Short communication

Teaching biostatistics and epidemiology in a postgraduate medical institution: are we going in the right direction?

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تعليم الإحصاء الحيوي والوبائيات في معاهد الدراسات العليا: هل نسير في الاتجاه الصحيح؟

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الخلاصة: درس الباحثان مواقف ومعارف 40 مشرفاً ومتدرباً كما درسا أثر الحلقات الدراسية على عمليات التفكير والتحليل الإحصائي في إحدى المرافق الطبية في باكستان؛ فوجدا أن 45٪ ممن شملتهم الدراسة يعتقدون بوجوب ترك الإحصاء والوبائيات للاختصاصيين بالإحصاء، وأن 86٪ من المتدربين و58٪ من المشرفين يعتقدون بوجوب تعليم الإحصاء كمادة مستقلة وكاملة، وأن 86٪ من المتدربين راضون بالحلقات العملية في مقابل 33٪ من المشرفين. وتدل هذه النتائج على الحاجة الماسة لمراجعة الأسلوب المتَّبع حالياً في تعليم الإحصاء والوبائيات.

ABSTRACT We examined the attitude and knowledge of 40 supervisors and trainees as well as the impact of workshops on statistical thinking and analytical processes in a medical facility in Pakistan: 45% thought that statistics and epidemiology should be left to professional statisticians; 86% of the trainees and 58% of the supervisors, however, thought that statistics should be taught as a full-time subject. The majority of trainees (86%) were dissatisfied with the workshops compared to 33% of supervisors. Our findings indicate an urgent need to revise our approach to teaching statistics and epidemiology.

Enseignement de la biostatistique et de l'épidémiologie dans un centre d'études médicales de troisième cycle : l'orientation suivie est-elle la bonne ?

RÉSUMÉ Nous avons examiné l'attitude et les connaissances de 40 enseignants et étudiants, ainsi que l'incidence des ateliers sur la pensée statistique et les processus d'analyse dans un établissement médical au Pakistan : 45 % pensaient que les statistiques et l'épidémiologie devaient être réservées aux statisticiens professionnels ; 86 % des étudiants et 58 % des enseignants pensaient en revanche que les statistiques devaient être une matière enseignée à part entière. La majorité des étudiants (86 %) n'étaient pas satisfaits des ateliers, contre 33 % des enseignants. D'après nos observations, il est urgent de revoir notre méthode d'enseignement des statistiques et de l'épidémiologie.

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Introduction

The practice of medicine is becoming more "evidence-based"; management decisions need to be based not only on clinical expertise and experience but on evidence provided by research conducted using appropriate methodology [*1*]. In almost all specialties of medicine, a more critical appraisal of current practices has led to the introduction of practice guidelines derived from evidence from randomized controlled trials. These guidelines have become tools for evaluating the quality, efficacy and cost-effectiveness of health care [*2,3*].

The resources available today for treating patients are more constrained than they were a few decades ago. Government agencies, donors and consumer groups view the increasing costs of medical care with concern, and are placing restrictions on allocation of funds, with preference being given to diagnostic therapeutic procedures demonstrated to be useful in properly conducted, controlled trials. These issues, which are at their heart statistical issues, will play an increasing role in administrative, legal and financial decisions.

Epidemiology and biostatistics are relatively recent arrivals in the field of medicine. We are just beginning to see formal teaching in biostatistics, and only at the postgraduate institutions. Clinicians generally consider these subjects either too difficult or an unnecessary burden in addition to their teaching responsibilities. Editors of medical journals try to screen out articles that lack proper statistical methodology but since very few editors have formal training in biostatistics, their focus is usually on the content rather than the methods employed [*4*]. Clinicians must, therefore, understand biostatistics and epidemiology to decide whether they can believe the results of studies published in medical research papers

The primary objective of this study was to determine the awareness of statistics and epidemiology as essential research tools amongst the teaching faculty and trainees at a hospital in Lahore, Pakistan. We also evaluated the in-depth knowledge of the trainers and trainees regarding the application of correct statistical procedures for conducting and evaluating research projects.

Methods

This observational study included 63 persons, 21 faculty members and 42 trainees from clinical departments of Shaikh Zayed Hospital, Lahore, Pakistan. All participants had attended a workshop on biostatistics held by the College of Physicians and Surgeons Pakistan as part of the mandatory requirements for trainers and trainees, and were thus expected to have a reasonable background in basic statistics and epidemiology. All participants of the workshop were given a questionnaire compiled by the authors based on their experience analysing data in dissertations and theses submitted by students in the institution.

The questionnaire comprised 20 questions aimed at evaluating the following domains:

- importance of biostatistics and epidemiology for research in hospitals/medical colleges,
- knowledge of basic statistics and epidemiology,
- application of the basic concepts to clinical research.

Statistical analysis

Numerical data were recorded as frequency/percentage and analysed using the chi-squared test, with significance level established at 5%.

Results

Nineteen questionnaires were not returned while another 4 were discarded owing to illegible overwriting and/or incomplete data. Thus the final analysis was based on the responses of 40 participants (63.5%), 12 faculty members and 28 trainees from various clinical departments.

A total of 18 (45%) respondents from both groups indicated that statistics and epidemiology should be left to professional statisticians as these subjects were not considered important for research scholars themselves (Table 1). However, 68% of the trainees felt that researchers should learn the subjects themselves in contrast to 25% of faculty members ($P = 0.018$).

The overwhelming majority of participants included in the survey supported the suggestion that hospitals should have the services of professional statisticians available. It was considered that departments of biostatistics and epidemiology should be granted a teaching status by 71% of trainees whereas this view was shared by only 42% of the supervisors ($P = 0.032$). Although 86% of the trainees suggested that statistics should be taught as a full-time subject in contrast to 58% of the supervisors, the difference was not statistically significant ($P = 0.097$).

A majority of both supervisors and trainees were of the opinion that biostatistics required a strong mathematical background and was thus a difficult subject to master (Table 1). The response to the question regarding utility of mandatory workshop on biostatistics and epidemiology showed a striking difference between supervisors and trainees with 86% of the trainees dis-

Table 1 **Response to questions evaluating importance given to biostatistics and epidemiology**

Item	Supervisors (*n* = 12)		Trainees (*n* = 28)		*P*-value
	No.	%	No.	%	
Statistics and epidemiology should be left to the professional statistician	9	75	9	32	0.018
Statisticians should be employed in all hospitals	9	75	22	79	1.00
Departments of biostatistics and epidemiology as teaching departments	5	42	20	71	0.032
Statistics should be taught as a full time subject	7	58	24	86	0.097
Biostatistics requires a strong mathematical background	9	75	19	68	0.725
Biostatistics workshops are sufficient to enable practical applications for research	8	67	4	14	0.002
Computer packages can be used without a background knowledge of statistics	4	33	10	36	1.00
Have received formal training in statistics and epidemiology	0	0	0	0	1.00

satisfied with the workshops compared to 33% of supervisors ($P = 0.002$), indicating that these workshops were not sufficient for learning practical application of the subject. Both supervisors and trainees overwhelmingly agreed that computer packages for statistical analysis still required a thorough knowledge of statistics before their output could be understood. None of the participants had ever had formal training in biostatistics and epidemiology.

Analysis of the responses to questions evaluating knowledge of statistics and its application to clinical and research data revealed uniformly deficient concepts: the majority of participants did not have a clear understanding of even the basic principles of statistics and epidemiology (Table 2). Responses to questions were either consistently wrong or the participants were unable to provide any answer.

Discussion

It is essential for physicians, both in clinical practice and research, to be able to judge the quality of research reported in journals to stay up-to-date in their profession. A clear understanding of the basic principles of biostatistics and epidemiology is required to achieve this goal. In a critical review of over 4000 research studies, only 20% of those reviewed had correct study design, data collection and statistical methods [*5*]. Although this was reported 2 decades ago, the problem persists and is the result of inadequate focus on biostatistics given during undergraduate and postgraduate years [*6*].

Doctors are exposed to the latest techniques in disease management while they are going through their residencies and this continues in their postgraduate years, where they keep up to date by reading journals, attending professional meetings and seminars, and participating in research. However, since no strong foundation in research methods is imparted in medical colleges, many doctors do not possess the skills to critically analyse research data, and simply accept what is presented in journals as research [*7*].

An increasing number of postgraduate programme directors have recognized these problems and are now introducing introductory courses in biostatistics and epidemiology for their trainees. These courses should ideally be focused on learning how to identify which statistical test to use in answering a particular research question, how to code data in a computer programme and how to interpret the results of a computer print-out giving details of a particular statistical test. Unfortunately the trend is to continue the conventional approach of giving didactic lectures where details of statistical concepts are discussed at length but the actual application in solving day-to-day research problems is missing. Students tend to remember very little of what is taught in these courses since the concepts are considered too abstract and detached from their clinical discipline [*8*]. Hence many trainees do not develop the essential analytical skills. Clearly there is a need for more-effective teaching methods.

The present study was conducted to evaluate these shortcomings in a tertiary care hospital. Failure of supervisors and trainees in recalling basic concepts of biostatistics and epidemiology and selection of the correct statistical procedure in data analysis have raised serious questions about the efficacy of the traditional lecture approach in promotion of long-term learning and an appreciation of the key role of statistics in scientific research. Review of the literature on statistical teaching indicates that this problem persists even in countries where educational institutions are considered more advanced than in developing

Table 2 **Response to questions evaluating basic concepts and applications of biostatistics and epidemiology**

Question	Supervisors (*n* = 12)						Trainees (*n* = 28)						*P*-value
	Yes		No		Don't know		Yes		No		Don't know		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Do you know the difference between standard deviation and standard error?	3	25	9	75	–	–	4	14	24	86	–	–	0.410
Do you know the differences between parametric and non parametric tests?	4	33	8	66	–	–	11	39	17	61	–	–	0.505
An independent sample ***t***-test can be used to examine differences in 3 groups	5	42	3	25	4	33	4	14	8	29	16	57	0.150
Can correlational data be used to establish cause and effect relationship?	7	58	2	17	3	25	2	7	10	36	16	57	0.002
Is it correct to test for Type I error instead of Type II error in hypothesis testing?	2	17	4	33	6	50	5	18	9	32	14	50	0.995
	Correct		Incorrect				Correct		Incorrect				
	No.	%	No.	%			No.	%	No.	%			
Why do we use the ***P***-value? What is it?	8	66	4	33			10	36	18	64			0.093
What is logistic regression analysis?	2	17	10	83			5	18	23	82			1.00
What is conditional probability?	8	66	4	33			11	39	17	61			0.170
What is stratified random sampling?	5	42	7	58			12	43	16	57			1.00
What is the difference between incidence and prevalence?	11	92	1	8			21	75	7	25			0.396
How does odds ratio differ from relative risk?	3	25	9	75			11	39	17	61			0.484
What is the difference between sensitivity and specificity?	10	83	2	17			18	64	10	36			0.285

countries. Only 17% of the respondents in a survey from the United States of America reported that teaching in biostatistics was adequate [*9*]. In another American report almost 75% of the respondents admitted not having full knowledge of all statistical procedures reported in medical journals [*10*]. The conclusion from both these studies was that due to lack of statistical knowledge by the residents, greater emphasis should be placed on teaching of statistics in the residency programmes.

Our findings have raised serious questions regarding reappraisal of statistics in the curricula in medical colleges. Cobb has suggested that the primary reason for a poor grasp of statistical concepts by students is that statistics is so often taught in undergraduate and postgraduate medical institutions by staff with very little formal training in the subject [*11*]. Additionally, the methods employed have generally been found not to be very effective. To foster statistical thinking, the focus should be on how to interpret the data and also to understand the limitations of statistical inferences.

We strongly agree with Hogg that undergraduate and postgraduate medical institutions should revise their curricula with greater emphasis on statistical thinking and reasoning, more reliance on computer automation and a greater focus on concepts rather than mathematical recipes for calculations [*12*].

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