How to rate the certainty of prediction modelling studies in a systematic review?

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Evidence-based by **CEBaP**

Background

Mass gatherings attended by large crowds are an increasingly common feature of society. In parallel, an increased number of studies have been conducted to identify those variables that are associated with increased medical usage rates.

Objectives

1. To conduct a systematic review answering the PICO question "Which predictive models (I) are available for emergency services planning (O) during mass gathering events (P)?
2. To apply the GRADE approach to rate the certainty of the included prediction modelling studies.

Methods

Search strategy

- Search strategies in 6 databases on 14 May 2019.

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Selection criteria

- *Population*: all types of mass events, such as sports events, music festivals and/or concerts.
- *Intervention*: development and/or validation of a multivariate statistical model that predict medical usage rates.
- *Outcomes*: medical usage rates including the Patient Presentation Rate (PPR) or the Transfer To Hospital Rate (TTHR).
- *Study design*: prediction model development studies with(out) external validation.

Data synthesis and critical appraisal

- Prediction model development studies: a narrative summary of the statistical significant ($p<0.05$) predictors from the multivariate models was conducted.
- Methodological limitations were assessed by making a judgment on the risk of bias items of the CHARMS checklist (Critical Appraisal and Data Extraction for Systematic Reviews of Prediction Modelling Studies). [1]
- GRADE was applied to assess the certainty in evidence.
- Meta-analyses have not been performed and data were summarised narratively. [2]

Results

- We identified 17 prediction modelling studies, performed in the USA (n=9), Australia (n=4), Japan (n=1), Singapore (n=1), South Africa (n=1) and The Netherlands (n=1), with a combined audience of >40 million people in >2000 mass gatherings.
- Statistically significant variables ($p<0.05$) to predict PPR and/or TTHR are shown in ***Figure 1***.
- The initial certainty level was set at 'high' (association between predictors and outcomes irrespective of any causal connection). The evidence was downgraded due to methodological limitations (-1) and indirectness (-1) resulting in a final low certainty evidence. (***Table 1***)

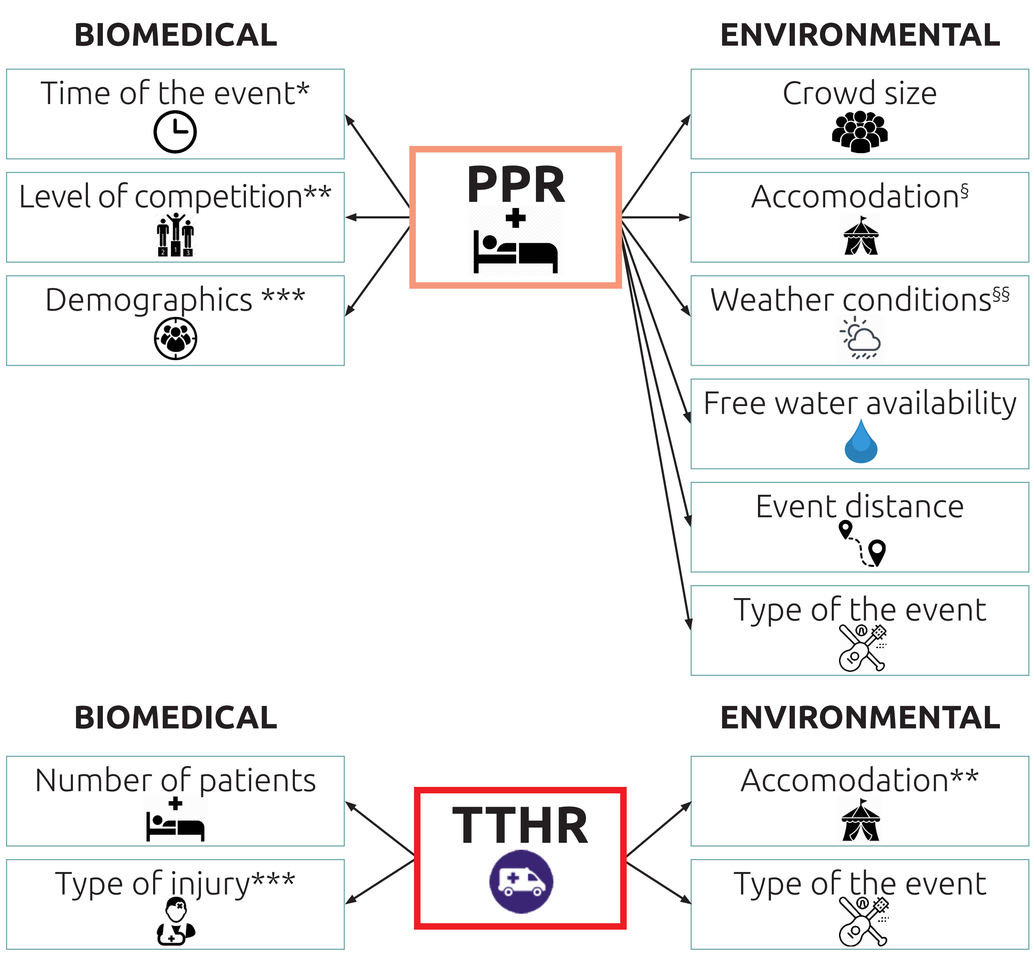
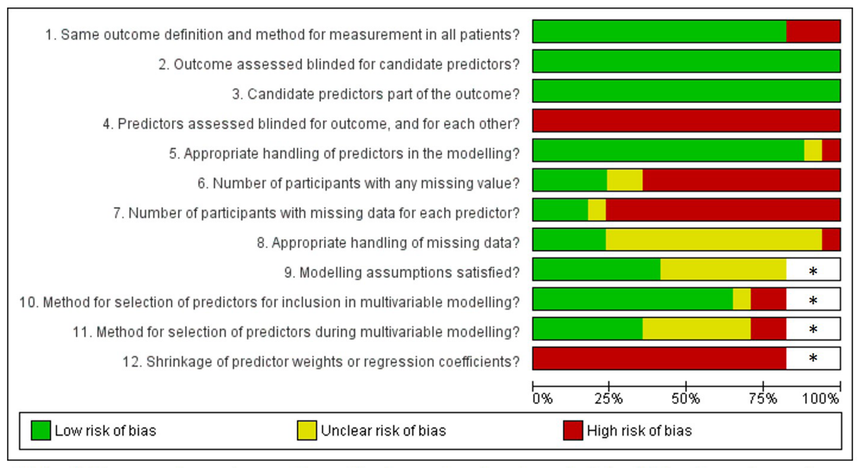


Figure 1. Statistical significant variables from multivariate regression analyses predicting patient presentation rate (PPR) and transfer to hospital rate (TTHR). *night vs day; **competitive vs non-competitive; ***age/gender; §seated, fenced/bounded, outdoor; §§humidity, heat index, air conditioning.

Table 1. Applying the GRADE approach when evidence for an effect is summarised narratively in a systematic review of prediction modelling studies.

Methodological limitations of the studies [1]: downgrade (-1)



Risk of bias graph: review authors' judgements about each risk of bias item, based on the CHARMS checklist, presented as percentages across all included studies.

* 3 external validation studies: modelling criteria nog appllicable.

Indirectness: downgrade (-1)

The studies are mainly conducted in USA/Australia and results can't be extrapolated to other contexts, continents, countries

Imprecision: no downgrade

No limited sample size and/or large variability in results

Inconsistency: no downgrade

Direction and magnitude of effect estimates varied across different trials, which was taking into account by downgrading for indirectness

Publication bias: no downgrade

No indications, comprehensive search strategy

Large effect, dose-response gradient, plausible confounding: no upgrade

GRADE

Conclusions

- The GRADE approach and the CHARMS checklist allow researchers to rate the certainty of prediction modelling studies.
- Further formal guidance from the GRADE working group is recommended to use the GRADE approach on prediction modelling studies. This will improve evidence-based mass gathering medicine by more effective pre-event planning and resource provision.

References: [1] Moons et al. PLoS Med 2014, 11:e1001744; [2] Murad et al. Evid Based Med 2017,22:85-87

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