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Evaluation of Scientific Rigor of Postgraduate Thesis at a tertiary care teaching hospital in PuducherryPoomathy P¹, Vinayagamorthy V², Amol R Dongre³**Affiliation:** 1Junior Resident,2 Associate Professor,& 3Professor and Head, Department of Community Medicine, Sri Manakula Vinayagar Medical College & Hospital, Puducherry**Date of Submission** : 14-11-2019**Date of online Publication** : 26-12-2019**Date of Acceptance** : 15-12-2019**Date of Print Publication** : 31-12-2019***Author for correspondence:** Dr Vinayagamorthy V, Associate Professor, Department of Community Medicine, Sri Manakula Vinayagar Medical College and Hospital, Puducherry-605001.E-mail: drvinayagamorthy@gmail.com**ABSTRACT**

Background: Since 2011, postgraduate training on research methods has been organised every year at the study setting and recently it is updated periodically. The objectives were to find out the scientific rigor of MD/MS thesis, and to find out the effectiveness of postgraduate training program on scientific rigor of MD/MS theses. **Materials and Methods:** It was an education evaluation based on secondary data, where 78 MD/MS thesis records of postgraduates, submitted to the University during the academic year 2017 and 2018 were reviewed. The Kirkpatrick level III framework of the evaluation was used. Thesis records were reviewed by trained postgraduate under the supervision of faculty from the Department of Community Medicine. The Epicollect-5 mobile application was used to enter the data and analysis was done using SPSS software package (version 24). **Results:** Most (90%) of the reviewed studies were hospital-based cross-sectional. Over the period of one year, there was an improvement in practices such as mentioning of the objectives as per SMART criteria (90% to 97.4%), reporting the details of sample size calculation (67.5% to 76.3%), data entry (62.5% to 68.4%) and data analysis (80% to 82%), and citing the references without errors (22.6% to 47.4%). **Conclusions:** Most of the studies were hospital-based cross-sectional studies. Over the period of one year, there was an improvement in some aspects of scientific rigor of MD/MS thesis however; there is scope for further improvement in the postgraduate training program.

Key Words: Evaluation, Kirkpatrick, Postgraduate, Scientific rigor, Thesis.**INTRODUCTION**

Scientific rigor is important for evidence based decision making in the field of health and education. National Institutes of Health defines scientific rigor as "the strict application of the scientific method to ensure robust and unbiased experimental design, methodology, analysis, interpretation, and reporting of the results" (p.21).¹ Appropriate use of a rigorous scientific method strengthens inference and reduces potential biases for drawing misleading conclusions.²

The Medical Council of India believes that research improves teaching and service hence 'thesis' is a mandate for postgraduate courses.³ Apart from providing training in research, the thesis is expected to inculcate an appreciation for research methodology and critical analysis among students. Inadequate training in epidemiological design, manuscript writing, and reporting tools is one of the main barriers of reliable and rigorous scientific work.⁴ Since the year 2011, the workshop on basic research methods is being organized every year as a part of the postgraduate orientation program in our college. Each cohort of postgraduates is exposed to series of training programs during the period of their post-graduation.

Evaluation is integral to the implementation and development of any educational activities. The process of educational program evaluation is defined as the "systematic collection and analysis of information related to the design, implementation, and outcomes of a program, for the purpose of monitoring and improving the quality and effectiveness of the program."⁵ The present study was planned to 1) find out the scientific rigor of MD/MS thesis and, 2) find out the effectiveness of postgraduate training program on scientific rigor of MD/MS theses.

MATERIAL AND METHODS

Settings: The study was planned and carried out at the Epidemiology Unit (EU), Department of Community Medicine of a tertiary care teaching hospital in Puducherry. The EU in collaboration with the Research Committee and the Medical Education Unit is actively involved in teaching scientific research methods to each cohort of postgraduates through series of workshop during the postgraduate course and also to the faculty. Each cohort is exposed to workshops on research methods during first year; quality assured efficient data entry and analysis using software

during second year; and scientific communication during their final year of post-graduation. Each year, these training programs are revised to meet the expectations and needs of the learners. All thesis guides receives feedback on their student's thesis they receive orientation on recent development in the field of research every year (Figure-1).

Design and evaluation framework: It was an educational evaluation, where, the relevant secondary data from the seventy-eight MD/MS thesis records of postgraduates submitted to the University, were reviewed. It was a quasi-experimental design, where we compared the effect of series of training programs on the scientific rigor of thesis between two cohorts of postgraduates. We used the Kirkpatrick - level-III as the framework for carrying out this evaluation.⁽⁶⁾ At level-III, the aim is to check the change in behaviours/practices of the learners as a result of exposure to an educational course.

Data collection and analysis: After approval from the Research Committee and Institutional Ethics Committee (IEC code: 17/2018), total 78 thesis records for the year 2017 (N=40) and 2018 (N=38), available at the central library of the college were obtained and reviewed. The data was collected using the checklist consisting of predefined variables related to the scientific rigor such as reporting of objectives as per SMART (Specific, Measurable, Achievable, Relevant, Timely) criteria, sample size/sampling, data collection, data analysis and citation of the references. Trained postgraduate in Community Medicine collected the data under the supervision of the two faculties and any difference in opinion among them was resolved by mutual discussion. The information retrieved from thesis records was entered using mobile software, Epicollect version 5. Data analysis was performed using Statistical Package for the Social Sciences software (version 24). Categorical data related to the scientific rigor were summarized in percentages and were compared between two cohorts using the Chi-square test. All tests were two-tailed and p-value < 0.05 was considered to be statistically significant.

RESULTS

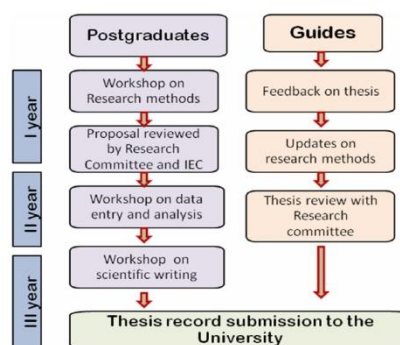
Out of total 78 thesis records reviewed, 49 (62.8%) were males and rest 29 (37.2%) were females. Majority of them were postgraduate of medical branches (80.7%) and others were from the surgical branch (19.2%). About 72 (92.3%) thesis were hospital-based studies and the remaining 6 (7.6%) were community-based studies. Out of 78 theses, 60 (76.9%) were cross-sectional studies followed by six (7.6%) case-control studies and only two were experimental studies (Table - 1).

About 60 students (76.9%) did not follow any specific format for reporting the review of literature, however, 12 (15.4%) and six (7.7%) followed author wise and theme wise reporting format respectively. Notably, 73 (93.6%) thesis had objectives mentioned according to SMART criteria. Over the period of one year, there was a 7.4%

Table-1: Comparison of basic characteristics of students and their thesis reviewed.

Characteristics	2017 batch, N=40	2018 batch, N= 38	Total
	n (%)	n (%)	N=78
Gender			
Male	27 (67.5)	22 (57.9)	49 (62.8)
Female	13 (32.5)	16 (42.1)	29 (37.2)
Speciality			
Doctor of Medicine	32 (80)	31 (81.5)	63 (80.7)
Master of Surgery	8 (20)	7 (18.5)	15 (19.2)
Study setting			
Hospital-based	38 (95)	34 (89.5)	72 (92.3)
Community-based	2 (5)	4 (10.5)	6 (7.6)
Study design			
Cross-sectional	30 (85.8)	30 (90.9)	60 (76.9)
Case-control	4 (11.4)	2 (6.1)	6 (7.6)
Experimental	1 (2.9)	1 (3.0)	2 (2.5)

Figure-1: Framework of training programs organised at the study setting for the postgraduate students and their guides.



improvement in this practice. Among 78 theses, 30 (38.4%) students described study setting, 56 (72%) students mentioned the sample size calculation, 14 (18%) mentioned software used in sample size calculation and only six (7.7%) mentioned sampling method. About 51 students (65.3%) mentioned the details about data entry and there was 5.9% improvement in this practice among the recent batch of students (Table-2).

Majority of students, 63 (80.7%) reported the software used for data analysis. Of the total students, 56 (71.7%) and 55 (70.5%) used measures of central tendency and dispersion respectively and there was a significant improvement in the usage of measures of central tendency and dispersion in data analysis. In discussion section, 23 (29.4%) students mentioned the strengths, 30 (38.4%) students mentioned limitations and 27 (34.6%) students mentioned recommendations. The practice of reporting strengths, weaknesses and recommendations showed improvement in 2018 batch. Out of 78 students, 26 (33.3%) cited their references as per the University requirement and this practice showed the significant improvement in 2018 batch

students. About 43 (55.1%) students could ensure correct in-text citation of the references (Table – 2).

Table-2: Comparison of scientific rigor of the MD/MS thesis submitted between two academic batches of the student.

	2017 batch	2018 batch	Total
Characteristics	N=40	N= 38	N=78
	n (%)	n (%)	
Reporting of review of literature			
Theme-wise	2 (5)	4(10.5)	6 (7.7)
Author wise	8 (20)	4 (10.5)	12 (15.4)
No specific format	30 (75)	30 (78.9)	60 (76.9)
Objectives and study setting description			
Objectives mentioned as per SMART criteria	36 (90)	37 (97.4)	73 (93.6)
Described study setting	13 (32.5)	17 (44.7)	30 (38.4)
Sample size and sampling			
Sample size calculation mentioned	27 (67.5)	29 (76.3)	56 (72)
Software used for sample size calculation	5 (12.5)	9 (23.7)	14 (18)
Sampling type mentioned	2 (5)	4 (10.5)	6 (7.7)
Data entry and Data analysis			
Details on data entry mentioned	25 (62.5)	26 (68.4)	51 (65.3)
Reporting of software used for data analysis	32 (80)	31 (81.6)	63 (80.7)
Details on statistics applied			
Measure of central tendency applied*	27 (67.5)	29 (76.3)	56 (71.7)
Measure of dispersion applied*	27 (67.5)	28 (73.7)	55 (70.5)
Inferential statistics applied	38 (95)	32 (84.2)	70 (89.7)
Figures reported	39 (97.5)	35 (92.1)	74 (94.8)
Other parameters			
Strengths of the study listed	11 (27.4)	12 (31.6)	23 (29.4)
Limitations reported	18 (45)	12 (31.6)	30 (38.4)
Recommendations given	10 (25)	17 (44.7)	27 (34.6)
Reference citation			
Reference listed without errors*	8 (22.6)	18 (47.4)	26 (33.3)
Flawless in-text-citation	21 (52.5)	22 (57.9)	43 (55.1)

In 78 theses, only seven (8.9%) students mentioned that they checked the distribution of data. Among 78 students, 65 (83.3%) students applied ANOVA as a statistical test of significance followed by 23 (29.4%) students applied Student's t-test. About 53 (70%) students applied Chi-square test as a non-parametric test of significance and 10 (12.8%) students used other non-parametric tests. Of the 78 students, 69 (88.4%) students used bar diagram and 57 (73%) students used the pie chart for the visual representation of the study findings (Table-3).

DISCUSSION

Most (92%) of the thesis were hospital-based cross-sectional studies. Over the period of one year there was improvement in parameters namely mentioning of the objectives as per SMART criteria, describing the details on sample size calculation including the software used for it, reporting the details of data entry, and listing the strengths and recommendations of the studies. There was an improvement in the practice of correctly citing the references. About 83% of students used ANOVA as a parametric test of significance and 70% of students used Chi-square as the non- parametric test. Nearly 88% used bar diagram and 73% used the pie chart for the visual representation of the results however the usage depends primarily on the type of result to be presented.

To the best of our knowledge, only a few studies were done in India and other countries, evaluating the scientific rigor of postgraduate thesis. Our study findings were consistent with the previously reported evaluation of Ph.D. Thesis submitted to the Indian Universities which showed 90% of the studies were descriptive in nature.⁷ Descriptive studies are comparatively easy to design and conduct, simple to perform analysis and straight forward to interpret the results however they are placed at the bottom of the evidence pyramid as their results have a more chance for bias.⁸ The prime purpose of the thesis is to learn various components of research including designing epidemiological study, data collection and entry, statistical analysis and interpretation, and reporting of the results. Hence more than the type of study design the scientific methods followed while carrying out and reporting is important.

Reporting the process of sample size calculation and the details of the sampling technique employed, improved in the present study. The scientific way of calculating sample size is crucial to ensure external validity of the study findings.⁹ Hence, it is a best practice to report the details of sample size calculation. This helps the readers to understand the process and verify the reported figure of sample size. Sampling is the scientific way of selecting suitable study subjects who are representative of the target population and the aim of sampling is to estimate the required population parameters at minimum cost and time.¹⁰ The study finding showed there was an improvement in mentioning the details of data handling. This improvement can be attributed to yearly improvement in the curriculum of postgraduate orientation program on research.

In both the batches, we found higher use of measures of central tendency as compared to the measures of dispersion. The similar behaviour has been found among students in higher education institutions in the Philippines.¹¹ The reporting of measures of central tendency alone is inadequate as the distribution of values around the central value gives a better picture of the data. Reporting of standard deviation helps any other researcher

to calculate sample size for their study.¹² We found that errors in in-text citation and reference list had significantly decreased over the period of one year. The correct referencing allows the readers to validate the proposed arguments and avoids plagiarism.¹³

The present study was an internal evaluation to further improve our practices. Such an evaluation helps to decide the areas for further improvement. However, the limitation of the study should be kept in mind. The improvement in scientific rigor of MD/MS thesis might be due to students' additional exposure in research methods held outside the college. It could also be attributed to individual difference in mentoring practices among thesis guides for two batches of postgraduates.

Conclusions and recommendations

There was improvement in various aspects of scientific rigor in MD/MS thesis. This study finding has implications for further improvement in the postgraduate training program. In addition to improvement in course curriculum on research methods, continuous skills up-gradation of thesis guides is crucial for continuous quality improvement in the postgraduate thesis.

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