Understanding biostatistics: A study of Nigerian dental resident doctors

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Abstract

Background: Central to the process of keeping current with clinical information in dentistry is the ability of a practitioner to evaluate the reliability and validity of current scientific evidence. Pertinent to this is a basic understanding of statistics. The level of understanding of biostatistics has not been reported among Dental resident doctors in Nigeria. **Aim:** The purpose of this study was to evaluate dental residents' understanding of biostatistics and the interpretation of research results. **Materials and Methods:** This was a study carried out among dental resident doctors who attended the revision course organized by the Faculty of Dental Surgery, National Postgraduate Medical College of Nigeria in March 2013. A cross-section of dental resident doctors at the Lagos University Teaching Hospital was also included in the study. Data collected through a self-administered questionnaire included demographic characteristics of the residents, their attitudes toward statistics, and their confidence about interpreting and assessing statistical concepts. Residents' knowledge of statistics was also tested by asking some basic statistical questions. **Results:** Eighty-one respondents completed the questionnaire. About two-third (66.7%) had taken a course in epidemiology; and 60.5% had taken a course in biostatistics. Only a quarter (25.9%) of respondents could correctly identify that "lower facial height in centimeters" as a continuous variable, and 23.5% thought that centimeters was a nominal measure of facial height. "Facial asymmetry classified as none, moderate, severe" was correctly identified as an ordinal variable by only a third (35.8%) of the respondents. Two keys to the highest level of evidence in a study are blinding and controls. Sixty-eight percent of the respondents correctly identified that this avoids observer and subject bias. However, only about one-fifth (22.2%) correctly identified that a $P > 0.05$ (not statistically significant) indicates at least a 1-in-20 chance occurrence. Overall, respondents' knowledge of biostatistics was low, with only 29% of the item answered correctly. **Conclusion:** Most residents in this study lack the knowledge in biostatistics needed to interpret many of the results in published clinical research. Because clinicians need to have such skills to engage in evidence-based practice, every effort needs to be made to include effective training in biostatistics during undergraduate and residency training programs.

Key words: Biostatistics, residents, understanding, scientific, evidence-based and dentistry

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INTRODUCTION

Dental surgeons know that evidence-based practice involves an ongoing process of keeping current with clinical information in their field and in medicine in general. Central to this process is the ability of a practitioner to evaluate the reliability validity of current scientific evidence. The American Dental Association's Center for Evidence-Based Dentistry recommends that practitioners use the highest level of evidence available for the current best evidence for a specific clinical question.[1,2] An important step in accomplishing this is the ability to critically appraise the literature.[3,4] Thus one cannot take the literature at face value and side step the necessary critical appraisal process. Pertinent to this is some understanding of statistics. It is doubtful if one who does not understand biostatistics can critically understand and appraise the literature. In a study

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carried out by Best and Laskin[5] among oral and maxillofacial surgery residents revealed that residents lack knowledge in biostatistics and the interpretation of research and are thus not adequately equipped to interpret the results of published clinical research. Therefore, they recommend that residency programs should include effective biostatistical training in their curricula to prepare residents in evidence-based dentistry.

Little is known about dental residents' ability to understand statistical methods or to appropriately interpret research outcomes. The purpose of this study was to evaluate dental residents' understanding of biostatistics and the interpretation of research results.

MATERIALS AND METHODS

Study Design

This was a cross-sectional study among Dental Resident Doctors who attended the biannual update course for resident's at all postgraduate levels of training all over Nigeria with the center at the Lagos University Teaching Hospital (LUTH) Lagos Nigeria to determine the current level of their understanding of biostatistics.

Sampling Method

A stratified sampling method was employed for recruiting the subjects into the study. This is a sampling technique in which the population is divided into homogeneous strata, and a simple random sampling was selected from each stratum. This was done by segregating the population into junior residents and senior residents so that an approximate number of each stratum can be achieved.

Survey Instrument

The questionnaire used was a modified form of Best and Laskin questionnaire.[5] This involved sections devoted to identifying demographic characteristics of the residents, the methodology courses they may have taken previously, their attitudes about statistics, and their confidence about interpreting, and assessing statistical concepts. Their knowledge of statistics was also be tested by asking some simple but relevant statistics questions.

Data Management

Data entry, cleaning, validation and analysis were done using Statistical Package for Social Sciences (IBM SPSS) version 20. Univariate and bivariate statistical techniques including mean, frequency distribution, proportion, and chi-square was employed. All tests were carried out at the 5% significant level.

Ethical Consideration

Ethics approval was obtained from the Health and Research committee of LUTH, Lagos. Verbal consent was also obtained from each participant after providing a description of the survey's purpose.

RESULTS

Characteristics of Respondents

Eighty-one respondents were involved in this study. Table 1 displayed the demographics of the population. The mean age ± SD of the respondents was 31.9 ± 5.3 years. A larger percentage was male respondents (54.3%) and majority of them (63%) were between 26-35 years. About two-third (66.7%) had taken a course in epidemiology; 60.5% had taken a course in biostatistics and 59.3% in evidence-based dentistry [Table 2].

Attitude and Confidence

Table 3 shows the response to some questions on biostatistics. Virtually all the respondents agreed that it is necessary to know something about statistics to be an intelligent reader of the literature. More than a quarter (29.6%) of them claimed to understand almost all of the statistical terms they encounter, but 58% disagreed with this claim. Less than half of the respondents (46.9%) said that they used statistical information in their decision making and about a quarter (22.2%) professed to distrust statistics [Table 3]. However, 66 (81%) of the respondents would like to learn more about statistics.

Table 1: Characteristics of interns and residents (*N* = 81)

Characteristic	Frequency	Percentage
Gender		
Male	44	54.3
Female	37	45.7
Age in years		
21-25	3	3.7
26-30	29	35.8
31-35	21	25.9
36-40	17	21.0
41-45	11	13.6
Degrees*		
DDS	21	25.9
MSc	2	2.5
MPH	2	2.5
Other	13	16.0
Years since dental school graduation		
<1	17	21.0
1-2	2	2.5
3-4	9	11.1
5-7	19	23.5
>=8	34	42.0
Current level of training		
Intern	17	23.6
Second-year resident	11	15.3
Third-year resident	16	22.2
Fourth-year resident	15	20.8
Fifth-year resident	9	12.5
Sixth-year resident	4	5.6

**Multiple response*

Table 2: Prior preparation and ongoing education (*N* = 81)

Characteristic	Frequency	Percentage
Ever taken a course in epidemiology?		
Yes	54	66.7
No	27	33.3
If yes, during what part of your education?		
College	9	11.1
Dental school	40	49.4
Residency	13	16.0
Other	4	4.9
Ever taken a course in biostatistics?		
Yes	49	60.5
No	32	39.5
If yes, during what part of your education?		
College	7	8.6
Dental school	29	35.8
Residency	12	14.8
Other	6	7.4
Ever had a dental school course in evidence-based dentistry?		
Yes	48	59.3
No	33	40.7
If yes, during what part of your education?		
Dental school	15	18.5
Residency	32	39.5
Other	1	1.2

Confidence in the respondent's ability to interpret results was assessed by the four questions relating to particular activities [Table 4]. Only 48% of the respondents reported fair to complete confidence in interpreting a *P* value. For the other confidence items, at least 38% of the respondents expressed at least a fair confidence in interpreting the results of a statistical method.

Knowledge of Statistical Methods

An average of 29% of respondents correctly answered the knowledge-based questions on statistics [Table 5]. Only a quarter (25.9%) of respondents could correctly identify that "lower facial height in centimeters" is a continuous variable. A nearly equal number (23.5%) thought that centimeters was a nominal measure of facial height. "Facial asymmetry" classified as none, moderate, severe" was correctly identified as an ordinal variable by one-third (35.8%) of the respondents. Few of them, thought it was only discrete (16.0%) or nominal (9.9%) and (1.2%) thought that the 3 categories of facial asymmetry were only dichotomous. "Manual, photographic, and cephalometric" evaluation type was correctly identified as nominal by only one-fifth (19.8%). A surprising 14.8% identified this as a discrete variable. These types of questions were incorrectly answered by 43% of the respondents. A case-control design was correctly identified by 44.4% of the respondents. Sixteen-percent thought that the study was of a single retrospective cohort, and two respondents identified this as a randomized clinical trial.

Table 3: Attitude of the residents toward use of statistics

Questions regarding Biostatistics	Attitude				
	Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
Given the chance, I would like to learn more about statistics	28 (40.5)	38 (26.9)	5 (9.6)	—	5 (15.6)
I can understand almost all of the statistical terms that I encounter in journal articles	—	14 (9.9)	10 (19.2)	47 (50.5)	8 (25.0)
Because it is easy to slant results with statistics, I don't trust them at all	4 (5.8)	14 (9.9)	15 (28.8)	33 (35.5)	9 (28.1)
I often use statistical information in forming opinions or making treatment decisions	1 (1.4)	37 (26.2)	20 (38.4)	12 (12.9)	8 (25.0)
To be intelligent reader of the literature, it is necessary to know something about statistics	36 (52.2)	38 (26.9)	2 (3.8)	1 (1.1)	2 (6.3)
Total	69 (100.0)	141 (100.0)	52 (100.0)	93 (100.0)	32 (100.0)

Table 4: Residents confidence in interpretation of statistical concepts

Current level of ability in the following activities	Confidence						
	None	A little	Fair Amount	A lot	Complete confidence	Mean	SD
Interpreting the *P* value for a given result	22	18	30	4	5	2.39	1.14
Interpreting the results of a statistical method used in research	13	27	35	4	1	2.41	0.67
Assessing if the correct statistical procedure was used to answer a research question	27	21	26	5	1	2.15	1.00
Identifying the factors that influence a study's power	28	19	26	3	2	2.13	1.04

Overall, respondents with higher attitude levels were not more likely to correctly identify the correct answers to the knowledge questions ($P = 0.051$).

Two keys to the highest level of evidence in a study are blinding and controls. Sixty-eight percent of the respondents correctly identified that this avoids observer and subject bias. However, only one-fifth (22.2%) correctly identified that a $P > 0.05$ (not statistically significant) indicates at least a 1-in-20 chance occurrence. Thirty percent (30.4%) interpreted this as a statistically significant finding. Overall, respondents' knowledge of biostatistics was low, with only 29% of the items answered correctly. Appendix 1a and 1b show the statistical methods applicable for varying combinations of dependent and independent variables.

Table 5: Proportion of the residents with correct responses to the knowledge-based questions on statistics

Item	Correct response
Identify continuous variable	21
Identify ordinal variable	29
Identify nominal variable	16
Recognize case-control study	36
Recognize purpose of double-blind study	55
Interpreting meaning of *P* >.05	18
Average	29 (35.8)

Appendix 1a: Conceptual framework involving one independent variable

Independent variable	Dependent variable	Statistical method
Nominal	Nominal	Chi-square
Nominal	Numerical	T-test
Nominal (*3 or more factors*)	Numerical	ANOVA
Numerical	Numerical	Regression

Appendix 1b: Conceptual framework involving two or more independent variables

Independent variable	Dependent variable	Statistical method
Nominal	Nominal	Log-linear
Nominal (*with confounding factors*)	Nominal	Mantel-Haenzel
Nominal (*with confounding factors*)	Numerical	ANCOVA
Nominal & Numerical	Nominal (*dichotomous*)	Logistic Regression
Nominal & Numerical	Nominal (*3 or more values*)	Discriminant Analysis
Numerical	Numerical	Multiple Regression
Nominal (*with 3 or more factors*)	Numerical (*censored*)	Cox Regression / Proportional Hazard Model (*survival analysis*)
Nominal	Nominal (*censored*)	Kaplan-Meier (*survival analysis*)

DISCUSSION

Biostatistics remains a critical methodological skill for researchers, as statistical methods are increasingly a necessary part of medical research. It is doubtful if one can adequately interpret the literature without adequate knowledge of biostatistics. For example, if an incorrect test is used in a study, then invalid results and misleading conclusions may be drawn from the study. In addition, inadequate sample size may affect the external validity of the results. Also, a lack of adequately reported randomization has been associated with bias in estimating the effectiveness of interventions. To comprehend the results of a randomized controlled trial (RCT), readers must understand its design, conduct, analysis, and interpretation.

The present study shows that the biostatistics knowledge of an average dental resident doctor who participated in this study was grossly inadequate. Most residents in this study lacked the knowledge in biostatistics needed to interpret many of the results in published clinical research. Less than two-third (60.5%) of the respondents had ever taken a course in biostatistics in which about one-third (35.8%) mainly occurring during medical school. Sixty-eight percent of the respondents correctly identified that the use of blinding and controls avoids observer and subject bias in the purpose of blinding. However, only 22% correctly identified that a $P > 0.05$ indicates at least a 1-in-20 chance occurrence. Windish *et al*.,[6] surveyed a cross-section of medical students and found that most of them lacked the knowledge and understanding of biostatistics necessary to interpret research results in medical literature. Since clinicians need to have such skills to engage in evidence-based practice, every effort needs to be made to include effective training in biostatistics within residency programs. Bookstaver *et al*.,[7] also studied pharmacy residents' knowledge of biostatistics and research design. They reported that pharmacy residents' perceptions and understanding of biostatistics were poor.

There was no evidence that a positive attitude toward statistics leads to higher levels of knowledge. Higher levels of confidence were correlated with objectivity poor levels of knowledge of biostatistics. The implication of this finding in our opinion is that it is only if the positive attitude is followed by adequate training that knowledge of biostatistics can be improved.

Historically, clinicians have been reported to demonstrate a lack of confidence and poor aptitude for biostatistics as a tool for medical literature interpretation.[7] The lack of confidence for biostatistics was also demonstrated by respondents in this study.

Although the disadvantage of this study is that it is a cross-sectional survey, however, we believe that the respondents fairly represented dental residents across all postgraduate dental training institutions in Nigeria.

CONCLUSION

The knowledge and application of biostatistics methods in the clinical research was low among the studied participants. Most respondents however, wished to learn more about biostatistics. Therefore, it is imperative that small group teachings and didactic lectures should be organized for biostatistics during preclinical dental and medical school training to aid their understanding for undergraduate research. Also, an effective biostatistics training program should be an integral part of dental residency training in Nigeria. Individual training institutions and the National Postgraduate Medical College of Nigeria and West African Postgraduate Medical College should also brace up to this challenge and make training in biostatistics compulsory during residency training.

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