



Teaching Biostatistics to Undergraduate Saudi Medical Students

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ABSTRACT

Background:

The knowledge and ability to use biostatistical techniques have become increasingly important in management of data and interpretation of results of different of studies related to health sciences. Understanding biostatistical methods may improve clinical thinking, decision making, evaluations, medical research and evidence based healthcare. Unfortunately, there is an increasing gap between medical students and mathematical notations usually part-and-parcel of medical and biostatistics. Lack of connection between medical curricula and introductory courses in statistics has negative attitude among medical students. This study is aimed at evaluating the effect of a new teaching method (which is based on a mix of theoretical concepts and its applications using computer facilities) in teaching biostatistics to undergraduate medical students in a Saudi Faculty of Medicine, and to measure the students' ability to understand the results of the statistical tests of the computer output and interpret them in meaningful texts.

Methods:

A new method of teaching biostatistics based on teaching theoretical concepts and application of the lectures using a real clinical dataset using PC-SPSS software. The results of this new teaching method was compared to the conventional method (based on lectures and scientific calculations) in two classes in two academic years.

Results:

Students in the two classes were 114 students; each class had 57 students. The new method's class scored significantly higher than those who were taught using the traditional method in the following topics: measures of variability, confidence intervals testing hypothesis, t-test, Analysis of Variance (ANOVA), multiple linear regression and data presentations. Writing and interpreting the results showed borderline statistical difference between the two methods. Mean satisfaction scores for the students toward biostatistics were significantly higher for the new method than the traditional one ($p < 0.05$).

Conclusion:

Teaching biostatistics for medical students should avoid calculations. Using computer software is recommended for analysis of real medical data.

KEYWORDS : Teaching, Biostatistics, Medical Students, Saudi Arabia, Curriculum

Introduction:

Medicine is based on scientific knowledge, and the need for applying such knowledge to medical and health problems increases day by day⁽¹⁾. The knowledge and ability to use biostatistical techniques have become increasingly important in health sciences. Understanding biostatistical methods may improve clinical thinking, decision making, evaluations, medical research and evidence based medicine. Biostatistics is considered as essential tool in planning and delivering healthcare systems^(2,3). There are many challenges in teaching statistics to medical students and convincing them that it is interesting; challenging and relevant to medicine, helps explaining many health related problems, and making appropriate inferences. Many reasons could be blamed for increasing the gap between medical students and biostatistics as statistical theories are technical in nature and mathematical notations are too mathematical. No connection seems apparent between medicine and introductory courses in statistics which results in a negative attitude among medical students specially that it is usually one of the core requirements they need to study⁽⁴⁾. Besides, many students feel that biostatistics is uninteresting, dry and not relevant to their practices⁽⁴⁾. West and Ficalora (2007) mentioned that improving teaching of biostatistics has been slightly improved and physicians think that both research and clinical practice are helpful in improving bio statistical teaching⁽⁵⁾. Saudi medical students seems to have the same attitude towards bio statistical courses, same as medical students worldwide. The majority of them believe that there is no need for this course in the medical school and that they would hardly use it in their future. For this reason, a real need for a new method of teaching biostatistics for medical students was provided.

Curriculum

The curricula in medical colleges have a provision of teaching biostatistics to both undergraduate and postgraduate medical students. In the Faculty of Medicine, King Fahad Medical City, Saudi Arabia, biostatistics used to being taught in the second semester during the third year along with basic medical sciences courses and just before the clinical years. Teaching biostatistics course was based on conventional methods of teaching, by delivering theoretical lectures to the students for two hours per week for 14 consecutive weeks with home-

work's and a midyear examination followed by a final examination at the end of the semester, accordingly. Calculations needed to solve problems in the entire course were done using scientific calculators.

Saudi medical students- as any medical students- don't like any type of calculations and mathematics in their studies. Most of them did this course just to pass it, as it is part of their core courses, but they rarely understood its concepts and if some of them understood it, they think they may never use it in their medical practice. Because of that, a new approach based on both understanding theoretical background of biostatistics and making use of the availability of both computers' hard and software facilities in teaching biostatistics was experimented.

Objectives:

The objectives of this study were to:

- 1- Evaluate the effect of a new teaching method (based on a mix of theoretical biostatistics and its applications using computer facilities) in teaching biostatistics to undergraduate medical students in the Faculty of Medicine, King Fahad Medical City.
- 2- Measure the students' ability to understand the results of the statistical tests of the computer output and interpret them in meaningful texts.

Methodology:

Fourth year medical students' class in 2010-2011 was used as a control group. They were taught biostatistics using traditional methods through lectures; homework assignments using calculations, besides a mid-term and final examination. The traditional class (2010-2011) had two hours of lecturing per week for 14 weeks, a mid-term examination in the 7th week, two practical home works, and a final examination in the 15th week. A proposal was submitted to the Curriculum Committee to use a new method to teach these students during the academic year 2011/2012. After the agreement of this committee, the 2011-2012 class experienced the new methods; i.e. using short introductory lectures for 20- minutes each and of the rest of the lecture's time (30 minutes) applications on the topic using computer software were introduced, accordingly. In both classes, a pre- test of the previ-

ous basic knowledge on biostatistics was done before the first session in order to determine the best way of teaching necessary to increase the students' understanding of the course topics. The new method of teaching was based on delivering the same topic in each week similar to the topic which has been delivered for the 2010 class in the exact corresponding week as per academic calendar week. These topics were: introduction to biostatistics, descriptive statistics: measures of central tendency and measure of variability, basic probability concepts and sampling distributions, estimation, normal distribution, testing hypothesis, simple linear regression, correlation, chi- squared distribution and data presentations.

For the new method; (2011-2012) class, the same bio statistical topics were taught in the same sequence in the traditional methods, in addition a one hour lecture on how to use SPSS software for data entry and analysis. The students were provided a real medical data set to use it in their applications. The rest of the 13 lectures covered the same topics during the same corresponding weeks as has been delivered in the traditional method (2010) class.

A mid- term examination, two in class exams and final examination were used the same way as in the traditional class except that the problems had to be solved using SPSS. Besides, reading, understanding and interpreting the output of SPSS statistical package output was an expected outcome of the teaching method.

At the end of the course in both methods, students had to give their feedback about the course and their satisfaction regarding it.

With respect to homework assignments, both mid- term and final exams were done. Similar problems have been used for evaluation purposes. For the traditional class, the necessary totals and averages have been provided to the students as appropriate in order to finish solving the problem on time. In the new method, the raw data have been provided to the students in order to entered and analyzed and solve the problem accordingly.

Statistical Analysis:

For the purpose of this study, data were entered and analyzed using SPSS version 17.0. Descriptive statistics were used. Mean and standard deviation were calculated for quantitative variables, while frequencies and percentages were computed for qualitative variables. The t- test was used to compare the results between the two groups. The level of statistical significance was set to be < 0.05 throughout the study.

Results:

The results of this study showed that no statistically significant difference between the total grades of the pretest between the two classes (class 2010 and 2011). Table 1 shows the new method's class scored significantly higher than those who were taught using the traditional methods in the following topics: measures of variability (p< 0.001), confidence intervals (p=0.046) testing hypothesis (t- test and Analysis of variance ANOVA (p< 0.001), multiple linear regression (p<0.001) and data presentations (p<0.001). Writing and interpreting the results showed borderline significant between the two methods results (p =0.05).

The results showed no statistically significant differences between both methods with respect to each of the following topics: variables (traditional class results scored slightly better than the new class (p=0.9), the same results were noticed with measures of central tendency usages and calculations (p=0.41), simple linear regression (p=0.9) and both writing and interpreting the obtained results between the two classes (p=0.05).

There were 36 (63.2%) students of the 2010-2011 who reported that they were satisfied with the course, while in 2011-2012 students 50(87.7%) were satisfied with the course (p=0.001). When they were asked if they thought that the course is needed for medical students; 51(89.5%) of the students in the traditional group mentioned that there was no need for that course in the medical curriculum, while only 11 (19.3%) % of the 2011-2012 students had the same feeling (p < 0.001). With respect to mean satisfaction scores, students who had the new method scores significantly higher than those had the course in the traditional methods (p<0.001).

Discussion:

Teaching statistics for undergraduate medical students is a challenge. Medical students are generally focused towards the study of medicine and basic sciences and have no or little desire of learning biostatistics. The results of this study show no difference in the final results and between students' scores with respect to the topics which did not need heavy calculations, especially measures of central tendency, since most of them know how to calculate during their high school studies (5, 6).

As the topics become advanced and/ or need more calculations, the new method showed higher students' scores compared to the traditional one, which may be explained by the fact that computers perform faster and more accurate calculations. Students' satisfaction significantly improved with the use of the new method.

The students who were taught using the new method showed higher satisfaction with the course compared to those who studied it in the traditional method. This outcome concurs with the results obtained by Lee in Korea (2001) who mentioned that those who used computer based courses had higher scores and higher performance than those who were taught using traditional methods⁽⁷⁾.

Teaching students using computer software with real medical data makes it more relevant and easy to understand than traditional methods as Bahn reported in his study⁽¹⁾ ensure better understanding and satisfaction by the medical students, while learning and applying biostatistical techniques and methods⁽⁸⁾.

Conclusion and Recommendations:

Hand calculations should be avoided as much as possible.

Computer based approach with real medical data sets should be introduced in teaching Biostatistics in medical curricula.

Biostatistics and research methodology courses are recommended to be taught at the end of basic sciences' courses and just before clinical years in medical schools.

Table 1: Comparison between students' grades in the new and traditional teaching methods, Riyadh, 2012

Biostatistical Topic	New Method (n=57) Mean ± sd	Traditional method (n=57) Mean± sd	P value
Variables	7.3 ±1.1	7.5±1.9	0.9
Measures of central Tendency	9.2± 0.7	9.1± 0.6	0.41
Measures of Variability	9.1 ± 0.9	7.2 ± 1.5	<0.001
Confidence Interval	9.3 ± 1.2	8.9 ±0.9	0.046
Hypothesis testing (t- test and ANOVA)	8.1 ± 1.7	7.3 ± 2.5	0.048
Analysis of Frequency data (Chi- Square)	9.4± 0.5	7.7 ± 2.3	<0.001
Simple Linear Regression & Correlation	8.5 ±0.4	8.9 ± 2.1	0.9
Multiple Linear Regression	9.5 ±0.4	6.3 ± 2.1	<0.001
Writing and interpret the results	8.5 ±2.1	8.3 ± 1.3	0.05
Data Presentations	9.5 ±0.4	8.3 ± 1.3	<0.001
Mean satisfaction scores	8.6±0.9	5.6± 1.5	<0.001

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