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# Statistical Literacy among Practicing Clinicians from India: A Brief Survey

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## Abstract

Objectives: To understand statistical literacy among practicing clinicians as well as to take suggestions on its implementation in medical curriculum. Methods: A web based online survey was conducted among practising clinicians of India. The questionnaire consisted of 30 questions in three parts. Part A included questions on general information (5 questions), Part B included questions on application of statistical concepts (20 questions), and Part C asked for opinions on integration of biostatistics in medical curriculum (5 questions). Part B questions were rated on a 5-point Likert scale in which 1 indicated no confidence and 5 indicated complete confidence. Results: A total of 416 clinicians responded to the questionnaire. Complete confidence in the use of SPSS software was seen in 15.8

***Index terms***— statistical knowledge, medical curriculum, evidence-based medicine, critical appraisal, medical students.

## 1 Introduction

s a fourth year medical student, I found difficulty in interpretating the results of research articles. I took assistance from my parents (who happen to be well known clinicians in their respective fields) but unfortunately they were also ignorant about the details of the statistics used. I searched our syllabus of medical education till final year and found no defined syllabus for medical statistics. I studied about the scenario of medical statistics in medical curriculum and its outcomes, and this led me to formulate this study.

In the era of evidence-based medicine, it is very pertinent for clinicians to critically appraise the published literature in terms of design, conduct and analysis of the study so as to logically interpret the results (McColl, 1998&Morris, 2002) This requires a fundamental knowledge of biostatistics which is lacking to a variable extent in practicing physicians as seen in several surveys conducted in 1980s (Weiss, 1980 **??**&, 1987). The problem has become more apparent in recent times because of the use of complicated statistical method, which has interpretation of results in only 21% of the published articles (Horton et al., 2005). It has been already suggested by Palmer that 21st century doctors will need an armoury of critical appraisal skills to assess the research data (Palmer, 2002). Keeping this background in mind, we conducted a survey with the main objective to assess the knowledge of the basic methods of research and data analysis among medical doctors in India and to get suggestions from practicing doctors as to how and when statistics should be integrated to medical curriculum.

## 2 II.

## 3 Materials and Methods

A web based online survey using Google webapplication was conducted between October to December 2020 among practising clinicians of various fields in government and private sector in India. The survey was floated on social media (WhatsApp) among various groups and they were informed that the results of the survey might be used for analysis and medical publication. The participation was voluntary with no compulsion and was not limited to any institution or geographic area. The respondents' anonymity was ensured.

The questionnaire consisted of 30 questions in three parts. Part A included questions on general information and demographics (5 questions), Part B included questions on detailed knowledge and application of statistical

concepts in medical research (20 questions), and Part C asked for opinions on integration of biostatistics in medical curriculum ??5 questions). Fourteen questions in part B were rated on a 5-point Likert scale in which 1 indicated no confidence and 5 indicated complete confidence.

# 4 ( )

# 5 Statistical Analysis

The data collected was transferred to MS Excel data sheet. Data analysis was performed using SPSS (Statistical Package for the Social Sciences) version 22.0developed by IBM Corporation. Qualitative data was expressed using frequency and percentage. Quantitative data was explained using descriptive statistics. To compare the relation of different statistical concepts with variables, Chi-square test was used. P value of 0.05 was considered as statistically significant.

IV.

# 6 Results

A total of 416 clinicians responded to the questionnaire over a period of three months. The results of different sections of the questionnaire are as follows-

# 7 Part A

Out of 416 clinicians, 272 (65.3%) were men and 144 (34.6%) were women with age varying from 25 years to 71 years. The mean age was 46.7 years and 224 (53.8%) clinicians were in the age group 45-55 years. Clinicians practicing oncology were 128 (30.7%), followed by paediatrics (7.69%), critical care and medicine (6.7% each) and rest were from gynaecology, neurosurgery, cardiology, and other clinical and nonclinical specialities [Table 1]. Most of the consultants were from private sector (57.1%) and 21.9% each from institutional and government sector. Years of practice ranged from 1 to 48 years with an average of 18.4 year and 14.4% had more than 20 years of practice in their respective fields. Part B 284 clinicians (68.3%) have done clinical research while 132 (31.7%) have never been involved in any clinical research so far. The number pf publications by the clinicians ranged from none to 184 in number with an average of 19.4 publications. When asked about the general understanding of all the statistical terms when reading a research article, only 10.3% were completely confident in their understanding whereas 4.8% were not at all confident (Table 2). The majority (42%) rated average confidence. However, 43.3% felt the relevance of biostatistics in medical curriculum (Likert scale 5). Only 17.3% clinicians (with complete confidence) indicated that they use statistical information in forming opinions or when taking decisions in medical care whereas 44.2% had more than average confidence on this question (Likert 4). Majority of the respondents (91.5%, Likert 4 and 5) agreed that to be an intelligent reader, it is necessary to know something about statistics.

Knowledge of fourteen statistical concepts was assessed on a Likert scale of 1 to 5 [table 2]. The results were as follows-understanding P value with complete confidence in 32.7% and more than average confidence in 31.7%. Confidence interval was completely understood in 25.2% and more than average in 33%. For standard deviation, 35.9% and 36.9% were completely confident and more than average confident respectively. Complete confidence in understanding of graphical presentation of data was seen in 44.7% of clinicians, survival analysis in 30.8% whereas it was only 11.7% for ROC curves(lowest respondents) and 13.3% for cluster analysis. Complete confidence in the use of software like SPSS was seen in 15.8% and near complete confidence in 23.8% of the responders whereas 26.7% had no confidence at all in its use. Sensitivity and specificity in a data could be interpretated completely in highest number of respondents (45.2%), laws of probability in 21.4 % and summarizing and analysing missing data in 15.5%. Regression analysis was completely interpretated in only 15.8% whereas 20.8%

had no knowledge about it. COX proportional hazard regression was seen with complete confidence in 12.9% and no confidence in 28.7% of the responders. More than average confidence in chi-square test (29.7%) and 9.9 % had no confidence at all. Most of the statistical concepts were rated as average confidence (Likert scale 3).

# 8 Part C

When asked about any previous training done in medical statistics, 136 (32.4%) responded that they did it as part of undergraduate curriculum, 128 (30.5%) did self-learning and 152 (37.1%) had received no formal training in statistics [Figure 1]. All the responders agreed that biostatistics should be included in medical curriculum and 92.3% were interested to learn more about it if given a chance. Seventy-five percent clinicians believed that MBBS is the apt time to learn medical statistics while 20.2% wanted to learn during junior residency [Figure 2]. A varied number of suggestions were given when asked about how to improve biostatistics training among doctors.

# 9 Discussion

Medical statistics (Biostatistics) has played an integral role in modern medicine. Statisticians help researchers design studies, analyse data from medical experiments, help interpret the results of the analyses, and collaborate in writing articles to describe the results of medical research (Google Scholar). However, statistics is full of concepts

and technical terms which may be difficult to understand and this presents an important barrier to knowledge use. Also anecdotal experience supports that statistics is not the most liked subject in the undergraduate medical curriculum (Altman et al., 1991& Freeman, 2008). To bridge this gap we need to integrate biostatistics in medical curriculum either at graduate or post graduate level **??**Editorial, Lancet, 2007).

We developed a basic survey questionnaire to assess the knowledge of statistics among practicing clinicians and reflect the statistical methods and results most represented in contemporary research studies. Our results suggest that only a limited number of clinicians were completely confident in using statistical equations and mostly scaled on average or below average on a Likert scale. This correlates well with the lesser confidence in the use of SPSS software (26.7% had lowest confidence and only 15.8% were completely confident). The highest confidence was seen in statistical equations like graphical representation of data (44.7%), and sensitivity and specificity (45.2%) which is the basic statistical concept whereas the lowest confidence was seen in COX proportional hazard regression (12.9% some training in biostatistics (Windish et al., 2007). Another reason might be the lesser involvement of clinicians in research activities which was 31.7% in our study, this number is far more than a study by Susan et al where10 % had never been involved in any health research (Miles et al.,2010). This may be due to fact that our cohort is diverse with respect to age, clinical experience and type of practice (government or private).

We found that a better knowledge of biostatistics in clinicians was associated with their prior training in statistics (either part of medical curriculum or self-learning), more years of clinical experience and more number of publications, although no statistical correlation could be found. Similar finding was seen in astudy by Novack et al (Novack et al., 2006). Respondents with higher confidence in their statistical knowledge performed better on the questions pertaining to statistical concepts in part B, also seen in Windish study (Windish et al., 2007).

Our findings suggest that all the doctors recognised the value of undergraduate training in statistics and majority (92.3%) have the desire to learn even now, which indicates the relevance of the topic. Similar results were seen in a study by Windish in which 95% responders agreed that to be an intelligent reader it is necessary to know statistics (Windish et al., 2007). More than 58% responders in their study indicated that they use statistical information in forming opinions and in our study it was seen in 61.5% responders (Likert 4 and 5).

Seventy five of the participants believed that medical statistics should be incorporated into undergraduate medical curriculum. This is very well established in various studies worldwide that the foundation years are the best to introduce any new syllabus for better understanding of the subject (McColl, 1998& Miles, 2010). The clinicians offered informative suggestions as to how undergraduate statistical training can be improved. First of all, medical statistics can be introduced along with epidemiology early in the undergraduate training. The main aim of the course is to understand the conceptual basis and usage of common statistical methods, and their application in clinical medicine (Swift et al., 2009). The teaching needs to ensure that medical students appreciate the relevance of learning a new skill. Secondly, it should be more interactive and practical oriented. The biostatistics course can be divided into small group tutorial based sessions based on one or more problems which contains both statistical and epidemiological data (Astin et al., 2002). The emphasis is on enabling students to critically appraise research and other evidence. In a study by Parkes, critical appraisal teaching resulted in a significant improvement in critical appraisal knowledge as compared to 6% improvement in control group (Parkes et al., 2002). Students can be provided with access to a computer assisted learning package which they can access freely. Finally the course can be concluded with a short examination on statistical methods. Later in the fourth year, some advanced topics such as meta-analysis and a project in which students can critically appraise research papers can be included in the curriculum. Furthermore, previously learned statistical concepts should be regularly reinforced throughout career with clinically integrated interactive teaching. This was seen in a survey Looney et al in which it was found that more than 90% of medical schools focussed their biostatical teaching in preclinical years without later reinforcement (Looney et al., 1998). On the contrary, few clinicians believed that medical students are already overburdened with their syllabus and there should not be extra subjects besides the existing ones. This implies that post graduation is better time for teaching other subjects as this time is ideal as they are more focussed on their clinical work and writing thesis. However interested students can learn it during vacation time or from online courses but first the students should be appraised of the need of such topic.

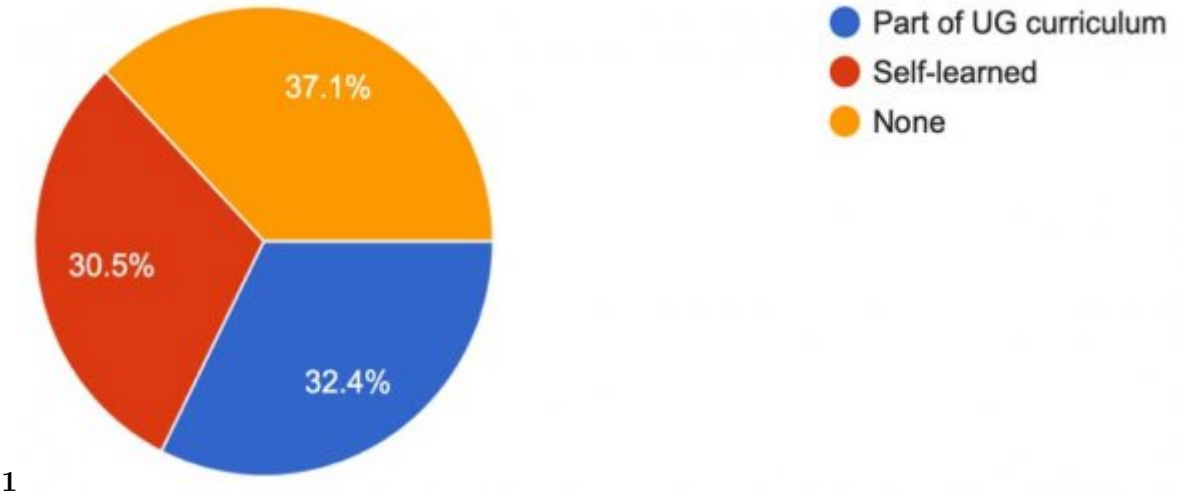
Our study has limitations, firstly the study cohort diversity. There is a diverse group of practising clinicians in terms of age, various specialties involved with different level of experience and type of practice. Secondly, our survey was purposely kept brief thus limiting our ability to assess understanding of all biostatistical concepts in detail. Nonetheless, our study is the first of its kind involving a large number of clinicians from India and it helps in providing useful information about the basic statistical knowledge among the practicing clinicians.

# 10 VI.

# 11 Conclusions

The results of this study suggest that knowledge of statistical software and statistical concepts is lacking to various extent among practicing clinicians of India. However, they are keenly interested to learn more about it even at any stage of their career. There is more favour towards integration of statistical literacy in undergraduate curriculum so as to form a firm base in those years. It involves learning of new skills, almost a new language, and thus a more interactive form of teaching is necessary in which problems and methods can be discussed (Barleyy

et al., 2016). Small group teaching sessions are therefore more appropriate for this. It is pertinent to not only make the teaching explicitly relevant to future practice but also implies the need for more robust training in biostatics among medical graduates.




**1**

Figure 1: Figure 1 :

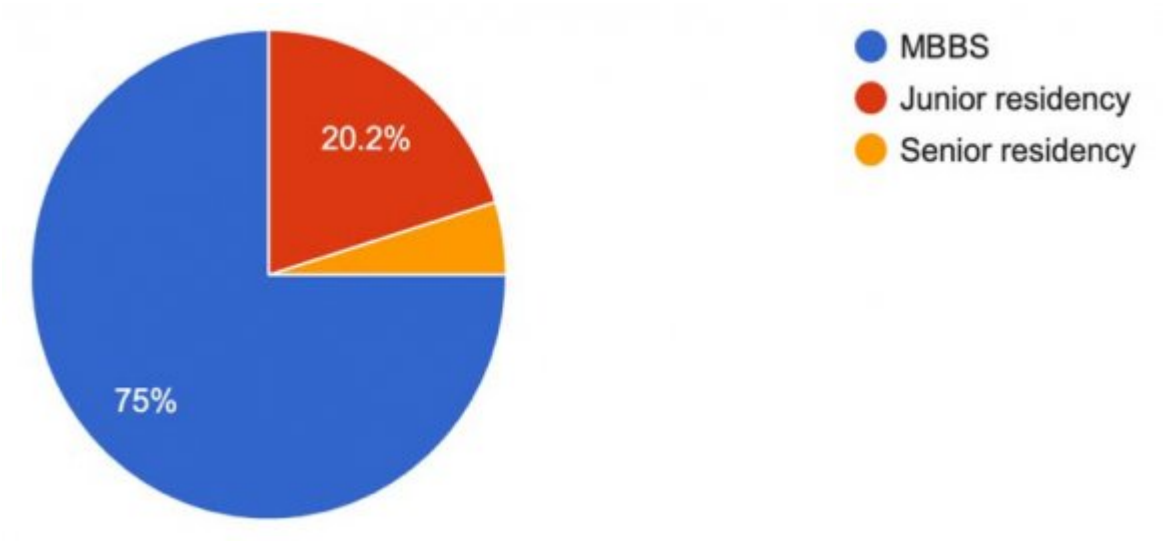



Figure 2: G

**1**

| Clinical Specialty | Number | Percentage (%) |
|---|---|---|
| Oncology | 128 | 30.7 |
| Pediatrics | 32 | 7.7 |
| Anesthesia | 28 | 6.7 |
| Medicine | 28 | 6.7 |
| Gynecology | 20 | 4.8 |
| Neurosurgery | 20 | 4.8 |
| Cardiology | 20 | 4.8 |
| Orthopedics | 20 | 4.8 |
| Pathology | 16 | 3.8 |
| ENT | 16 | 3.8 |
| Ophthalmology | 16 | 3.8 |
| Nephrology | 12 | 2.8 |
| General surgery | 12 | 2.8 |
| Radiodiagnosis | 8 | 1.9 |
| Dermatology | 8 | 1.9 |
| Others | 32 | 7.7 |

Figure 3: Table 1 :

**2**

| Questions | Lowest confidence n (%) | Little more confidence n (%) | Average confidence n (%) | More than average confidence n (%) | Highest confidence n (%) |
|---|---|---|---|---|---|
| When reading a research article do you understand all the statistical terms mentioned (n = 416) | 20 (4.8) | 71 (17.0) | 175 (42.0) | 107 (25.7) | 43 (10.3) |
| How do you perceive the relevance of biostatistics in medical curriculum (n = 416) | 4 (1) | 8 (1.9) | 60 (14.4) | 164 (39.4) | 180 (43.3) |
| I often use statistical information for forming opinions or making a decision in medical care (n = 416) | 12 (2.9) | 40 (9.6) | 108 (26) | 184 (44.2) | 72 (17.3) |
| To be an intelligent reader is it necessary to know statistics? (n = 416) | 4 (1) | 12 (2.9) | 36 (8.7) | 164 (39.4) | 200 (48.1) |
| p-value (n = 416) | 24 (5.8) | 48 (11.1) | 76 (18.3) | 132 (31.7) | 136 (32.7) |
| Confidence interval (n =412) | 36 (8.7) | 52 (12.6) | 84 (20.4) | 136 (33) | 104 (25.2) |
| Standard deviation (n=412) | 16 (3.9) | 20 (4.9) | 76 (18.4) | 152 (36.9) | 148 (35.9) |
| Graphical presentation of data (n=412) | 12 (2.9) | 8 (1.9) | 32 (7.8) | 176 (42.7) | 184 (44.7) |
| Survival analysis (n=416) | 40 (9.6) | 32 (7.7) | 80 (19.2) | 136 (32.7) | 128 (30.8) |
| ROC curve (n=412) | 64 (15.5) | 68 (16.5) | 112 (27.2) | 120 (29.1) | 48 (11.7) |
| Cluster analysis (n=408) | 68 (16.7) | 80 (19.6) | 92 (22.5) | 112 (27.5) | 56 (13.7) |
| Use of software like SPSS (n=404) | 108 (26.7) | 44 (10.9) | 92 (22.8) | 96 (23.8) | 64 (15.8) |
| Sensitivity and Specificity (n=416) | 12 (2.9) | 28 (6.7) | 56 (13.5) | 132 (31.7) | 188 (45.2) |
| Laws of probability (n=412) | 28 (6.8) | 52 (12.6) | 108 (26.2) | 136 (33) | 88 (21.4) |
| Summarizing and analyzing missing data (n=412) | 52 (12.6) | 76 (18.4) | 108 (26.2) | 112 (27.2) | 64 (15.5) |
| Regression analysis (n=404) | 84 (20.8) | 80 (19.8) | 112 (27.7) | 64 (15.8) | 64 (15.8) |
| COX proportional hazard regression (n=404) | 116 (28.7) | 68 (16.8) | 80 (19.8) | 88 (21.8) | 52 (12.9) |
| Chi-square test (n=404) | 40 (9.9) | 64 (15.8) | 96 (23.8) | 120 (29.7) | 84 (20.8) |

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## .2 Conflict of interest

None.

## .3 Financial support Nil



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