The safety value of guardrails and crash cushions: a meta-analysis of evidence from evaluation studies

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Authors' objectives
To evaluate the effects of median barriers, guard rails along the edge of the road and crash cushions (impact attenuators) on the probability and severity of accidents.

Searching
The reference sections of selected journals were examined for relevant material. A more detailed description of the search is given in Elvik (see Other Publications of Related Interest no.1).

Study selection
Study designs of evaluations included in the review
Before-and-after designs and case-control designs were included.

Specific interventions included in the review
Median barriers and guard rails along the edge of the road (concrete barrier, steel W-beam guard rail, steel wire guard rail) and crash cushions (impact attenuators).

Participants included in the review
The participants were road users.

Outcomes assessed in the review
Accident rate (number of accidents per million vehicle kilometres of travel), fatal accidents (conditional probability of sustaining fatal injury, given that an accident has occurred) and injury accidents (conditional probability of sustaining personal injury, given that an accident has occurred).

How were decisions on the relevance of primary studies made?
The author does not state how the papers were selected for the review, or how many of the reviewers performed the selection.

Assessment of study quality
The effects of study design, confounding variables controlled in each study design, type of object guarded and year of publication of the study were investigated. The author does not state how the papers were assessed for validity, or how many of the reviewers performed the validity assessment.

Data extraction
Predefined data were extracted.

Methods of synthesis
How were the studies combined?
The studies were combined using the logodds method (see Other Publications of Related Interest no.2): the results are weighted by means of weights that are proportional to the inverse of the variance of each result.

How were differences between studies investigated?
Different sources of variation in the study results were investigated: these were publication bias, random variation in the number of accidents, variation related to the design and quality of data of each evaluation study and systematic
variation in the effect of the countermeasure.

Results of the review
A total of 32 studies containing 232 numerical estimates of the effects of barriers, guardrails and crash cushions: 4 before-and-after studies with a matched comparison group; 5 before-after-studies with no comparison group; 19 case-controlled studies; 3 containing both case-controlled studies and uncontrolled before-and-after studies; and 1 of unknown design.

Installation of median barriers increased accident rate by 29% (95% confidence interval, CI: +25, +32), but decreased fatal accidents by 32% (95% CI: -14, -4) and did not affect injury accident (-2% change, 95% CI: +4, -7). Guard rails significantly reduced accident rates by 27% (95% CI: -18, -35), fatal accidents by 44% (95% CI: -40, -48) and injury accident by 52% (95% CI: -51, -53). Crash cushions also reduced accident rates by 84% (95% CI: -74, -90), fatal accidents by 69% (95% CI: -46, -83) and injury accidents by 68% (95% CI: -60, -74).

Authors' conclusions
Median barriers are found to increase accident rate but reduce accident severity. Guard rails and crash cushions are found to reduce both accident rate and accident severity. The effects of guard rails and crash cushions on accident rates have been less extensively studied than the effects on accident severity. Current estimates on the effects on accident rate are highly uncertain because of methodological shortcomings of available studies. The effects of guard rails on accident severity are fairly robust with respect to study design and the number of confounding variables controlled by each study. In general, random variation in the number of accidents is the most important source of variation in the study results.

CRD commentary
This appears to be a thorough review of this area. However, it is not possible to evaluate the strength of the literature search as it was published elsewhere. No details are given of the mechanics of quality assessment although sources of variation appear to have been thoroughly explored, e.g. by funnel plots for publication bias. The merit of combining data that comes from studies other than randomised controlled trials is uncertain.

Bibliographic details

PubMedID
7546065

Other publications of related interest

Indexing Status
Subject indexing assigned by NLM

MeSH
Accidents, Traffic /prevention & control /statistics & numerical data; Bias (Epidemiology); Evaluation Studies as Topic; Humans; Injury Severity Score; Protective Devices; Reproducibility of Results; Research Design; Risk Factors

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Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.