

Critical appraisal of published research papers – A reinforcing tool for research methodology: Questionnaire-based study

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Abstract

Background and Objectives: Critical appraisal of published research papers is routinely conducted as a journal club (JC) activity in pharmacology departments of various medical colleges across Maharashtra, and it forms an important part of their postgraduate curriculum. The objective of this study was to evaluate the perception of pharmacology postgraduate students and teachers toward use of critical appraisal as a reinforcing tool for research methodology. Evaluation of performance of the in-house pharmacology postgraduate students in the critical appraisal activity constituted secondary objective of the study.

Materials and Methods: The study was conducted in two parts. In Part I, a cross-sectional questionnaire-based evaluation on perception toward critical appraisal activity was carried out among pharmacology postgraduate students and teachers. In Part II of the study, JC score sheets of 2nd- and 3rd-year pharmacology students over the past 4 years were evaluated.

Results: One hundred and twenty-seven postgraduate students and 32 teachers participated in Part I of the study. About 118 (92.9%) students and 28 (87.5%) faculties considered the critical appraisal activity to be beneficial for the students. JC score sheet assessments suggested that there was a statistically significant improvement in overall scores obtained by postgraduate students ($n = 25$) in their last JC as compared to the first JC.

Conclusion: Journal article criticism is a crucial tool to develop a research attitude among postgraduate students. Participation in the JC activity led to the improvement in the skill of critical appraisal of published research articles, but this improvement was not educationally relevant.

Keywords: Journal club, perception, performance, pharmacology, postgraduate

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INTRODUCTION

Critical appraisal of a research paper is defined as “The process of carefully and systematically examining research to judge its trustworthiness, value and relevance

in a particular context.”^[1] Since scientific literature is rapidly expanding with more than 12,000 articles being added to the MEDLINE database per week,^[2] critical appraisal is very important to distinguish scientifically

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useful and well-written articles from imprecise articles.

Educational authorities like the Medical Council of India (MCI) and Maharashtra University of Health Sciences (MUHS) have stated in pharmacology postgraduate curriculum that students must critically appraise research papers. To impart training toward these skills, MCI and MUHS have emphasized on the introduction of journal club (JC) activity for postgraduate (PG) students, wherein students review a published original research paper and state the merits and demerits of the paper. Abiding by this, pharmacology departments across various medical colleges in Maharashtra organize JC at frequent intervals^[3,4] and students discuss varied aspects of the article with teaching faculty of the department.^[5] Moreover, this activity carries a significant weightage of marks in the pharmacology university examination. As postgraduate students attend this activity throughout their 3-year tenure, it was perceived by the authors that this activity of critical appraisal of research papers could emerge as a tool for reinforcing the knowledge of research methodology. Hence, a questionnaire-based study was designed to find out the perceptions from PG students and teachers.

There have been studies that have laid emphasis on the procedure of conducting critical appraisal of research papers and its application into clinical practice.^[6,7] However, there are no studies that have evaluated how well students are able to critically appraise a research paper. The Department of Pharmacology and Therapeutics at Seth GS Medical College has developed an evaluation method to score the PG students on this skill and this tool has been implemented for the last 5 years. Since there are no research data available on the performance of PG Pharmacology students in JC, capturing the critical appraisal activity evaluation scores of in-house PG students was chosen as another objective of the study.

MATERIALS AND METHODS

Description of the journal club activity

JC is conducted in the Department of Pharmacology and Therapeutics at Seth GS Medical College once in every 2 weeks. During the JC activity, postgraduate students critically appraise published original research articles on their completeness and aptness in terms of the following: study title, rationale, objectives, study design, methodology-study population, inclusion/exclusion criteria, duration, intervention and safety/efficacy variables, randomization, blinding, statistical analysis, results, discussion, conclusion, references, and abstract.

All postgraduate students attend this activity, while one of them critically appraises the article (who has received the research paper given by one of the faculty members 5 days before the day of JC). Other faculties also attend these sessions and facilitate the discussions. As the student comments on various sections of the paper, the same predecided faculty who gave the article (single assessor) evaluates the student on a total score of 100 which is split per section as follows: Introduction –20 marks, Methodology –20 marks, Discussion – 20 marks, Results and Conclusion –20 marks, References –10 marks, and Title, Abstract, and Keywords – 10 marks. However, there are no standard operating procedures to assess the performance of students at JC.

Methodology

After seeking permission from the Institutional Ethics Committee, the study was conducted in two parts. Part I consisted of a cross-sectional questionnaire-based survey that was conducted from October 2016 to September 2017. A questionnaire to evaluate perception towards the activity of critical appraisal of published papers as research methodology reinforcing tool was developed by the study investigators. The questionnaire consisted of 20 questions: 14 questions [refer Figure 1] graded on a 3-point Likert scale (agree, neutral, and disagree), 1 multiple choice selection question, 2 dichotomous questions, 1 semi-open-ended questions, and 2 open-ended questions. Content validation for this questionnaire was carried out with the help of eight pharmacology teachers. The content validity ratio per item was calculated and each item in the questionnaire had a CVR ratio (CVR) of >0.75.^[8] The perception questionnaire was either E-mailed or sent through WhatsApp to PG pharmacology students and teaching faculty in pharmacology departments at various medical colleges across Maharashtra. Informed consent was obtained on E-mail from all the participants.

Part II of the study consisted of evaluating the performance of postgraduate students toward skills of critical appraisal of published papers. For this purpose, marks obtained by 2nd- and 3rd-year residents during JC sessions conducted over a period of 4 years from October 2013 to September 2017 were recorded and analyzed. No data on personal identifiers of the students were captured.

Statistical analysis

Marks obtained by postgraduate students in their first and last JC were compared using Wilcoxon signed-rank test, while marks obtained by 2nd- and 3rd-year postgraduate students were compared using Mann–Whitney test since the data were nonparametric. These statistical analyses

were performed using GraphPad Prism statistical software, San Diego, California, USA, Version 7.0d. Data obtained from the perception questionnaire were entered in Microsoft Excel sheet and were expressed as frequencies (percentages) using descriptive statistics.

RESULTS

Participants who answered all items of the questionnaire were considered as complete responders and only completed questionnaires were analyzed. The questionnaire was sent through an E-mail to 100 students and through WhatsApp to 68 students. Out of the 100 students who received the questionnaire through E-mail, 79 responded completely and 8 were incomplete responders, while 13 students did not revert back. Out of the 68 students who received the questionnaire through WhatsApp, 48 responded completely, 6 gave an incomplete response, and 14 students did not revert back. Hence, of the 168 postgraduate students who received the questionnaire, 127 responded completely (student response rate for analysis = 75.6%). The questionnaire was E-mailed to 33 faculties and was sent through WhatsApp to 25 faculties. Out of the 33 faculties who received the questionnaire through E-mail, 19 responded completely, 5 responded incompletely, and 9 did not respond at all. Out of the 25 faculties who received the questionnaire through WhatsApp, 13 responded completely, 3 were incomplete responders, and 9 did not respond at all. Hence, of a total of 58 faculties who were contacted, 32 responded completely (faculty response rate for analysis = 55%). For Part I of the study, responses on the perception questionnaire from 127 postgraduate students and 32 postgraduate teachers were recorded and analyzed. None of the faculty who participated in the validation of the questionnaire participated in the survey. Number of responses obtained region wise (Mumbai region and rest of Maharashtra region) have been depicted in Table 1.

As per the data obtained on the Likert scale questions, 102 (80.3%) students and 29 (90.6%) teachers agreed that critical appraisal trains the students in doing a review of literature before selecting a particular research topic. Majority of the participants, i.e., 104 (81.9%) students and 29 (90.6%) teachers also believed that the activity increases student's knowledge regarding various experimental

evaluation techniques. Moreover, 112 (88.2%) students and 27 (84.4%) faculty considered that critical appraisal activity results in improved skills of writing and understanding methodology section of research articles in terms of inclusion/exclusion criteria, endpoints, and safety/efficacy variables. About 103 (81.1%) students and 24 (75%) teachers perceived that this activity results in refinement of the student's research work. About 118 (92.9%) students and 28 (87.5%) faculty considered the critical appraisal activity to be beneficial for the students. Responses to 14 individual Likert scale items of the questionnaire have been depicted in Figure 1.

With respect to the multiple choice selection question, 66 (52%) students and 16 (50%) teachers opined that faculty should select the paper, 53 (41.7%) students and 9 (28.1%) teachers stated that the papers should be selected by the presenting student himself/herself, while 8 (6.3%) students and 7 (21.9%) teachers expressed that some other student should select the paper to be presented at the JC.

The responses to dichotomous questions were as follows: majority of the students, that is, 109 (85.8%) and 23 (71.9%) teachers perceived that a standard checklist for article review should be given to the students before critical appraisal of journal article. Open-ended questions of the questionnaire invited suggestions from the participants

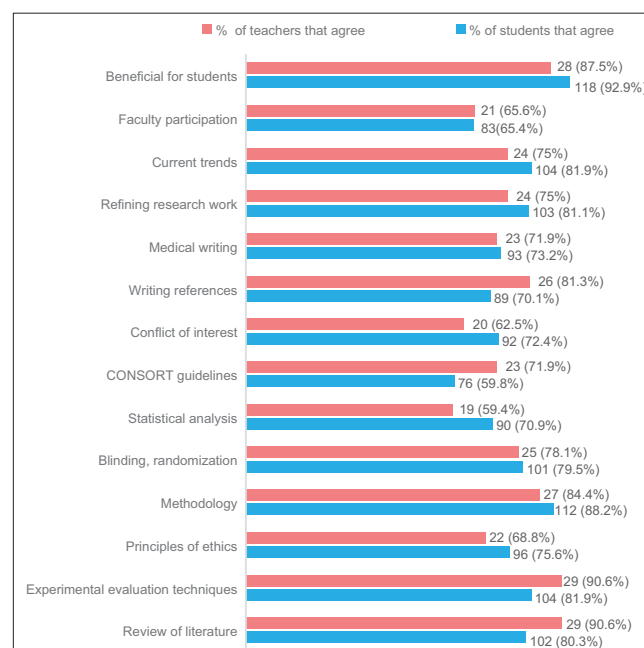


Figure 1: Graphical representation of the percentage of students/teachers who agreed that critical appraisal of research helped them improve their knowledge on various aspects of research, perceived that faculty participation is important in this activity, and considered critical appraisal activity beneficial for students. The numbers adjacent to the bar diagrams indicate the raw number of students/faculty who agreed, while brackets indicate %

Table 1: Region-wise distribution of responses

| | Students (n=127) | Faculty (n=32) |
|------------------------------|------------------|----------------|
| Mumbai colleges | 58 (45.7) | 18 (56.3) |
| Rest of Maharashtra colleges | 69 (54.3) | 14 (43.7) |

Number of responses obtained from students/faculty belonging to Mumbai colleges and rest of Maharashtra colleges. Brackets indicate percentages

regarding ways of getting trained on critical appraisal skills and of improving JC activity. Some of the suggestions given by faculty were as follows: increasing the frequency of JC activity, discussion of cited articles and new guidelines related to it, selecting all types of articles for criticism rather than only randomized controlled trials, and regular yearly exams on article criticism. Students stated that regular and frequent article criticism activity, practice of writing letter to the editor after criticism, active participation by peers and faculty, increasing weightage of marks for critical appraisal of papers in university examinations (at present marks are 50 out of 400), and a formal training for research criticism from 1st year of postgraduation could improve critical appraisal program.

In Part II of this study, performance of the students on the skill of critical appraisal of papers was evaluated. Complete data of the first and last JC scores of a total of 25 students of the department were available, and when these scores were compared, it was seen that there was a statistically significant improvement in the overall scores ($P = 0.04$), as well as in the scores obtained in methodology ($P = 0.03$) and results section ($P = 0.02$). This is depicted in Table 2. Although statistically significant, the differences in scores in the methodology section, results section, and overall scores were 1.28/20, 1.28/20, and 4.36/100, respectively, amounting to 5.4%, 5.4%, and 4.36% higher scores in

the last JC, which may not be considered educationally relevant (practically significant). The quantum of difference that would be considered practically significant was not decided *a priori*.

Scores of two groups, one group consisting of 2nd-year postgraduate students ($n = 44$) and second group consisting of 3rd-year postgraduate students ($n = 32$) were compared and revealed no statistically significant difference in overall score ($P = 0.84$). This is depicted in Table 3. Since the quantum of difference in the overall scores was meager 0.84/100 (0.84%), it cannot be considered practically significant.

DISCUSSION

The present study gauged the perception of the pharmacology postgraduate students and teachers toward the use of critical appraisal activity as a reinforcing tool for research methodology. Both students and faculties (>50%) believed that critical appraisal activity increases student's knowledge on principles of ethics, experimental evaluation techniques, CONSORT guidelines, statistical analysis, concept of conflict of interest, current trends and recent advances in Pharmacology and trains on doing a review of literature, and improves skills on protocol writing and referencing. In the study conducted by Crank-Patton *et al.*, a survey on 278 general surgery program directors

Table 2: Comparison of marks obtained by pharmacology residents in their first and last journal club

| Section | Marks obtained by pharmacology residents in their first journal club (n=25) | | Marks obtained by pharmacology residents in their last journal club (n=25) | | Wilcoxon signed-rank test |
|---|---|--------------|--|----------------|---------------------------|
| | Mean±SD | Median (IQR) | Mean±SD | Median (IQR) | P value |
| Introduction (maximum: 20 marks) | 13.48±2.52 | 14 (12-16) | 14.28±2.32 | 14 (13-16) | 0.22 |
| Methodology (maximum: 20 marks) | 13.36±3.11 | 14 (12-16) | 14.64±2.40 | 14 (14-16.5) | 0.03* |
| Results and conclusion (maximum: 20 marks) | 13.60±2.42 | 14 (12-15.5) | 14.88±2.64 | 15 (13.5-16.5) | 0.02* |
| Discussion (maximum: 20 marks) | 13.44±3.20 | 14 (11-16) | 14.16±2.78 | 14 (12.5-16) | 0.12 |
| References (maximum: 10 marks) | 7.12±1.20 | 7 (6.5-8) | 7.06±1.28 | 7 (6-8) | 0.80 |
| Title, abstract, and keywords (maximum: 10 marks) | 7.44±0.92 | 7 (7-8) | 7.78±1.12 | 8 (7-9) | 0.17 |
| Overall score (maximum: 100 marks) | 68.44±11.39 | 72 (64-76) | 72.80±11.32 | 71 (68-82.5) | 0.04* |

Marks have been represented as mean±SD. The maximum marks that can be obtained in each section have been stated as maximum. *Indicates statistically significant ($P < 0.05$). IQR=Interquartile range, SD=Standard deviation

Table 3: Comparison of marks obtained by 2nd- and 3rd-year pharmacology residents in the activity of critical appraisal of research articles

| Section | Marks obtained by 2 nd -year pharmacology students (n=44) | | Marks obtained by 3 rd -year pharmacology students (n=32) | | Mann-Whitney test, P value |
|---|--|------------------|--|----------------|----------------------------|
| | Mean±SD | Median (IQR) | Mean±SD | Median (IQR) | |
| Introduction (maximum: 20 marks) | 14.09±2.41 | 14 (13-16) | 14.28±2.14 | 14 (13-16) | 0.7527 |
| Methodology (maximum: 20 marks) | 14.30±2.90 | 14.5 (13-16) | 14.41±2.24 | 14 (13-16) | 0.8385 |
| Results and conclusion (maximum: 20 marks) | 14.09±2.44 | 14 (12.5-16) | 14.59±2.61 | 14.5 (13-16) | 0.4757 |
| Discussion (maximum: 20 marks) | 13.86±2.73 | 14 (12-16) | 14.16±2.71 | 14.5 (12.5-16) | 0.5924 |
| References (maximum: 10 marks) | 7.34±1.16 | 8 (7-8) | 7.05±1.40 | 7 (6-8) | 0.2551 |
| Title, abstract, and keywords (maximum: 10 marks) | 7.82±0.90 | 8 (7-8.5) | 7.83±1.11 | 8 (7-8.5) | 0.9642 |
| Overall score (maximum: 100 marks) | 71.50±10.71 | 71.5 (66.5-79.5) | 72.34±10.85 | 73 (66-79.5) | 0.8404 |

Marks have been represented as mean±SD. The maximum marks that can be obtained in each section have been stated as maximum. $P < 0.05$ was considered to be statistically significant. IQR=Interquartile range, SD=Standard deviation

was carried out and more than 50% indicated that JC was important to their training program.^[9]

The grading template used in Part II of the study was based on the IMRaD structure. Hence, equal weightage was given to the Introduction, Methodology, Results, and Discussion sections and lesser weightage was given to the references and title, abstract, and keywords sections.^[10] While evaluating the scores obtained by 25 students in their first and last JC, it was seen that there was a statistically significant improvement in the overall scores of the students in their last JC. However, the meager improvement in scores cannot be considered educationally relevant, as the authors expected the students to score >90% for the upgrade to be considered educationally impactful. The above findings suggest that even though participation in the JC activity led to a steady increase in student's performance (~4%), the increment was not as expected. In addition, the students did not portray an excellent performance (>90%), with average scores being around 72% even in the last JC. This can be probably explained by the fact that students perform this activity in a routine setting and not in an examination setting. Unlike the scenario in an examination, students were aware that even if they performed at a mediocre level, there would be no repercussions.

A separate comparison of scores obtained by 44 students in their 2nd year and 32 students in their 3rd year of postgraduation students was also done. The number of student evaluation sheets reviewed for this analysis was greater than the number of student evaluation sheets reviewed to compare first and last JC scores. This can be spelled out by the fact that many students were still in 2nd year when this analysis was done and the score data for their last JC, which would take place in 3rd year, was not available. In addition, few students were asked to present at JC multiple times during the 2nd/3rd year of their postgraduation.

While evaluating the critical appraisal scores obtained by 2nd- and 3rd-year postgraduate students, it was found that although the 3rd-year students had a mean overall score greater than the 2nd-year students, this difference was not statistically significant. During the 1st year of MD Pharmacology course, students at the study center attend JC once in every 2 weeks. Even though the 1st-year students do not themselves present in JC, they listen and observe the criticism points stated by senior peers presenting at the JC, and thereby, incur substantial amount of knowledge required to critically appraise papers. By the time, they become 2nd-year students, they are already well versed with the program and this could have led to similar overall mean

scores between the 2nd-year students (71.50 ± 10.71) and 3rd-year students (72.34 ± 10.85). This finding suggests that attentive listening is as important as active participation in the JC. Moreover, although students are well acquainted with the process of criticism when they are in their 3rd year, there is certainly a scope for improvement in terms of the mean overall scores.

Similar results were obtained in a study conducted by Stern *et al.*, in which 62 students in the internal medicine program at the New England Medical Center were asked to respond to a questionnaire, evaluate a sample article, and complete a self-assessment of competence in evaluation of research. Twenty-eight residents returned the questionnaire and the composite score for the resident's objective assessment was not significantly correlated with the postgraduate year or self-assessed critical appraisal skill.^[11]

Article criticism activity provides the students with practical experience of techniques taught in research methodology workshop. However, this should be supplemented with activities that assess the improvement of designing and presenting studies, such as protocol and paper writing. Thus, critical appraisal plays a significant role in reinforcing good research practices among the new generation of physicians. Moreover, critical appraisal is an integral part of PG assessment, and although the current format of conducting JCs did not portray a clinically meaningful improvement, the authors believe that it is important to continue this activity with certain modifications suggested by students who participated in this study. Students suggested that an increase in the frequency of critical appraisal activity accompanied by the display of active participation by peers and faculty could help in the betterment of this activity. This should be brought to attention of the faculty, as students seem to be interested to learn. Critical appraisal should be a two-way teaching–learning process between the students and faculty and not a dire need for satisfying the students' eligibility criteria for postgraduate university examinations. This activity is not only for the trainee doctors but also a part of the overall faculty development program.^[12]

In the present era, JCs have been used as a tool to not only teach critical appraisal skills but also to teach other necessary aspects such as research design, medical statistics, clinical epidemiology, and clinical decision-making.^[13,14] A study conducted by Khan in 2013 suggested that success of JC program can be ensured if institutes develop a defined JC objective for the development of learning capability of students and also if they cultivate more skilled faculties.^[15] A good JC is believed to facilitate relevant, meaningful

scientific discussion, and evaluation of the research updates that will eventually benefit the patient care.^[12]

Although there is a lot of literature emphasizing the importance of JC, there is a lack of studies that have evaluated the outcome of such activity. One such study conducted by Ibrahim *et al.* assessed the importance of critical appraisal as an activity in surgical trainees in Nigeria. They reported that 92.42% trainees considered the activity to be important or very important and 48% trainees stated that the activity helped in improving literature search.^[16]

This study is unique since it is the first of its kind to evaluate how well students are able to critically appraise a research paper. Moreover, the study has taken into consideration the due opinions of the students as well as faculties, unlike the previous literature which has laid emphasis on only student's perception. A limitation of this study is that sample size for faculties was smaller than the students, as it was not possible to convince the distant faculty in other cities to fill the survey. Besides, there may be a variation in the manner of conduct of the critical appraisal activity in pharmacology departments across the various medical colleges in the country. Another limitation of this study was that a single assessor graded a single student during one particular JC. Nevertheless, each student presented at multiple JC and thereby came across multiple assessors. Since the articles addressed at different JC were disparate, interobserver variability was not taken into account in this study. Furthermore, the authors did not make an *a priori* decision on the quantum of increase in scores that would be considered educationally meaningful.

CONCLUSION

Pharmacology students and teachers acknowledge the role of critical appraisal in improving the ability to understand the crucial concepts of research methodology and research conduct. In our institute, participation in the JC activity led to an improvement in the skill of critical appraisal of published research articles among the pharmacology postgraduate students. However, this improvement was not educationally relevant. The scores obtained by final-year postgraduate students in this activity were nearly 72% indicating that there is still scope of betterment in this skill.

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Conflicts of interest

There are no conflicts of interest.

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