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Analytic choices in road safety evaluation: Exploring second-best approaches

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ABSTRACT

Conducting rigorous before-and-after studies is essential for improving knowledge regarding the effects of road safety measures. However, state-of-the-art approaches like the empirical Bayes or fully Bayesian techniques cannot always be applied, as the data required by these approaches may be missing or unreliable. The choice facing researchers in such a situation is to either apply "second-best" approaches or abstain from doing an evaluation study. An objection to applying second-best approaches is that these approaches do not control as well for confounding factors as state-of-the-art approaches. This paper explores the implications of choice of study design by examining how the findings of several evaluation studies made in Norway depend on choices made with respect to:

1. Using the empirical Bayes approach versus using simpler approaches;
2. Use or non-use of a comparison group;
3. The choice of comparison group when there is more than one candidate.

It is found that the choices made with respect to these points can greatly influence the estimates of safety effects in before-and-after studies. Two second-best techniques (i.e. techniques other than the empirical Bayes approach) for controlling for confounding factors were tested. The techniques were found not to produce unbiased estimates of effect and their use is therefore discouraged.

1. Introduction

Methods for conducting observational before-and-after studies of road safety measures have developed considerably in the past 15–20 years. The empirical Bayes (EB) approach (Hauer, 1997) has been extensively applied and come to be regarded almost as the "gold standard" for before-and-after studies (Persaud and Lyon, 2007). The EB-approach is recommended and explained in detail in the Highway Safety Manual (2010). Recently, however, fully Bayesian (FB) approaches have been proposed as an equally rigorous method for performing before-and-after studies of road safety measures (Persaud et al., 2010).

Both EB and FB approaches require fairly extensive data and computations if applied in their most rigorous form. These data may not always be available or easy to collect. Problems of data availability may prevent application of the most rigorous techniques for before-and-after studies. A case in point is the evaluation of the lowering of the legal limit for blood alcohol concentration (BAC-limit) in Norway from 0.05 percent to 0.02 percent in 2001 (Assum, 2010). The new BAC-limit was introduced in the whole country; a comparison group retaining the old BAC-limit did not exist. No roadside surveys of the amount of drinking and driving had been made; effects on behaviour could therefore only be assessed in terms of self-reported behaviour. Finally, accidents involving drivers who had been drinking were not recorded; the evaluation had to rely on surrogate accidents that tend to involve a high proportion of drinking drivers (e.g. single vehicle accidents at night). In short, many compromises that reduced study quality had to be made. The dilemma facing analysts in such situations is whether to try to perform a "second best" evaluation study, or refrain from doing an evaluation study at all, given the risk that findings could be misleading.

The objective of this paper is to explore the use of second best approaches to road safety evaluation studies in order to gain an impression of whether such approaches are likely to be so erroneous as to be discouraged altogether, or whether they can be applied when certain conditions are fulfilled. Analysis proceeds in two stages. The first stage compares different study designs to determine the extent to which findings based on less rigorous study

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