Original Article

# The Fruit of Teaching Epidemiology and Biostatistics to Undergraduate Medical Students

**Yousif A. Raheem* FICMS, CM**

**Summary:**

**Background:** All medical colleges give students courses in epidemiology and biostatistics to help them in understanding medical data and to prepare them to conduct graduate and professional research. After graduation, understanding and correct application of the principles of epidemiology and biostatistics help the physicians in making better diagnostic and management decision based on best evidence.

**Patients and Methods:** A cross-sectional questionnaire-based survey was carried out among junior (chronic resident) doctors at several hospitals in Baghdad from the 1st of January till the 31st October 2009. A total of 212 physicians answered the questionnaire which covered demographic characteristics, average score of graduation, number of published or accepted to publish researches, reading health/medical journals, understanding the methods and statistical analysis of research and the answers of 25 multiple choice questions (MCQs) in basic epidemiology and biostatistics.

**Results:** No physician conducted or participated in any medical or health research. Only 19.34% of them read medical/health journals regularly, 29.72% read occasionally, and 50.94% not read. For those who read the medical/health journals regularly or occasionally (104 respondents), 42.31% not understand the methods and the statistical analysis of the researches. For those who not read (108 respondents), 61.11% blame the difficulty of the methods and statistics of researches as a main cause to flee from the journals. The mean of the MCQs exam was 62.38% (which is not very promising), more than 50% 0f the physician got score below 55%, and more over, about one third failed in the exam.

**Conclusion:** Improving our students (who will become doctors) experience of learning and knowledge of epidemiology and biostatistics courses is an urgent need to meet the evidence based transition in medicine.

**Key words:** Teaching, Epidemiology, Biostatistics, Medical students

*Fac Med Baghdad 2010; Vol. 52, No.2*
*Received Dec.,2009*
*Accepted Feb.,2010*

## Introduction:

After graduation, clinicians use and evaluate new information throughout their life. Reading literatures and conducting researches begin early in the training of health professionals and continue throughout their carrier (1). They want to apply the population based information to decision making about individual patients. To do so, they must understand the concepts of biostatistics and epidemiology which were given in courses during their undergraduate medical study (2). Moreover, as medicine has moved to become more evidence based, epidemiology and medical statistics have become ever more important and relevant both to the practice of medicine and the education of tomorrow's doctors (3). So, teaching epidemiology and biostatistics to medical students is an important primary step for establishing efficient abilities in the medical community, including the critical reading and writing of articles and the ability to base treatment on the best current evidence. These skills are important for all physicians, not just those engaged in research (4). Epidemiology is the study of the distribution of diseases in populations and of factors that influence the occurrence of disease. The objectives for students in epidemiology teaching include being collaborated on applied population health research; Interpret epidemiologic findings, effectively communicating them to lay and professional audiences, and apply them to the development of evidence-based interventions to improve population health (5, 6). Statistics is the science and art of collecting, summarizing, analyzing and interpreting data. Biostatistics is the application of statistics to biological problems (1). Statistics is an indispensable tool in epidemiology. All epidemiological studies rely on the quantification of health and disease events in populations. However, it is common for medical students to dislike and under-perform the courses involving epidemiology or statistics (7). This creates an unfortunate gap between academics teaching desire in medical college and the practitioners' performance in their fields. Health professionals (particularly doctors) have deep rooted fear of statistics. It is commonly held that statistics is an abstract science with no real life applications and that one has to have an IQ of around 140 or be a math's whiz to be able to understand statistics! The problem is often worsened by the fact that statistics is taught hardly and separately during undergraduate medical training. (8). In Baghdad, there are four medical colleges, with the same six-year program, where epidemiology and biostatistics courses taught in 4th and 3rd years respectively. The courses are given in 15 theoretical and 30 praical hours for each using the traditional, lecture approach, learning. A disadvantage of the lecture approach is that it is fundamentally subject-based rather than problem-

**Dept. of Community Medicine, Al- Kindy College of Medicine*

based; that is, the focus is on learning basic concepts, not on the process of using statistics and epidemiology to solve community problems. This would let the students to consider biostatistics as a pure mathematics and epidemiology as paramedical science. It is noteworthy to mention that we did not find any article which methodically studies the success of statistics teaching in medical colleges, moreover, reviewing the literature regarding the teaching of statistics to university students; in general, reveals equally limited findings. Very little research which systematically and meticulously examines the effectiveness of teaching epidemiology and biostatistics has been done to date (7, 9). The aim of this study is to assess the success of epidemiology and biostatistics teaching in medical colleges by investigating the ability of practicing physicians to recall and use these skills that they were taught in medical colleges, in conducting and evaluating researches and answering the questions regarding the basic concepts of epidemiology and biostatistics.

**Patients and Methods:**

A cross-sectional questionnaire-based survey was carried out among junior (chronic resident) doctors recruited from several hospitals in Baghdad from the 1st of January till the 31st October 2009. Only physicians with 3-5 years duration after graduation were included. Data were collected by especially designed questionnaire prepared by the researcher and approved by an expert panel in public health. A total of 212 physicians answered the questionnaire which covered demographic characteristics (age, gender and residence), college graduation score, and questions about number of published or accepted to publish researches, reading health/medical journals, and understanding the methods and statistical analysis of research. In order to provide an objective evaluation for epidemiological and statistical knowledge, 25 multiple choice questions (MCQs) were selected from The United States Medical Licensing Examination (USMLE) textbook (Epidemiology and Biostatistics for the USMLE) (10). The 25 MCQs which test the basic information (disease measurement, study designs, statistical methods and their clinical significance in contemporary medical practice) were selected, and 25 minutes time was allowed to each physician for answering the MCQs. Data was entered and analyzed by MINITAB 13 statistical program. Analysis was done by using;

1- Descriptive statistics (tables & frequencies)

2-Inferential statistics (Chi Square test & one way ANOVA test), P-value <0.05 considered to be statistically significant.

**Results:**

Basic demographics*:* The mean (± SD) age of the respondents was 26.5 (± 1.8) years with 3-5 years duration in their job (after graduation). 59.9% of them with medium score graduation. About two third (68%) of them were male. All of the physicians had graduated from the capital medical colleges (Baghdad, Al Kindy, Al Mustanserria, And Al Nahrain medical colleges). About 98% of them were live in Baghdad, Table (1) Research performance: Unfortunately, no physician conducted or participated in any medical or health research. Only 19.3% of them read medical/health journals regularly, 29.7% read occasionally, and 50.9% not read. The difference is statistically highly significant regarding the graduation score, Table (2) For those who read the medical/health journals regularly or occasionally (104 respondents), 42.3% not understand the methods and the statistical analysis of the researches. For those who not read (108 respondents), 61.1% blame the difficulty of the methods and statistics of the researches as a main cause to flee from the journals, Table(2) MCQs results*:* The final score of MCQs exam was discouraging. Although the mean of the total sample was 62.38% (which is not very promising), more than 50% 0f the physician got score below 60%, and more over, about one third failed in the exam. The significance in mean score difference is statistically significant among groups classified as graduation score (Table 3), as well as, reading health/medical journal classification, Table 4.

**Table1: Distribution of the respondents regarding age, gender and graduation score**

| Criteria | Male | Female | Total |
|---|---|---|---|
| Sample size | | | |
| No (%) | 145 (68.40) | 67 (31.60) | 212 (100) |
| Age (years) | | | |
| Mean (SD) | 26.89 (1.46) | 25.30 (2.18) | 26.46 (1.8) |
| Graduation score | | | |
| No (%) | | | |
| Good | 16 (7.55) | 6 (2.83) | 22 (10.38) |
| Medium | 82 (38.68) | 45 (21.22) | 127 (59.90) |
| Accepted | 47 (22.17) | 16 (7.55) | 63 (29.72) |

**Table2: The answers of physicians to research questions regarding their graduation score**.

| Criteria | Graduation Score | | | Total | P value |
|---|---|---|---|---|---|
| | Good No (%) | Medium No (%) | Accepted No (%) | No (%) | |
| Conductingor participating in medical research | | | | | - |
| Yes | 0 (0) | 0 (0) | 0 (0) | 0 (0) | |
| No | 22 (100) | 127 (100) | 63 (100) | 212 (100) | |
| Reading health /medical journals | | | | | |
| Always | 14 (63.63) | 23 (18.11) | 4 (6.35) | 41 (19.34) | |
| Sometime | 5 (22.73) | 37 (29.13) | 21 (33.33) | 63 (29.72) | 0.000 |
| No | 3 (13.64) | 67 (52.76) | 38 (60.32) | 108 (50.94) | |
| | 22 | 127 | 63 | 212 | |
| Understanding the methods and statistical analysis for those always or sometime read (n=104) | | | | | |
| Always | 7 (36.84) | 9 (8.66) | 3 (12.00) | 19 (18.27) | |
| Sometime | 10 (52.63) | 22 (21.15) | 9 (36.00) | 41 (39.42) | 0.025 |
| No | 2 (10.53) | 29 (27.89) | 13 (52.00) | 44 (42.31) | |
| Total | 19 | 60 | 25 | 104 | |
| Reasons for those not read (n=108) | | | | | |
| Not interested | 1 (33.33) | 6 (8.96) | 4 (10.53) | 11 (10.19) | |
| No time | 2 (66.67) | 9 (13.43) | 13 (34.21) | 24 (22.22) | 0.122 |
| Of no value | 0 (0) | 4 (5.97) | 3 (7.89) | 7 (6.48) | |
| Not understanding the methods and statistics of research | 0 (0) | 48 (71.64) | 18 (47.37) | 66 (61.11) | |
| Total | 3 | 67 | 38 | 108 | |

**Table3: The MCQs score of the studied physician crossed by their graduation score**

| Graduation score | No | MCQs score (Mean± SD) | P value |
|---|---|---|---|
| Good | 22 | 72.64 (2.43) | 0.000 |
| Medium | 127 | 64.86 (6.88) | |
| Accepted | 63 | 48.86 (5.16) | |
| Total | 212 | 62.38 (5.66) | |

**Table4: The MCQs score of the studied physicians crossed by their habit in reading health/medical journal**

| Reading health /medical journals | No | MCQs score (mean± SD) | P value |
|---|---|---|---|
| Always | 41 | 69.14 (4.56) | 0.000 |
| Some time | 63 | 64.22 (4.43) | |
| No | 108 | 54.28 (6.12) | |
| Total | 212 | 62.38 (5.66) | |

**Discussion:**

The mission of medical college is to assist the student to become effective healthcare professionals who will apply their knowledge and skills for the benefit of their patients and communities. Collection, analyzing understanding of health data are of major importance not only in research work but also in clinical practice of medicine (11). Epidemiology and statistics are the backbone in this process. They provide opportunity for medical students to develop mature clinical judgment, and appreciation of the limitation of health system competence (6). Our ultimate goal as teachers is, for our students, to use biostatistics and epidemiology properly in their daily practice of medicine. Our evaluation for the physician was done immediately after finishing the clerkship (3-5 years after graduation). The junior physicians in this period use their skills and knowledge actively to prove themselves in career. They are still memorizing the theoretical and practical knowledge that they have learned in the medical college (12). The other purpose of this selection is to defeat the misconception that research work should be restricted to senior specialists and for promotion purposes only. Both senior specialists and junior colleagues should read and involve in medical research for better clinical judgment and future career. A structured questionnaire with panel discussions was used to better validate the results and good assessment. This assessment will help our colleagues, lecturers of epidemiology and biostatistics in medical colleges, to formulate a comprehensive view regarding the current status of our graduated physicians. The answers to first question were grim. None of the doctors participated in or conducted any research. Furthermore the answers of the second question revealed that only 19.34% of them read medical/health journals regularly. These results point out that the thinking of our doctors are faraway from medical researches or journals which need understanding of a physician's reasons for this avoidance as they often feel writing health or medical research is a waste of valuable time as their career preference is clinical e.g. surgery, medicine, obstetrics and gynecology…etc (13). Two reasons might be behind this feeling:

first, they don't have enough skills to write research. Secondly, they feel in a large gap between what is written in journal and current situation. Besides they recognize the motivation or promotion on research work seems unfair. This makes the doctors not interested and far from researches. About one half of the doctors read medical journal regularly or occasionally, but only 18.27% of the always understand the methods and statistical analysis of these researches and 81.73% have problem in understanding these methods. This reflect the fact that many doctors fail to understand even the basic concepts of epidemiology and statistics, which impacts negatively on their use and interpretation of medical data as well as conducting or reading research. Apparently, most of our postgraduate students, not undergraduate, contact a statistical consultant privately for help in their graduation research. This is in contrast with the growing awareness of the importance of epidemiology and statistics to current medical practice, dating back to the 1993 General Medical Council report *Tomorrow's Doctors* which recommended that medical education be required to promote 'the critical evaluation of evidence to cope the continuing evolution of health care delivery and with advances in medical technology (14). From other side we must assess the educational process in our colleges especially after the last situations in Iraq. Educational theorists have demonstrated that knowledge is recalled more easily, retained longer, and more readily applied when the process of learning corresponds to the way that the knowledge is to be used (15). The results provide indicators of motivation to change the current curriculum in teaching epidemiology and biostatistics to meet the scientific revolution in educational measurement at the university level in particular which has been moved in the last years from the paper-and-pencil learning towards the use of computer- and/or Internet-based learning using the problem based learning (PBL) methods. Medical students in a traditional didactic curriculum learn epidemiology, biostatistics, and other basic medical sciences, separately from the clinical sciences that emphasize the diagnosis and treatment of disease, whereas students in a PBL curriculum learn statistical and methodological principles by solving clinical problems. If the statistical concepts are not integrated with their discipline knowledge, it may be difficult for students to recall and apply these concepts later. It is now widely recognized that the traditional methods of teaching epidemiology and statistics, in a traditional didactic way (subject-based), are neither engages the students nor meets their needs. These methods often viewed as being ineffective because they fail to establish a clear link between theoretical lectures and their uses in the real world (16). And as a matter of prudence, it is essential to understand that epidemiology and biostatistics are integral to each other and should taught together, not separately, in undergraduate as most of student don't recognize this fact. Moreover, the involving of biostatistics and epidemiology teaching longitudinally throughout the curriculum (not only in 3rd and 4th years) will provide a certain degree of integration with clinical courses. Besides, each medical student is required to conduct an independent research, guided by a faculty member. It is in this experience that the students learn the importance and role of epidemiology and biostatistics in research. Two cohorts of students were studied, one with old style and one with new style teaching. Both were similar with respect to age, gender and previous level of statistics. Students who were taught using the new approach could better define the key concepts of p-value and confidence interval. They were more likely to regard statistics as integral to medical practice and to use it in their medical career (17). In the light of those finding, a useful question should be asked 'Why our junior doctors away from research and medical journal?' Further comprehensive studies are needed and the physician should also be specifically asked about his or her opinions to overcome this problem, as well as the lecturer in medical colleges must be properly selected in teaching epidemiology and biostatistics as most of lecturers in Iraqi medical colleges have their degrees (master, doctorate or board) in community medicine specialty not in epidemiology and biostatistics. Finally, the curriculum in medical colleges must reevaluated despite the fact that the system of graduate medical education has served the country well, but it is now necessary to reform the system to make the system more responsive to the nation's physician manpower needs.

**References:**

*1- Beth D and Robert G. Basic and Clinical Biostatistics. 4th edition, Lang Medical Book, 2004; 1-3*

*2- Jenkins T, Astin J. Medical students' perspective on teaching medical statistics. Statistics in Medicine 2001; 21:1003–1006.*

*3- Armstrong GK, Walters SJ. Discussion: does EBM offer the best opportunity yet for teaching medical statistics? Statistics in Medicine 2002; 21:979–981.*

*4- Dixon RA. Medical statistics: content and objectives of a core curriculum for medical students. Medical Education 1994; 28:59–67.*

*5- Gordis L. Epidemiology. 2nd ed. Philadelphia, PA: W. B. Saunders, 2000.*

*6- Olsen J, Saracci R, Trichopoulos D, eds. Teaching epidemiology, a guide for teachers in epidemiology, public health and clinical medicine. 2nd ed. New York, NY: Oxford University Press, 2001.*

*7- Windish DM, Huot SJ, Green ML. Medicine Residents' Understanding of the Biostatistics and Results in the Medical Literature. Journal of American Medical Association. 2007; 298:1010–1022.*

*8- Nigel Bruce, Daniel Pope and Debbi S. Quantitative Methods for Health Research John Wiley & Sons Ltd. 13th edition 2008.*

*9- Becker BJ. A look at the literature (and other resources) on teaching statistics. Journal of Educational and Behavioral Statistics 1996; 21:71–90.*

*10-Edward J. Gangadhar M, Epidemiology and Biostatistics for the USMLE. Appleton& Lange 1994.*

*11-David P. ABC of learning and teaching in medicine BMJ 2003;326:268-270*

*12-Ambrosius WT, Manatunga AK. Intensive short courses in biostatistics for fellows and physicians.* Statistics in Medicine. *2002; 21:2739–2756.*

*13-Dorsey ER, Jarjoura D, Rutecki GW: The influence of controllable lifestyle and sex on the specialty choices of graduating U.S. medical students, 1996-2003. Acad Med 2005, 80:791-6.*

*14-Sackett DL, Rosenberg WM, Gray JA, Haynes RB, Richardson WS. Evidence-based medicine: what it is and what it isn't. BMJ 1996;312:71-2.*

*15-Straus SE, Green ML, Bell DS, Badgett R, Davis D, Gerrity M, et al. Evaluating the teaching of evidence based medicine: conceptual framework. BMJ 2004; 329:1029-32.*

*16-Amir Herman, Netta Notzer, Zipi Libman, Rony Braunstein and David M. Steinberg. Statistical education for medical students-Concepts are what remain when the details are forgotten Statist. Med. 2007; 26:4344–4351*

*17-Jenny V Freeman, Steve Collier, David Staniforth, and Kevin J Smith Innovations in curriculum design: A multi-disciplinary approach to teaching statistics to undergraduate medical students.*