Evaluating a Short Biostatistics Course for Improving Statistical Knowledge in Biomedical Researchers: A Pilot study

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Introduction

- Evidence informed decision making in medicine relies on sound research on which to base decisions.
- A good knowledge of statistical concepts and ability to apply these concepts is crucial for researchers.
- In the medical field, knowledge of biostatistics is essential for designing appropriate studies as well as the accurate analysis and interpretation of results obtained.
- Additionally, healthcare workers must have a knowledge of biostatistics and critical appraisal skills in order to be able to interpret current biomedical literature.

Problem statement

- Lack of biostatistical knowledge can lead to unethical research, which has a negative impact on the practice of evidence based medicine and global healthcare.
- In SA, training in biostatistics for medical students may be deficient because of overemphasis on general purpose and descriptive statistics.
- Courses in biostatistics and epidemiology are the subjects most disliked by South African medical students. This may be due to lecturers who are not appropriately trained in biostatistics or fail to inspire students.
- Deficiencies in maths and science education at school level may also contribute to the aversion to statistics.


YOU WILL LEARN STATISTICS!
SADISTICS?

Objectives

- Research question:
  - *Will a short-course aimed at postgraduate health science researchers increase participants' **theoretical knowledge** of biostatistics as well as improving their **competency** in using computer based statistical software for data analysis?*
- The specific objectives of this pilot study were to:
  - *Measure baseline **knowledge** of biostatistics and **competency** in the use of a statistical package in analysis of data.*
  - *To evaluate using subjective and objective measures whether the short-course has brought about a change in these outcomes.*

Methods

- Study design:
  - *This was an evaluation of a teaching and learning program using pre and post course self-administered questionnaires.*
- Setting:
  - *The course was offered within the CHS and took place during and after office hours at a campus computer laboratory.*
  - *The target population was postgraduate students and biomedical researchers at UKZN CHS.*

Methods (cont.)

- Study sample:
  - *All participants attending the four-day short-course during February 2011 (n=40). Those who did not complete either the baseline or follow-up questionnaires were excluded from analysis.*
- Measurement instrument:
  - *A self-administered questionnaire was administered at two time points, before the course and two months after the course.*
  - *The questionnaire included objective questions on knowledge of choice of statistical tests and questions on self- reported understanding of statistical theory (measured on a five point Likert scale). Questions on competence with a computer-based statistical software package were also included.*

Methods (cont.)

- Course presentation:
  - *Four-day training facilitated by two CHS biostatisticians (TE and NM).*
  - *The format was 45-minute theory lectures followed immediately by one-hour facilitator guided practical sessions in the mornings.*
  - *Practical session in the afternoons for students to work through exercises covering the content from that day, with facilitator guidance.*
  - *Participants were encouraged to bring their own research datasets for the practical sessions.*
  - *Participants received 10 theoretical lectures covering topics from hypothesis testing to descriptive and inferential biostatistics, including correlation and linear regression.*
  - *The practical training focused on the use of Statistical Package for the Social Sciences (SPSS) in the analysis of raw data.*

Methods (cont.)

- Data analysis:
  - *Quantitative data were captured and analyzed using SPSS version 20.*
  - *Responses to objective knowledge questions were scored and scores were expressed as a percentage of the total number of questions.*
  - *Participants' pre and post course data, linked via unique study numbers, were compared using non-parametric Wilcoxon signed ranks tests.*
  - *A p-value <0.05 was considered statistically significant.*
- Ethical issues:
  - *Ethical approval was obtained from the Biomedical Research Ethics Committee (BREC), UKZN. Informed consent was obtained from all participants.*
  - *Responses were anonymized with unique study numbers. Repeated follow-up attempts were made to encourage completion of post-course questionnaires, however completion was entirely voluntary.*

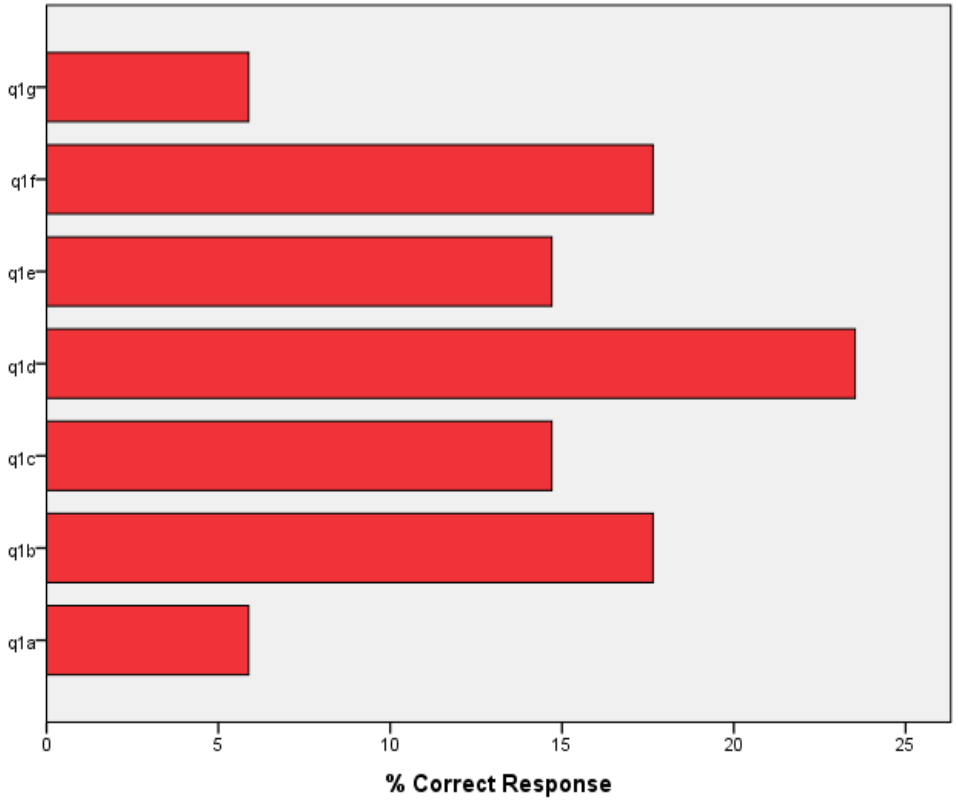
Results

- Response rate and demographics
  - *There were 40 eligible participants of which 34 (85%) completed the baseline questionnaire.*
  - *Sixty-five percent of participants were female, while 55% were qualified researchers including research supervisors.*
  - *The rest were postgraduate students or healthcare professionals.*
  - *Follow up response was poor, with only 6 respondents (17.6%).*

Results (cont.)

- Pre-course evaluation
  - *Baseline statistical knowledge was assessed using seven questions.*
  - *Respondents showed very poor understanding and content knowledge of basic biostatistics terminology and methodology at baseline. Scores for core knowledge revealed a median score of 0% (53% of baseline respondents), with a 75th percentile of 28.6%, and a maximum score of 71.4%*

Percentage of correct responses for knowledge questions at baseline



Results (cont.)

- Pre course evaluation (cont.)
  - *Self- reported knowledge and confidence required in carrying out simple data management and statistical procedures were limited.*
  - *Knowledge and skills on general epidemiological and data management aspects was slightly better than that of more theoretical and applied statistical concepts. Less than 20% of participants had attempted or succeeded in carrying out simple statistical procedures prior to registering for the course.*

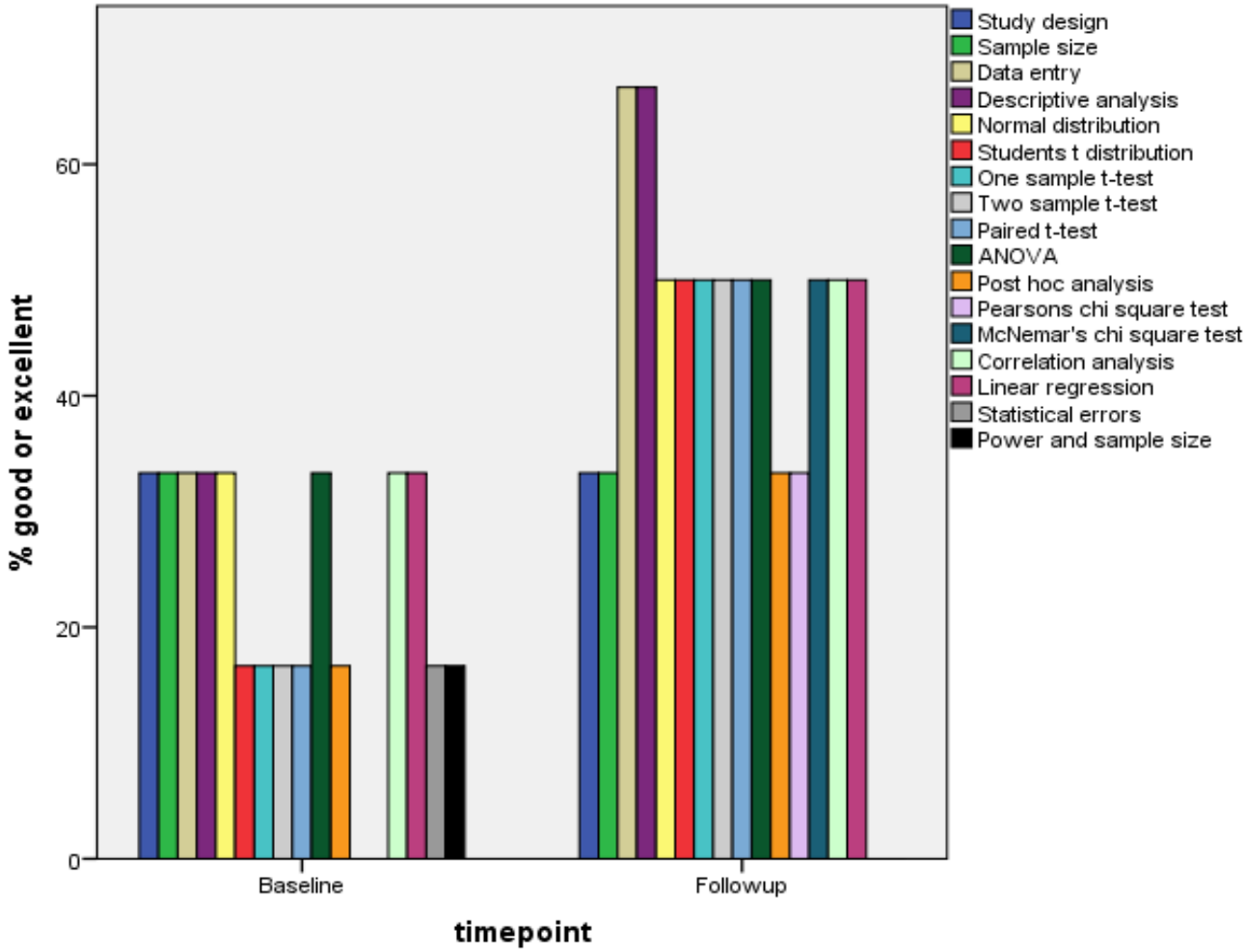
Results (cont.)

- Post course evaluation and comparison:
  - *Of the 6 participants who completed follow up, there was a trend of overall improvement in statistical knowledge with the median knowledge score increasing from 7.1% to 28.5% and the 75th percentile score from 14.3% to 85.7% (p=0.109).*
  - *However, the power of the study was low as this comparison was based on 6 respondents.*
  - *There was a trend towards improved understanding of statistical concepts and improved ability to carry out basic analyses using statistical software.*
  - *For most constructs measured, there was an increase in the proportion who reported good and excellent understanding. A similar trend regarding self-reported ability to carry out procedures using statistical software was found.*

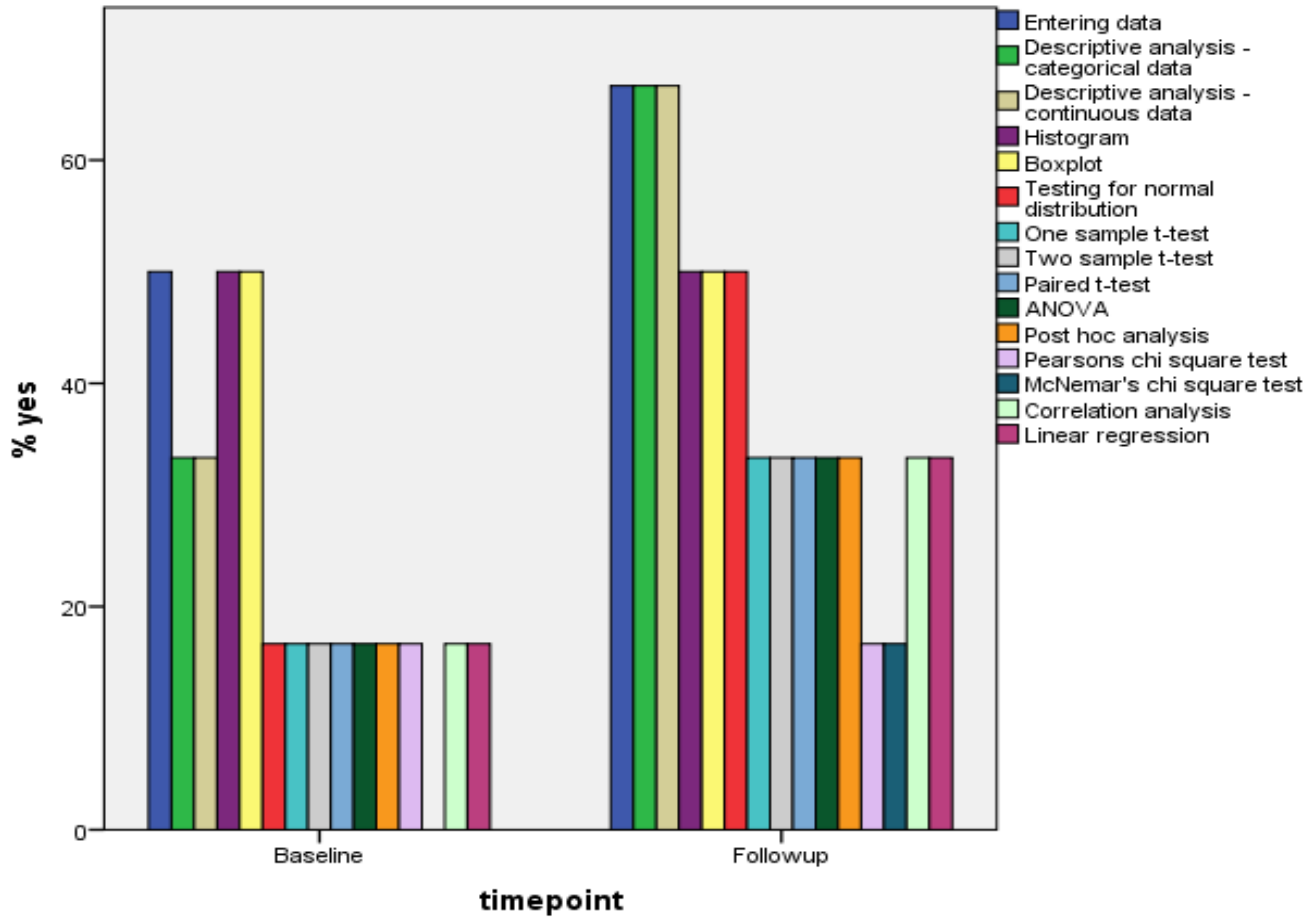
Comparison of median knowledge score between baseline and follow up (n=6)

	Median	Percentile 25	Percentile 75	p (Wilcoxon signed ranks test)
Knowledge score baseline	7.14	.00	14.29	0.109
Knowledge score follow up	28.57	.00	85.71	

Percentage reporting good or excellent level of self-reported understanding of epidemiological and statistical theory at baseline and follow up (n=6)



Percentage reporting being able to carry out data management and statistical procedures using statistical software at baseline and follow up (n=6)



Discussion

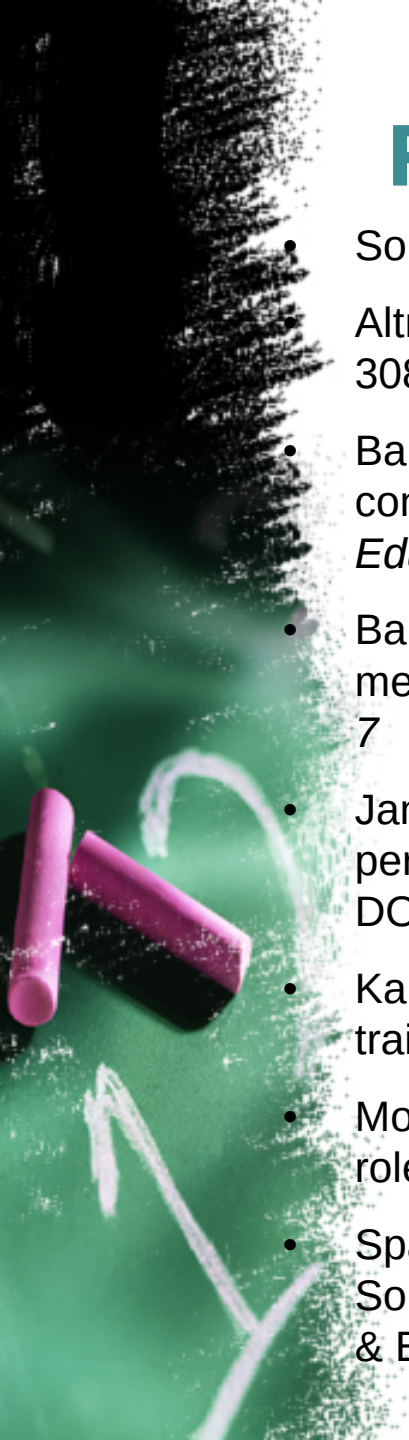
- Baseline results showing deficiency in core knowledge confirms recent reports of deficiencies in undergraduate and school education regarding statistics
- The post course results suggested improvement in core knowledge as well as ability to perform basic statistical analysis
- These results mirror results obtained from a similar sized cohort of biomedical researchers from Iran.
- Results suggest that this short-course will provide effective return on investment if applied to a larger audience.

Limitations

- This was a pilot study, and of limited size, therefore limiting the generalizability of the results.
- There may have been a selection bias in the follow-up group. It is possible that those participants who were familiar with biostatistics self-selected themselves to complete the post course evaluation.
- This could have led to an overestimation of the impact of this training exercise.

Conclusion

- This pilot study appears to reaffirm the ongoing reports of poor knowledge and training in mathematics education at the primary, and secondary school level, and in statistics and research methods at the tertiary level.
- There is need for continuous professional development courses in the areas of biostatistics and applied mathematics to assist in improving the core knowledge of biomedical researchers in the performance of their duties.



References

- Some relevant papers referred to in this work include:

Altman, D.G. (1994).The scandal of poor medical research. *BMJ*, 308; 283. Doi 308.6924.283

- Bansilal. S., Brijlall, D., & Mkhwanazi T (2014). An exploration of the common content knowledge of high school mathematics teachers. *Perspectives in Education*, 32, 34-50
- Barzagan A., & Vallai N. (2006). Strengthening research and statistical skills of medical doctors through a hands-on approach: a case study from Iran. *ICOTS-7*
- Janks, H. (2013). Globalisation, diversity, and education: a South African perspective. The Educational forum, 78, 8-25, DOI:10.1080/00131725.2014.850981
- Kamanzi-wa-Binyavanga (1998). Statistics education in South African medical training institutions. ICOTS-5, 1998
- Mostert, P. (2006). Changing approaches and perceptions: Biostatistics and its role in teaching the Stellenbosch doctor. ICOTS-7
- Spaull, N. (2013). South Africa's education crisis: The quality of education in South Africa 1994-2011. Report Commissioned by the Centre for Development & Enterprise. *Informing South African Policy*, October 2013.

Thank you!