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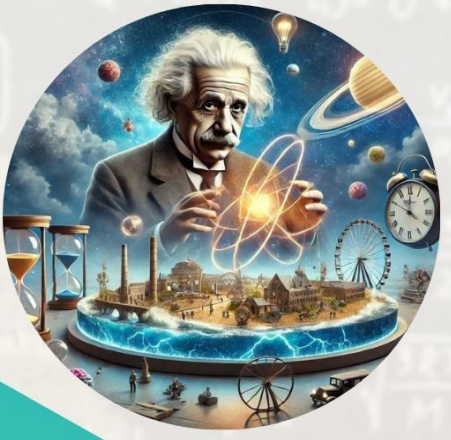

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# The familiarity with and outlook on the principles of biostatistics and research methodology among resident physicians

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## ABSTRACT

The purpose of this study is to evaluate medical residents' familiarity with and perspective on research methods and biostatistics. Our methodology included a cross-sectional investigation that took place at King Abdulaziz University Hospital in Jeddah, Saudi Arabia, from November 2014 to October 2014. All participants were given a self-administered questionnaire. There was a 90% response rate. The survey yielded 122 valid responses from locals. Over half of the locals felt comfortable evaluating the findings of scientific articles, and the majority had a good grasp of fundamental ideas including "P" values, study power, and case control studies. In contrast, almost 67% of the locals lacked understanding of more complex biostatistical concepts. Not only did non-specialist residents ($p=0.003$) but also residents with prior training in evidence-based medicine ($p=0.05$) had significantly higher likelihood of having superior knowledge scores. In both instances, those with prior expertise in epidemiology and biostatistics, as well as females ($p=0.003$), had a favorable attitude toward biostatistics ($p<0.001$). Compared to residents who never read journals, those who read medical journals had worse scores ($p=0.001$).

## Introduction

showed that male gender and having taken EBM classes before were related with higher knowledge ratings. There has to be more training for future doctors that combines biostatistics with epidemiology and research techniques after they finish medical school. Studying statistics within the framework of biological science is known as biostatistics or medical statistics.To rephrase, it is a subfield of statistics concerned with the statistical aspects and data pertaining to health, illness prevention, and medical care.Evidence-based medicine (EBM) relies on biostatistics, yet undergraduates learn the subject with a heavy focus on theory and not enough on its practical applications. So, physicians need to continue their education in biostatistics after finishing medical school since they do not have a solid foundation in the field.3 Students in the Kingdom of Saudi Arabia are expected to complete a year-long pre-med course that includes medical biostatistics. There were 29 medical schools in the Kingdom of Saudi Arabia in 2014, with 20 being non-profit and 9 being private. Every year, these institutions welcome around 6,000 new students. Most of these schools don't spend much time studying epidemiology and biostatistics, which discourages students from pursuing careers in research. One possible explanation is that medical students and practitioners have a strong desire to practice medicine, but not a strong enough desire to learn biostatistics or other related fields. Students also differ in their mathematical interest, knowledge, and aptitude. As a result, doctors seldom really learn statistical procedures and end up being less effective researchers.4 More student participation in research increases the likelihood that they will get the necessary information.5 One probable explanation for medical students' lack of proficiency in statistics is that the course was unique compared to others offered during their time in medical school.6 In contrast to biostatistics and epidemiology, where students need a competent instructor to make sense of complex ideas, medical students may usually study up on diseases and medical problems on their own. Finding out how much resident doctors know and think about biostatistics and research methods is the primary goal of this study.
Methods. From November 2014 to October 2014, a cross-sectional survey was carried out. We decided to carry out this research at King Abdulaziz University Hospital in Jeddah, Kingdom of Saudi Arabia. All Saudi nationals enrolled in any level or specialty of the seven medical schools that make up the Saudi Commission for Health Specialties training programs make up the study population. The individuals chosen for the study were selected using a convenience sampling technique. Exclusion criteria included graduates who did not finish their internship and residents who were affiliated with academic institutions as protestors.

Prior to inclusion, all participants were apprised of the research's purpose and were asked to provide their permission. Additionally, they were told that their answer would be kept anonymous. This study was approved by the hospital's research and ethical council at King Abdulaziz University.

Based on the research of Windish et al.3, we used a self-administered questionnaire. Nevertheless, our survey went a

step further by including four questions designed to gauge the respondent's level of engagement with research and publication. The appropriate author was contacted via email to seek permission to use the questionnaire. A variety of statistical tests, from the most basic (chi-square, 't' test, and analysis of variance [ANOVA]) to the most complex (multivariate logistic regression and Cox proportional hazards regression), were included in the survey. The following parts were used to organize the questionnaire: There were fourteen questions designed to gauge demographic information, such as participants' ages, genders, levels of education, experience with biostatistics and evidence-based medicine (EBM) coursework, research participation, and journal reading habits. There were also five questions designed to gauge participants' attitudes toward statistics, four questions designed to gauge their confidence in interpreting and evaluating statistical concepts, and twenty questions designed to test their knowledge of biostatistics and research methods. Each question in the test had a possible score of 100 points, with five points awarded for each subject area.3 The survey is accessible online, legitimate, and dependable.3

Participants were asked to fill out the surveys on their own time by the researchers. There was a thirty-minute time limit. The day of collection for all questionnaires was uniform. Due to the one-month duration of the research, there was no chance of contamination (information bias) in the results. Only at the conclusion of the whole research time were the most important responses and comments provided. In accordance with the principles outlined in the Helsinki Declaration, all ethical issues were adhered to. Number crunching. For this study, we used IBM SPSS Statistics for Windows version 20, developed by IBM Corp. of Armonk, New York, USA, to input and analyze the data. All variables were subjected to descriptive statistics.Frequency (%) and mean (standard deviation) are the ways the results are presented in item 7. When comparing the means of two continuous variables, we used a student t-test, and when assessing the relationship or difference between categorical variables, we used a chi-square test. The researchers used a multiple linear regression model to determine which variables best predicted the average knowledge scores. A 2-tail probability of '$p<0.05$' was used to establish statistical significance.

Final product. Out of 180 residents who were asked to participate, 162 (or 90%) actually took part. The majority of the volunteers, who were typically 30 years old or younger, were male. Nearly all of the participants were Saudi nationals, and more than half had just completed medical school within the last year. Internal medicine and surgery were the two most general areas of expertise for the doctors. Less than 10% of the people surveyed were not specialists in the field. Not only that, forty percent of the doctors said they've taken a biostatistics or epidemiology class; thirty-seven percent said the same about evidence-based medicine; and ten percent or fewer said they read medical publications.

Over half of those who took the survey were sure they could understand and apply fundamental research principles including case control studies, study power, and 'P' values. On the other side, the more technical words were foreign to almost 67% of the people who took the survey. Additional research revealed that women tended to see biostatistics in a more favorable light ($p=0.003$; Table 1), whereas men fared better on a test measuring their familiarity with biostatistics-related terminology ($p=0.006$; Table 2). Furthermore, residents who did not specialize in biostatistics had a similar attitude to their colleagues from other disciplines, although they were more informed overall ($p=0.003$). Both male and female physicians who had previous experience in epidemiology and biostatistics had a favorable attitude towards biostatistics ($p<0.001$). There was no statistically significant difference in views toward EBM courses between doctors who had never attended one and those who had, while doctors who reported having attended an EBM course were more likely to have higher scores ($p=0.05$). There was a statistically significant difference between the views of physicians who read medical journals and their colleagues who reported never reading journals ($p=0.22$), and a lower score for physicians who read journals compared to those who never read journals ($p=0.001$).Table 3 shows that knowledge scores were linked with gender, previous courses in biostatistics and EBM, and multiple linear regression analyses.

Discussion. Our research demonstrated that, likely due to a lack of training, the resident doctors who made up our target audience did not have the biostatistics expertise necessary to understand and apply the majority of the findings reported in the medical literature. Among those who took the survey, over 50% said they had no background in biostatistics, epidemiology, or evidence-based medicine. during their time spent studying medicine at the postgraduate level. It is conceivable that not even those who received biostatistics instruction in their college years were able to solidify this information in their professional lives. Even more concerning is the fact that a large percentage of resident doctors in this research did not read medical publications, suggesting that physicians lacked interest in and understanding of biostatistics. Consistent with previous research, we found that resident doctors had some understanding of p-values, results interpretation, study power, and case control studies.WHO said in a study that doctors

**Table 1 -** Attitudes toward biostatistics and research methods by participant characteristics.

| Characteristic | Attitude | | Chi-square | *P*-value |
|---|---|---|---|---|
| | Negative | Positive | | |
| ***Age*** | | | | 0.007 |
| ≤30 years | 25 (19.2) | 105 (80.8) | 7.28 | |
| >30 years | 0 (0.0) | 32 (100) | | |
| ***Gender*** | | | | 0.003 |
| Male | 25 (20.2) | 99 (79.8) | 9.06 | |
| Female | 0 (0.0) | 38 (100.0) | | |
| ***Nationality*** | | | | 0.79 |
| Saudi | 23 (15.2) | 128 (84.8) | 0.07 | |
| Non-Saudi | 2 (18.2) | 9 (81.8) | | |
| ***Years after graduation*** | | | | |
| 1 | 20 (19.0) | 85 (81.0) | | |
| 2 | 5 (16.1) | 26 (83.9) | | |
| 3 | 0 (0.0) | 16 (100.0) | | |
| 4 | 0 (0.0) | 10 (100.0) | 5.81 | 0.12 |
| ***Specialty*** | | | | 0.18 |
| Family medicine | 0 (0.0) | 14 (100.0) | | |
| Surgery | 5 (15.2) | 28 (84.8) | | |
| Non-specialist residents | 4 (36.4) | 7 (63.6) | 7.59 | |
| Internal medicine | 11 (19.0) | 47 (81.0) | | |
| Pediatrics | 2 (9.5) | 19 (90.5) | | |
| Obs/Gyn | 3 (12.0) | 22 (88.0) | | |
| ***Previous courses in biostatistics*** | | | | <0.001 |
| Yes | 0 (0.0) | 70 (100.0) | 22.49 | |
| No | 25 (27.2) | 67 (72.8) | | |
| ***Previous course work in epidemiology*** | | | | <0.001 |
| Yes | 0 (0.0) | 69 (100.0) | 21.93 | |
| No | 25 (26.9) | 68 (73.1) | | |
| ***Previous courses in EBM*** | | | | 0.07 |
| Yes | 7 (9.7) | 65 (90.3) | 3.24 | |
| No | 18 (20.0) | 72 (80.0) | | |
| ***Reads medical journals*** | | | | 0.22 |
| Yes | 25 (16.2) | 129 (83.8) | 1.54 | |
| No | 0 (0.0) | 8 (100.0) | | |

Obs/Gyn - obstetrician/gynecologist, EBM - evidence-based medicine

| Covariant | β | t-test | *P*-value |
|---|---|---|---|
| Gender* | -4.75 | -2.70 | 0.008 |
| Age | -0.84 | -0.36 | 0.720 |
| Nationality | -0.79 | -0.25 | 0.800 |
| Specialty | -4.05 | -1.56 | 0.120 |
| Years after graduation | -3.68 | -1.88 | 0.060 |
| Previous courses in epidemiology | 6.07 | 1.88 | 0.060 |
| Previous courses in biostatistics† | 7.04 | 2.28 | 0.030 |
| Previous courses in evidence-based medicine‡ | -13.94 | -4.65 | <0.001 |
| Reads medical journals | 5.05 | 1.40 | 0.150 |

$r^2$=0.24. *0 - male, 1 - female, †0 - yes, 1 - no, ‡0 - yes, 1-no

**Table 2 -** Mean knowledge scores in biostatistics and research methods by participant's characteristics.

| Characteristic | Knowledge | | |
|---|---|---|---|
| | Mean score | t-test | *P*-value |
| ***Age*** | | | 0.88 |
| ≤30 years | 23.75 | -0.15 | |
| >30 years | 24.06 | | |
| ***Gender*** | | | 0.006 |
| Male | 25.00 | 2.77 | |
| Female | 19.86 | | |
| ***Nationality*** | | | 0.25 |
| Saudi | 24.07 | 1.15 | |
| Non-Saudi | 20.45 | | |
| ***Years after graduation*** | | | 0.25 |
| 1 | 23.13 | | |
| 2 | 27.09 | 1.39 | |
| 3 | 23.13 | | |
| 4 | 22.00 | | |
| ***Specialty*** | | | 0.003 |
| Family medicine | 20.36 | | |
| Surgery | 22.03 | | |
| Non-specialist residents | 35.45 | 3.85 | |
| Internal medicine | 23.45 | | |
| Pediatrics | 22.86 | | |
| Obs/Gyn | 24.60 | | |
| ***Previous courses in biostatistics*** | | | 0.83 |
| Yes | 23.62 | -0.21 | |
| No | 23.97 | | |
| ***Previous course work in epidemiology*** | | | 0.94 |
| Yes | 23.75 | -0.08 | |
| No | 23.87 | | |
| ***Previous courses in EBM*** | | | 0.05 |
| Yes | 25.56 | 1.96 | |
| No | 22.44 | | |
| ***Reads medical journals*** | | | 0.001 |
| Yes | 23.09 | -3.34 | |
| No | 32.92 | | |

Obs/Gyn - obstetrician/gynecologist, EBM - evidence-based medicine

**Table 3 -** Multiple linear regression model for covariates predicting mean knowledge scores in biostatistics and research methods.

## Discrussion

P-values and chi-square tests were common terms that the students were aware with. On the flip side, our study's participants lacked knowledge of more complex concepts like analysis of variance (ANOVA), sample size (SST), and odds ratio. This is not unexpected considering the dearth of continuing education opportunities for postgraduate students and the general disincentive against physicians engaging in research. Males had higher mean scores on measures of knowledge and positive attitude, which may be attributable to gender-specific instruction in the first years of medical school. While we did detect a correlation between gender and expertise in evidence-based practice, other researchers have shown no such thing.9 Knowledge scores were much higher among respondents with prior exposure to EBM courses compared to those without. Further, we discovered that doctors' generally favorable views of research's significance were significantly associated with their prior coursework in epidemiology and biostatistics. Respondents' views were unaffected by prior EBM coursework or journal reading habits, however. High knowledge scores were significantly predicted by prior EBM courses and being male. A previous research found the same thing when they looked for five factors that might predict knowledge scores: gender, years since medical school graduation, advanced degrees, prior biostatistics training, and years since medical school graduation.The results of the knowledge exam were lower for three residents who had taken biostatistics classes before. This is in line with a similar finding in a study that indicated that practitioners' research talents and skills are not likely to be improved by taking independent biostatistics courses.5 On the other side, physicians' research skills and patient care choices will be favorably impacted by the integrated approach of biostatistics, epidemiology, and research methodologies.10,11 There was a strong correlation between specialty and knowledge scores; residents who did not specialize in a particular field performed the highest. This could be because generalist residents are under more scrutiny and have a broader range of patients to handle, which forces them to stay up-to-date on medical research. An earlier research found the same thing: that senior residents did worse than younger doctors. The author hypothesized that this discovery may have resulted from either a lack of reinforcement or a gradual erosion of prior knowledge.3 The significance of including biostatistics, epidemiology, and EBM courses into the curriculum at all levels is emphasized by this research. Encouraging residents to take classes in biostatistics or epidemiology and conduct many studies is a good idea.

## conclusion

Furthermore, a recognized set of guidelines should be in place to assist locals in carrying out accurate studies. Yet, difficulties are to be anticipated, as a recent systematic study demonstrated the difficulty of implementing such programs and the ineffectiveness of several journal clubs and EBM curricula.12 This emphasizes the need for new interactive, integrated, and self-directed strategies, such as incorporating practical multi-task research into medical school curricula to promote frequent journal reading among doctors. Take the Saudi commission for health specialties as an example. During training years, the scientific committees of different specialties can implement a strategy that encourages residents to conduct research. This can be achieved by introducing courses in biostatistics, epidemiology, and research methods, which are currently not taught in many specialties. Regrettably, present procedures offer nothing to encourage residents, particularly those who have already completed medical school, to further their education in biostatistics and EBM.14

We cannot generalize our findings since the research was limited to one training location and used a convenience non-probability sampling approach.

Final thoughts: being male and having taken EBM classes before were factors in higher knowledge scores. Biostatistics education should not end with the first year of medical school; rather, it should be an ongoing component of every doctor's toolbox. As a result, training shouldn't end with medical school graduation. More effort should be devoted to merging biostatistics and epidemiology, with an emphasis on the pragmatic components of research—the bedrock of conventional medical care—because

of the significance of statistical approaches in research. Male resident doctors may have a better knowledge score in biostatistics and research methods, but this conclusion has to be further investigated.

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