INTRODUCTION

With the introduction of evidence-based medicine (EBM) in twentieth century, we have entered new era of practical implementation of our knowledge and information. Biostatistics, which is collection, interpretation and analysis of data, is a core subject of EBM. Worldwide all medical schools offer courses of biostatistics for their students; but unfortunately, this field is considered tough by them.¹

Biostatistics is well recognized as an essential tool in medical research, clinical decision making, and health management. Deficient basic biostatistics knowledge adversely affects research quality. Deficiency in understanding the application of biostatistics is a universal problem, but articles on this issue are not widely researched. There should be workshops and refresher courses of medical education for refreshing this subject.² Windish DM et al also supported the idea that residents mostly lacked the perception of biostatistics, which is very important for the understanding of published research articles. Biostatistics training in the form of workshops should be provided to postgraduate medical students.³

Medical statistics should be taught early to students in their undergraduate level and regular ongoing exercise on upgradation of these statistical courses in their postgraduate levels should be provided. For improvements in skills, there is a need that we design workshops and other reinforcement courses in such an informative way that these will help students to improve and apply their knowledge correctly.⁴

The need for biostatistics in research and evidence-based medicine is well recognised by most postgraduate medical students and institutes in developed countries; but still it is not a part of postgraduate medical curriculum in most of the developing countries, including Pakistan.⁵

Research activities in Pakistan are still in infancy. A survey conducted on undergraduate students showed that 76% students suggested that this should be included in the curriculum of first two years of medical education.⁶ Observations have shown that the students have interest in conducting research, but lack of facilities and guidance is main hindrance.⁷

Research is an integral part of postgraduate medical education. This is essential to integrate research into medical community. In Pakistan, College of Physicians and Surgeons Pakistan (CPSP), Pakistan Medical and

ABSTRACT

Objective: To evaluate understanding of biostatistics among postgraduate medical trainees before and after biostatistics workshop.

Study Design: Quasi experimental study.

Place and Duration of Study: Regional Centre, Islamabad, College of Physicians and Surgeons Pakistan, from March to September 2017.

Methodology: Two hundred and seventy postgraduate trainees were enrolled after taking informed consent. Structured questionnaire containing 21 multiple choice questions regarding understanding and application of biostatistics was given to all participants on the first and the last day of workshop and compared pre- and post-workshop by McNemar test of significance. SPSS version 21 was used for data analysis with p-value <0.05 as significant level.

Results: The response rate was 100%. Among these participants, males were 81 (30%) and females were 189 (70%), mean age was 28.5 ±2.5 years. One hundred and twenty-five (46%) postgraduate trainees were from Islamabad. Most of the doctors were in the first year (37%) and second year (57%) of their training. With total correct answers of 42.9% (pre-workshop) and 57% (post-workshop), p-value was <0.001.

Conclusion: Understanding regarding application of biostatistics in research among PGTs improved significantly and immediately after teaching biostatistics in research methodology workshop.

Key Words: Biostatistics. Postgraduate medical trainee. Evidence-based medicine.
Dental Council (PMDC), Pakistan Health Research Council (PHRC), Ministry of Health, and Higher Education Commission (HEC) are trying to promote good quality research among Pakistani doctors and postgraduate students. Taking into account, College of Physicians and Surgeons (CPSP) has a mandatory workshop on research methodology and biostatistics during postgraduate fellowship programme for improving PGTs’ understanding of subject.

The objective of this study was to assess understanding regarding application of biostatistics in research from postgraduate trainees (PGTs) before and after conducting research methodology and biostatistics workshop.

**METHODOLOGY**

This quasi experimental study was conducted at the Regional Center Islamabad, College of Physicians and Surgeons Pakistan, from March to September 2017. Two hundred and seventy postgraduate medical students were enrolled in the study by consecutive nonprobability sampling technique. They were enrolled during research methodology and biostatistics workshop. These PGTs were working in government, private, and military set-up of Rawalpindi and Islamabad and nearby cities. They were all from first year to fourth year of training. Ethical approval was taken from authorities.

Data collection tool was a questionnaire, containing 21 multiple choice questions, all the questions were based on the understanding of PGTs regarding application of biostatistics knowledge during designing and applying statistical methods in research. After taking informed consent about ensuring confidentiality, questionnaire was delivered to the PGTs on the first day of workshop before the session of biostatistics and then on the last day of workshop after the session of biostatistics was done. All the procedures were done by the principal researcher herself.

Data was analysed on SPSS version 21. Descriptive statistics were calculated. Mean and standard deviations were calculated for the quantitative variables like age. Qualitative variables were presented by frequencies and percentages. McNemar test was applied for the pairwise comparison. A p-value of less than 0.05 was considered as a significant value.

**RESULTS**

Two hundred and seventy respondents, who had given the written consent of participation, were included in the study. Response rate was found to be 100%. There were 81 (30%) males and 189 (70%) females with the mean age of 28.5 ±2.5 years. One hundred and twenty-five (46.3%) PGTs were from Islamabad; 43 (15.9%) from Military Hospitals, and 102 (37.8%) from Rawalpindi-based hospitals. One hundred (37%) of the participants were first year post graduate trainees, 154 (57%) of second year, 15 (5.6%) of third year, and 1 (0.4%) was fourth year trainee (Figure 1). Pre, at first day of workshop and post, last day of workshop comparison of

<table>
<thead>
<tr>
<th>Questions</th>
<th>Pre-workshop</th>
<th>Post-workshop</th>
<th>p-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is variable?</td>
<td>248 (91.9%)</td>
<td>260 (96.3%)</td>
<td>0.045</td>
</tr>
<tr>
<td>What are the types of variable?</td>
<td>249 (92.2%)</td>
<td>267 (98.9%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Examples of qualitative data?</td>
<td>236 (87.4%)</td>
<td>259 (95.9%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Examples of quantitative data?</td>
<td>172 (63.7%)</td>
<td>205 (75.9%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Measure of central tendency?</td>
<td>208 (77%)</td>
<td>256 (94.8%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Measure of dispersion?</td>
<td>234 (86.7%)</td>
<td>250 (92.6%)</td>
<td>0.018</td>
</tr>
<tr>
<td>How do you present qualitative data?</td>
<td>183 (67.8%)</td>
<td>240 (88.9%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>How do you present quantitative data?</td>
<td>173 (64.1%)</td>
<td>237 (87.8%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>What is the graphical presentation of qualitative data?</td>
<td>121 (44.8%)</td>
<td>225 (83.3%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>What is the graphical presentation of quantitative data?</td>
<td>126 (46.7%)</td>
<td>224 (83%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>In normal distribution curve, 1SD stands for which percentage of population?</td>
<td>167 (61.9%)</td>
<td>246 (91.1%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>In normal distribution curve, 2SD stands for which percentage of population?</td>
<td>183 (67.8%)</td>
<td>255 (94.4%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>In normal distribution curve, 3SD stands for which percentage of population?</td>
<td>202 (74.8%)</td>
<td>260 (96.3%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>What is the best way to increase confidence interval?</td>
<td>182 (67.4%)</td>
<td>231 (85.6%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Test of the significance tests, which of the hypothesis?</td>
<td>184 (68.1%)</td>
<td>191 (70.7%)</td>
<td>0.494</td>
</tr>
<tr>
<td>If p-values is &lt;0.05, it signifies?</td>
<td>159 (58.9%)</td>
<td>231 (85.6%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>t-test is applicable for what?</td>
<td>143 (53%)</td>
<td>211 (78.1%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>To measure association between qualitative variables, which test of significance we should select?</td>
<td>147 (54.4%)</td>
<td>238 (88.1%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>If a researcher wants to measure mean BP between two groups by conducting a randomised control trial, which test of significance is applicable?</td>
<td>86 (31.9%)</td>
<td>144 (53.3%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>If a researcher wants to measure frequency of pain between groups by conducting a randomised control trial, which test of significance should be used?</td>
<td>73 (27%)</td>
<td>163 (60.4%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>To compare mean BP pre- and post-intervention in one group, which test of significance should be used?</td>
<td>83 (30.7%)</td>
<td>156 (57.8%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total</td>
<td>3566 (62.9%)</td>
<td>4742 (83.6%)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
the understanding of biostatistics was given in Table I. The total correct answers were 42.9% before, and 57% after workshop, (p-value <0.001). Participants had adequate knowledge of descriptive biostatistics, but very little knowledge of inferential biostatistics. Only 30% had concept of application of different test of significance pre-workshop, but this was improved significantly post-workshop. Knowledge of p-value also improved from 58.9% to 85.6%.

**DISCUSSION**

Biostatistics plays a vital role in the field of research. Knowledge of biostatistics, if applied correctly, will help in generating accurate results, thus establish evidence regarding the assumption made by research.

In this study, the response rate was 100%, which was different as compared to other studies showing response rate of 51.67%, and 64.3%; but almost similar to the results reported by Ejaz (94%) and Zhang (97.6%).

In this study, male students were only 30% as compared to female students (70 %). In most of the other studies males were more prevalent as compared to females. In the study by Gore et al., males were 56.45% and females were 42.58%. In the study by Zhang, male students were 57.1%.

Mean age of students in our study was 28.5 ±2.5 years. This was similar with the study conducted by Zhang et al., showing mean age of 26.7 ±3.7 years. But different from another study by Gore, showing mean age of 38.3 ±11 years.

In this study, the understanding of PGTs regarding application of biostatistics in research before taking workshop was not good, but improved significantly after attending workshop. This was consistent with the study by Butt et al., showing importance of knowledge of biostatistics for evidence-based medicine. That study was done in 2015 on 56 trainees and supervisors of Sheikh Zaid Hospital Lahore to evaluate perception of them regarding effectiveness of CPSP research methodology and biostatistics workshop. In that study, 75% acknowledged the importance of biostatistics, 56% gained skills about reading and writing research papers. Overall, 54% were satisfied with this workshop. That study also suggested that pre- and post-evaluation should be done to see how much knowledge they have gained.

These research works are also in line with study by Gore et al. that showed nearly half of the students were having knowledge of application of biostatistics and they were not using this in practical purposes; and 53.87% found it difficult to understand. In that study, participants had very little knowledge about sample size calculation and test of significance used for data analysis. Moreover, 46.1% respondents found inferential biostatistics difficult. This was consistent with the results of the present study. In that study, only 2.9% correctly gave the meaning of p-value. This was different from the present research, which showed that 58.9% knew about p value which was improved to 85.6%. It was concluded that most of the postgraduate students did not apply correct statistical analysis for their research, although they wanted to improve their skills but were lacking in knowledge of biostatistics, which was similar to the opinion of our responders.

In another study by West et al., 87.3% found biostatistics very useful but difficult subject to learn. A study by Zhang et al., was somewhat similar to this; in which researcher used SATS-28 scale to evaluate attitude of postgraduate medical students during and after their completion of course. Student attitudes showed negative changes after completion of statistics course. But this study was different in this aspect that students had experience of applicability of biostatistics and had attended one or more courses on that, whereas in our study this was first exposure to biostatistics by most of the PGTs.

Another study showed postgraduate students had moderate knowledge, but high attitude towards biostatistics. Moreover, 81.7% believed that they should have knowledge of biostatistics to read research paper; 75% believed that they could not read statistical portion of research paper.

A similar study was conducted on first-year postgraduate medical students. Ten lectures of biostatistics were delivered and knowledge of biostatistics was evaluated pre- and post-lecture.

In that study, no student had ever attended research methodology workshop; whereas in this study, 10.7%
had participated in such workshops and 50.7% students had knowledge of biostatistics. There was statistically significant improvement in mean knowledge score pre- and post-lecture.\textsuperscript{11}

Workshop is very important source for improvement in understanding and perception of PGTs, this was supported by study done on students of dental institute, and among them 86% was aware of the importance of biostatistics. But mostly had poor knowledge of biostatistics, 53% was unaware of the statistical test applied. This study concluded that there is utmost need of the time that workshops should be conducted to increase knowledge of these students, conduct valuable workshops and give more evidence to the present practice.\textsuperscript{12}

This was also supported by Sharma, showing average knowledge of biostatistics but having good attitude towards it. The main obstacle was lack of facilities provided to postgraduate students for that, with correct response was 54%.\textsuperscript{13} This was also consistent with another study by Novack et al., showing medical professionals were lacking in basic knowledge of research methodology and data analysis.\textsuperscript{14}

Another study used methodology of journal clubs to improve the knowledge of epidemiology and biostatistics, and concluded that 86% of the students improved their knowledge through attending these journal clubs.\textsuperscript{15}

In Pakistan, students have interest in conducting research but facilities and curriculum is inadequate. This was supported by a research done in Aga Khan Medical University, where 50% found research inadequate in Pakistan and 91% showed interest in research. This study also concluded that most of the students attended workshops and submit their synopsis just to fulfill requirements of CPSP.\textsuperscript{7} Doctors are lacking skills of statistics, thus special emphasis should be given at post-graduate level during teaching biostatistics, so that knowledge could be improved.\textsuperscript{16} Biostatistics knowledge and use of SPSS has very crucial role in training of students for their research work.\textsuperscript{17} In designing and conducting research understanding, biostatistics is most important and difficult for clinicians. So, the major task is to teach and overcome this difficulty of clinicians through good teaching and applicable contents of workshops.\textsuperscript{18}

Lack of knowledge could be the reason for lack of PGTs participation in research. Most of the PGTs had the idea that they did not remember biostatistics which is taught in undergraduate level; so there should be workshops and training which could help them in increasing their knowledge. Biostatistics is very important for medical research and EMB, upgradation of knowledge is need of the time.\textsuperscript{19,20}

The limitation of this research is that no long-term follow-up was carried out to determine the understanding of biostatistics in terms of its perception and application by the postgraduate trainees.

The authors suggest that biostatistics as a subject should be incorporated in curriculum of residents; and more effective interventions in the form of workshops are needed to help students, because at present these are only source of biostatistical knowledge improvement for our residents here in Pakistan.

**CONCLUSION**

Understanding regarding application of biostatistics in research among PGTs improved significantly and immediately after teaching biostatistics in research methodology workshop.

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