 (55.7%)	10.1 ± 3.8‡ (50.5%)	8.4 ± 3.3 (42.0%)	13.5 ± 4.9* (56.3%)	11.4 ± 5.9 (47.5%)	9.6 ± 3.8‡ (60.0%)	7.6 ± 4.2 (47.5%)	9.4 ± 4.1† (47.0%)	8.2 ± 3.4 (41.0%)
Group 1 ≤ 8 years	18.9 ± 4.4** (67.5%)	15.2 ± 4.8 (54.3%)	8.6 ± 3.4† (43.0%)	7.7 ± 3.6 (38.5%)	12.1 ± 4.3† (50.4%)	10.6 ± 5.0 (44.2%)	8.8 ± 3.1‡ (55.0%)	7.2 ± 3.1 (45.0%)	9.1 ± 3.6† (45.5%)	8.1 ± 3.0 (40.5%)
Group 2 > 8 years	21.7 ± 4.2‡ (77.5%)	18.1 ± 3.9 (64.6%)	10.7 ± 3.7† (53.5%)	9.3 ± 3.3 (46.5%)	14.7 ± 3.8* (61.3%)	12.5 ± 5.4 (52.1%)	10.8 ± 2.0* (67.5%)	9.0 ± 3.6 (56.3%)	10.2 ± 3.7† (51.0%)	9.0 ± 3.3 (45.0%)
MD/PhD Yes	20.2 ± 4.7** (72.1%)	16.3 ± 4.9 (58.2%)	9.9 ± 3.6** (49.5%)	8.6 ± 3.7 (43.0%)	13.3 ± 4.3** (55.4%)	11.2 ± 5.3 (46.7%)	9.7 ± 3.2** (60.6%)	7.9 ± 3.4 (49.4%)	9.7 ± 3.8‡ (48.5%)	8.5±3.3 (42.5%)
MD/PhD No	18.3 ± 3.4 (65.4%)	15.9 ± 3.8 (56.8%)	7.3 ± 3.1 (36.5%)	6.7 ± 2.7 (33.5%)	11.6 ± 4.1 (48.3%)	11.4 ± 4.8 (47.5%)	8.8 ± 2.4 (55.0%)	7.4 ± 3.3 (46.3%)	8.5 ± 2.5 (42.5%)	8 ± 2.2 (40.0%)
PGME: Yes[a]	20.5 ± 4.2** (73.2%)	16.8 ± 3.9 (60.0%)	10.1 ± 3.5** (50.5%)	8.6 ± 3.0 (43.0%)	13.4 ± 4.4** (55.8%)	11.2 ± 5.3 (46.7%)	10.3 ± 2.5** (64.4%)	8.6 ± 3.0 (53.8%)	9.8 ± 3.5** (49.0%)	8.3 ± 3 (41.5%)
PGME: No[b]	18.4 ± 5.0* (65.7%)	15 ± 5.9 (53.6%)	7.8 ± 3.5 (39.0%)	7.5 ± 4.5 (37.5%)	12.1 ± 4.2 (50.4%)	11.4 ± 5.2 (47.5%)	7.8 ± 3.4 (48.8%)	6.2 ± 3.4 (38.8%)	8.9 ± 4 (44.5%)	8.6 ± 3.5 (43.0%)
Total	19.8 ± 4.5** (70.7%)	16.2 ± 4.7 (57.9%)	9.4 ± 3.6‡ (47.0%)	8.2 ± 3.6 (41.0%)	13 ± 4.3** (54.2%)	11.3 ± 5.2 (47.1%)	9.5 ± 3.1** (59.4%)	7.8 ± 3.3 (48.8%)	9.5 ± 3.6‡ (47.5%)	8.4 ± 3.1 (42.0%)

*ADV = advantages of animal experiments in learning; DIS = disadvantages of animal experiments in learning; CON = logistics of conducting animal experiments; PER = faculty perceptions of student experiences with animal experiments; ALT = alternatives to existing animal experiments; max. score = maximum score of domain; Group 1 = faculty with 8 years of teaching experience or less; Group 2 = faculty with more than 8 years of teaching experience; PGME = postgraduate medical education; UGME = undergraduate medical education; [a]Yes = faculty with postgraduate teaching experience; [b]No = faculty without postgraduate teaching experience. **p < 0.001; ‡p < 0.005; *p < 0.01 and †p < 0.05 indicate statistically significant differences between PGME and UGME.*

PGME, as well as in UGME. These were irrespective of age, teaching experience, educational qualifications and postgraduate teaching experience (Table 2). However, the male faculty members gave highest scores to the domain PER and the lowest score to CON, for animal use in UGME.

Analysis of the mean scores for individual statements showed that the highest scores were given to the statement "*Government laws have been framed with regard to use of animals in education/ research*" for both PGME and UGME. The faculty members perceived that "*if alternatives are available, animal experiments should be continued with a reduction in the number or refinement of the use of animals"* for PGME and that "*there are alternatives to animal experiments for practical teaching"* for UGME, so these statements had the least score for the respective courses (Table 3). For UGME, there were 17 statements (63%) indicating negative perceptions with a mean score of 2 or less. One statement of positive perception, with a mean score above 3 (3.7%), was apparent for UGME, and the remaining nine statements were neutral perceptions (33.3%). The domain DIS had most of the negative perception statements (see Figure 1). However, faculty members showed a more positive perception of the use of animal experiments in PGME, as 11 statements had scores indicating negative perceptions (40.7%); four statements of positive perceptions (14.8%), and the remaining 12 statements were neutral perceptions (44.4%). The maximum number of negative perception statements was in the CON domain.

At the time of this survey, all of the colleges participating in this study were conducting between three and eight animal experiments in UGME, and between three and five animal experiments (per annum) in PGME. In UGME, the percentage of colleges undertaking the various animal experiments were as follows: the effects of drugs on the rabbit eye (100%), the action of general anaesthetics in the rat (91%), the effects of CNS stimulants and depressants on the mouse (64%), and the action of local anaesthetics in the toad (55%). The *in vivo* experiments conducted in PGME were tests for drug screening and determining toxicity in the rat, mouse and rabbit (100%) and graded dose responses in isolated toad rectus (100%), isolated rat colon (83%), isolated guinea-pig ileum (50%), isolated toad heart (33.3%) and isolated rabbit aorta (16.7%). Consequently, the most commonly-used species in UGME were the rabbit (100%), the rat (91%), the mouse (82%) and the toad (45.5%). For PGME, they were the rat, the mice, the toad, the rabbit (100% each) and the guinea-pig (33%).

Discussion

Animal experiments have traditionally been an important tool in the training of undergraduates and postgraduates in the discipline of Pharmacology in India. However, live animal experiments are known to have many disadvantages (1, 5, 6, 9). Research has also shown that the use of alternatives to animal experiments in UGME (e.g. simulated clinical trials, computer simulation models, etc) can circumvent most of the problems associated with animal experiments, whilst achieving equivalent learning outcomes (16, 18–21).

Our study aims to assess and compare the perceptions of faculty members with regard to animal use in UGME and PGME. The total mean scores obtained in our study indicate that the majority of faculty members support animal experiments in PGME more than in UGME. This indicates that faculty members perceive the need for animal experiments in PGME, as it focuses on biomedical research and the development, or the pharmacological and toxicological testing, of drugs. However, they believe that UGME may not require animal experiments to fulfil its learning objectives and deliver its teaching content. This is also currently reflected in the reduction in the use of animal experiments in UGME (22). The Government of India has also recently issued guidelines to the Pharmacy Council of India and the Medical Council of India (MCI) to discontinue live animal experiments in the training of medical, pharmacy and other graduates and postgraduates in universities and colleges, and instead use alternatives to animal experimentation (23).

As there was a paucity of studies comparing the perceptions of faculty members to animal use in PGME and UGME, we explored studies that dealt with the faculty perceptions of animal experiments either in UGME or in PGME. We found a plethora of data which detailed faculty and student perceptions to animal experiments in UGME (9–11, 17, 24). In the survey by Roy and Tekur (9), 51% of faculty members felt the need to discontinue animal experiments in UGME. However, studies by Shehnaz *et al*. (17) and Rai *et al*. (24) concluded that the majority of Indian pharmacologists surveyed favoured animal experiments in UGME, but with a reduction in the number and refinement in the use of the animals. To our knowledge, no studies had focused on the faculty perceptions to animal experiments in PGME.

In our study, the total and domain scores showed that, based on age and duration of teaching experience, faculty members had similar perceptions and supported animal experiments more in PGME than in UGME. However, the perceptions differed according to gender, postgraduate teaching experience and educational qualifications. Although male faculty members, those without MD/PhD degrees, and without postgraduate teaching experience, supported animal experiments in PGME more than in UGME in all of the domains, it was

Table 3: Individual statement scores for faculty perceptions regarding animal use in postgraduate and undergraduate medical education

Domain	No.	Statement	Mean ± SD PGME	Mean ± SD UGME
ADV	2	Animal experiments leave a long-lasting impression of the discipline/drug action on the students	2.88 ± 1.1†	2.54 ± 1.2
	5	Animal experiments help to encourage 'student-centred education'	2.63 ± 1.0*	2.33 ± 1.1
	6	Animal experiments improve dissection skills	2.83 ± 1.0	2.6 ± 1.1
	7	Animal experiments encourage the development of scientific research outlook	3.13 ± 0.9‡	2.77 ± 1.1
	15	Students learn to handle live tissues through animal experiments	2.54 ± 1.1‡	1.62 ± 1.2
	24	Animal experiments provide an opportunity for in-depth learning rather than superficial learning	2.81 ± 0.9†	2.48 ± 1.1
	27	Animal experiments seem relevant to a career in medicine/biomedical research	3.02 ± 0.9**	1.90 ± 1.2
DIS	*4*	*Animal experiments give too much importance to factual learning (a method of learning which concentrates on memorising information)*	1.77 ± 1.1	1.98 ± 1.2
	14	*Animal experiments cause unnecessary distress to the animals*	1.19 ± 1.2	1.02 ± 1.0
	16	*The same understanding of concepts of the discipline can be achieved without these experiments*	1.98 ± 1.2	1.79 ± 1.1
	18	*The main objective of students doing animal experiments is to pass University examinations*	2.21 ± 1.4*	1.83 ± 1.5
	26	*Students resist performing animal experiments*	2.21 ± 1.1**	1.62 ± 1.1
CON	1	Animal experiments should be conducted in the programme	3.12 ± 0.9**	2.42 ± 1.3
	8	The current use of animals for teaching purposes is ethically justified	2.6 ± 1.2‡	2.12 ± 1.3
	17	*The duration of time spent on animal experiments is too long*	1.94 ± 1.2	1.87 ± 1.2
	19	Animal experiments allow enhanced potential for repeatability of learning exercises compared with other alternatives	1.62 ± 1.2	1.48 ± 1.2
	20	Animal experiments are economically viable	1.92 ± 1.2	1.75 ± 1.2
	23	Animal experiments offer flexibility as to when and where experiments are conducted	1.81 ± 1.1†	1.62 ± 1.1
PER	3	Students find animal experiments stimulating	2.52 ± 1.1	2.33 ± 1.2
	9	Students are aware of the learning objectives for animal experiments prior to the practical	2.98 ± 0.7**	2.48 ± 1.1
	21	Animal experiments result in lower student stress during exams	1.58 ± 1.2	1.62 ± 1.2
	22	*Demonstrations (of animal experiments in batches) are preferred rather than experiments done by students individually*	2.42 ± 1.2**	1.40 ± 1.2

Table 3: continued

Domain	No.	Statement	Mean ± SD PGME	Mean ± SD UGME
ALT	10	*There are alternatives to animal experiments for practical teaching*	1.23 ± 1.1*	0.88 ± 0.9
	11	*Alternatives to animal experiments can achieve equivalent learning outcomes compared to animal experiments*	1.69 ± 1.2†	1.4 ± 1.2
	12	*If alternatives (like computer-assisted learning experiments, models) are available, animal experimentations should be totally discontinued*	2.19 ± 1.2*	1.67 ± 1.4
	13	*If alternatives are available, animal experiments should be continued with a reduction in the number or refinement of the use of animals*	1.17 ± 1.1	1.25 ± 1.2
	25	Government laws have been framed with regard to the use of animals in education/research	3.21 ± 0.5	3.19 ± 0.7

ADV = advantages of animal experiments in learning; DIS = disadvantages of animal experiments in learning; CON = logistics of conducting animal experiments; PER = faculty perceptions of student experiences with animal experiments; ALT = alternatives to existing animal experiments. Negative statements are in italics with the reversed scores inserted in the Table. The higher the score for these items, the more the faculty members disagreed with the statement. PGME = postgraduate medical education; UGME = undergraduate medical education. **p < *0.001;* ‡p < *0.005;* *p < *0.01 and* †p < *0.05 indicate statistically significant differences between PGME and UGME.*

not statistically significant, except in the ADV domain for males and faculty without postgraduate teaching experience. The significantly higher mean domain scores recorded in all domains for PGME by faculty members with postgraduate teaching experience and MD/PhD degrees was not unexpected, as most of them will have been employing animal experiments for a long time as a teaching tool. Hence, it is evident that there is strong support for animal experiments to be continued in PGME, by all the different groups of faculty members.

On analysis of the domains, the highest mean scores in the domain ADV (which is significantly higher for PGME as compared to UGME), again reflected the positive perceptions of faculty members concerning animal experiments. Comparing the scores for domains ALT and DIS (with negative statements) for PGME and for UGME, the significantly higher scores for PGME also indicate that the faculty members are not fully aware of alternatives to animal experiments in PGME, and are not aware of all the disadvantages of animal experiments in PGME.

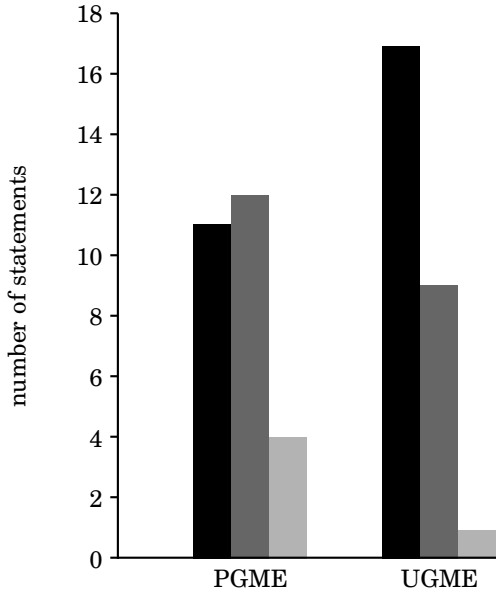
Analysis of the individual statements indicated that the teachers are up to date on government regulations with regard to the use of animals in education/research as evidenced by the highest scores for statement 25 in both PGME and UGME. In PGME, the lowest score for statement number 13 echoes strong sentiments to continue animal experiments with a reduction in the number or refinement in the use of animals. In UGME, the lowest score for statement number 10 indicates that the faculty members are aware of alternatives to animal experiments (Table 3).

The univocal support for animal experiments in PGME is also indicated by faculty members rendering significantly higher scores to all but one statement in the ADV domain (statement numbers 2, 5, 7, 15, 24 and 27). In the DIS domain, the faculty members disagreed with the negative statements about doing *"animal experiments to pass University examinations"* and *"students resisting animal experiments"* significantly more for PGME than for UGME, which reinforces their positive perceptions about animal experiments in PGME. The significantly higher scores obtained for the statements about animal experiments to be conducted in the programme, the ethical justification of animal experiments for teaching purposes, and the flexibility of animal experiments in the domain CON, indicate that there is substantial support for animal use in PGME, as compared to UGME.

The perception of the teachers about the significantly increased awareness of the learning objectives by postgraduate students than by undergraduates is reassuring. Furthermore, the significantly higher scores obtained for PGME to the negative statement number 22 indicate that faculty members perceive the need for postgraduates to perform animal experiments individually.

The faculty support for animal experiments in PGME more than in UGME is also highlighted by the fact that they significantly disagreed with the statements number 11 and 12. The significantly higher scores for PGME to the negative statement *"there are alternatives to animal experiments for*

Figure 1: Mean statement scores for postgraduate and undergraduate medical education



= ≤ 2 *(negative perceptions);*
= 2–3 *(neutral perceptions);*
= ≥ 3 *(negative perceptions).*
PGME = postgraduate medical education;
UGME = undergraduate medical education.

practical teaching" reveals that the faculty members are more familiar with alternatives for use in UGME than they are with those for use in PGME. The considerable backing of the teachers for animal experiments in PGME is also indicated by the high scores (≥ 3) given to the statements that animal experiments "*encourage the development of scientific research outlook*", are "*relevant to a career in medicine/biomedical research"*, and *"should be conducted in the programme"*. Conversely, the low scores (≤ 2) to the statements regarding enhanced repeatability, economic viability, flexibility and lower student stress during exams, and for the negative statements regarding importance to factual learning, distress to animals, understanding of concepts achieved without these experiments and length of time spent, reinforces the belief that the faculty members perceive animal experiments in PGME to have some shortcomings. The low score given to negative statement number 13 for PGME again conveys the positive perceptions of the faculty. This support is also apparent in Figure 1.

Our study has found that the majority of pharmacology faculty members support animal experiments in PGME more than in UGME. The teachers seem to be aware that current international trends dictate that the use of animals in education must be limited to the bare minimum. Realising that the use of animals should be directly related to the students' future profession, the faculty members in our study have perceived that the need for animal experiments in UGME is relatively minor. On the other hand, they felt that animal experiments are essential in PGME. This support for animal experiments in PGME might be due to the fact that Indian drug approval regulations demand animal studies, and that the future of many postgraduates lies in research. Similar views were also evident in the Third National Conference of the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) in India (25). In view of the diversity in the postgraduate curricula (1) with respect to animal experiments in the 188 postgraduate institutes of India, and hence the recognition by the MCI to overhaul postgraduate courses, these perceptions hold serious implications.

In India, organisations such as the Mahatma Gandhi-Doerenkamp Center for Alternatives to Use of Animals in Life Science Education, I-CARE, People for Animals, People for the Ethical Treatment of Animals (PETA) India, JIPMER (Pondicherry) and InterNICHE, are publicising the use of alternatives to animal experiments (26) in UGME. PETA India has also recently organised a series of medical education workshops at premier medical colleges in India, in order to guide faculty members toward the use of alternatives in their MBBS programmes (27). However, most of the efforts by these organisations are directed at UGME, and our study has revealed that faculty members seem to be less familiar with alternatives in PGME. As the availability of relevant information regarding alternative methods forms the crux of any strategy for the implementation of the Three Rs concept, we advocate greater exposure of teachers to the alternatives used in biomedical research. Different strategies can be suggested to integrate alternatives to animal experiments into PGME (28–32). Educators can be provided with practical information about alternatives, through:

1. Electronic databases and websites that specify methodologies in animal experiments, alternative methods with Three Rs concepts, funding opportunities for Three Rs research, methods to minimise animal use in the pharmaceutical industry, pilot studies and systematic reviews, for example — the NORINA database, InterNICHE, Go3R, and the NC3RS.
2. Pharmacology-based national and international scientific meetings.
3. Published articles and workshops about alternatives.

Complete descriptions of the alternatives, the hardware requirements, cost, availability, and evidence of bio-research effectiveness through validation against the 'gold standard' animal test, are

essential (7). Providing educators with training opportunities via workshops and symposia, and creating curricula that identify or utilise alternatives, will also assist in changing the mindset of the teachers. The better the closeness-of-fit of the alternative with the course outcomes, then the greater will its acceptance be by the faculty members (33).

The learning objectives for laboratory classes involving animal experiments should be clear, and the students should be made aware of the reasons for conducting them. If the PGME course learning objectives include training in animal handling, acquisition of surgical/dissection skills, and the development of proper attitudes toward animal experimentation, then the conduct of animal experiments can be justified only after ascertaining that the use of animals is the *only* and the *best* way to achieve these objectives (33). Moreover, in view of the positive perceptions of our sample toward animal experiments in PGME, strong efforts should be made to use the smallest number of animals necessary to achieve the desired scientific outcome, while reducing animal suffering to an absolute minimum. Consequently, faculty members should also be offered access to information about current trends on sound experimental designs, appropriate statistical tests, and emerging technologies with impact on the Three Rs (34). The introduction of a laboratory animal science course based on FELASA guidelines can be one way for attitude building, clarifying ethical and legal issues regarding animal experiments, and imparting principles of good animal experimental design to the postgraduates (35).

The suggestions of the teachers and students to update the present postgraduate curriculum so as to give the students adequate training in recent advances and to incorporate other topics pertinent to the pharmaceutical industry, Clinical Research Organisations (CROs) and Site Management Organisations (SMOs), should be considered. Clinical research, medical marketing, pharmacoepidemiology, pharmacoethics, pharmacovigilance, pharmacoeconomics, regulatory affairs, patent laws, etc, can all be areas of focus (1, 15, 36–38). The limitations of our study stem from the use of a questionnaire to assess the perceptions of faculty members, as we might have omitted some specific components. Moreover, our study sample is quite regional and small, and thus might not be representative of the faculty members of the rest of India. Therefore, further studies elaborating the viewpoints of faculty members from other parts of India are needed.

Conclusion

Our findings indicate that faculty members in the medical colleges in southern India support animal use in PGME more than in UGME. Moreover, the faculty members appear to be more familiar with alternatives in UGME than with those in PGME. Therefore, the way forward could be to educate faculty members about the alternatives to animal experiments in PGME and subsequently to encourage the incorporation of these alternatives into the curricula. Integration of the Three Rs concept will equip our postgraduates with the knowledge and skills to generate superior quality scientific research with minimum harm to laboratory animals.

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