

Reporting of Bayesian analysis in epidemiologic research should become more transparent

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Abstract

Objectives: The objective of this systematic review is to investigate the use of Bayesian data analysis in epidemiology in the past decade and particularly to evaluate the quality of research papers reporting the results of these analyses.

Study Design and Setting: Complete volumes of five major epidemiological journals in the period 2005–2015 were searched via PubMed. In addition, we performed an extensive within-manuscript search using a specialized Java application. Details of reporting on Bayesian statistics were examined in the original research papers with primary Bayesian data analyses.

Results: The number of studies in which Bayesian techniques were used for primary data analysis remains constant over the years. Though many authors presented thorough descriptions of the analyses they performed and the results they obtained, several reports presented incomplete method sections and even some incomplete result sections. Especially, information on the process of prior elicitation, specification, and evaluation was often lacking.

Conclusion: Though available guidance papers concerned with reporting of Bayesian analyses emphasize the importance of transparent prior specification, the results obtained in this systematic review show that these guidance papers are often not used. Additional efforts should be made to increase the awareness of the existence and importance of these checklists to overcome the controversy with respect to the use of Bayesian techniques. The reporting quality in epidemiological literature could be improved by updating existing guidelines on the reporting of frequentist analyses to address issues that are important for Bayesian data analyses. © 2017 Elsevier Inc. All rights reserved.

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1. Background

Over the past few decades, an extensive body of literature has been published describing the rationale and (potential) advantages of Bayesian data analysis

techniques within epidemiological research (see, e.g. [1–7]). These articles discuss the advantages and flexibility of Bayesian approaches in the process of, for example, prediction model development, interim analysis, and sample size calculation.

Despite the attention Bayesian techniques receive in methodological literature, at the beginning of the millennium, the use of Bayesian methods in applied research seemed limited. This conclusion followed from a nonsystematic search in the medical literature by Altman [8] and from a systematic review by Spiegelhalter et al. [9] which focused on statistical methods in health technology

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What is new?**Key findings**

- For the reviewed epidemiological journals, the number of studies in which Bayesian analyses were used remains constant over the years.
- Often information on the process of prior elicitation, specification, and evaluation was lacking from research reports.

What this adds to what was known?

- Several guidance papers have recently been published on transparent reporting of research results. Our review indicates that adherence to these guidelines seems particularly urgent for Bayesian data analyses, as controversy around their implementation often relates to the choice of prior distributions.

What is the implication and what should change now?

- The reporting quality of papers in epidemiological journals could be improved by updating existing guidelines on reporting to specifically address issues that are relevant for both frequentist and Bayesian data analyses.

assessment. A recent update of this review more than a decade later revealed a huge increase in the use of Bayesian statistics in the field of health technology assessment [10]. Furthermore, in a review on the use of Bayesian statistics in publications in Statistics in Medicine [11], it was concluded that the use of Bayesian methodology had increased in all major areas of medical statistics. On the other hand, in a review on the current state of Bayesian methods in medical product development [12], only a slight increase in the implementation of these techniques was found. In addition, the persistency of the underuse of Bayesian methods in current research was reported by Pibouleau and Chevret [13] in a review on the evaluation of the effectiveness of implantable medical devices.

Given the increasing acknowledgment of Bayesian statistics and the different conclusions drawn in the above reviews, we question whether the conclusion of the underuse of these techniques is still justified for the field of epidemiological research. Therefore, with the current study, we aim to update the series of reviews of Bayesian techniques that were done in related research areas as mentioned above with an extensive systematic review on the use of Bayesian techniques in epidemiological research in general in the period 2005–2015.

Furthermore, several guidelines have been developed to help researchers to report on Bayesian data analyses in a structured and transparent manner (see, e.g., BayesWatch [9], the BaSiS guidelines for reporting Bayesian Analysis [14], and the ROBUST criteria as specified by Sung et al. [15]). It remains unclear whether these guidelines were implemented successfully in epidemiological research. Therefore, in addition to gaining insight in the number of Bayesian publication, we aim to evaluate the reporting quality in the identified research reports.

2. Methods**2.1. Search strategy**

The search for studies reporting Bayesian data analysis focused on issues of the original research papers published in the top 5 epidemiological journals (ISI Web of Knowledge, 2010) as displayed in Table 1.

To select only original research reports and exclude publications such as editorials, letters, and commentaries, we made use of the PubMed Publication Characteristics (publication types). Eligible publication types are clinical trials (phases I–IV), journal articles, multicenter studies, randomized controlled trials, comparative studies, technical reports, controlled clinical trials, twin studies, evaluation studies, and validation studies.

Identification of eligible papers published within the selected journals and journal types followed the two search paths as displayed in Fig. 1. The left-hand side of the flow diagram shows the identification of epidemiological or medical studies using PubMed with the search terms [Bayes* OR MCMC OR “credible interval”] in combination with the name of each of the epidemiological and medical journals separately and the period of interest (e.g., [(Bayes* OR MCMC OR credible interval) AND “J Clin Epidemiol”][Journal] AND “2005/01/01”[Entrez Date]: “2005/12/31”[Entrez Date]]).

Because we expected authors not to provide a detailed description of the performed analyses in titles, abstracts, and keywords and because PubMed does not index publications based on analysis technique, we expected that the above search strategy would not be able to identify all relevant research papers. Therefore, a full-text within-

Table 1. Epidemiological journal rankings on 5-year impact factor according to ISI Web of Knowledge

| Top 5 epidemiological journals | Abbreviated journal title |
|--|------------------------------|
| American Journal of Epidemiology | Am J Epidemiol |
| International Journal of Epidemiology | Int J Epidemiol |
| Epidemiology | Epidemiol |
| Journal of Epidemiology & Community Health | J Epidemiol Community Health |
| Journal of Clinical Epidemiology | J Clin Epidemiol |

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