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Interpreting interaction effects in estimates of the risk of traffic injury associated with the use of illicit drugs

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A B S T R A C T

Interactions characterise the relationship between use of amphetamines, cannabis and opiates as a driver and the risk of traffic injury associated with the use of these drugs. Inverse risk curves have been found for these drugs, meaning that the higher the proportion of drivers in normal traffic testing positive for the drugs, the lower is the increase in risk associated with them. The inverse risk curves can arise in many ways. The paper discusses ten different interpretations of the curves; seven of these are methodological and claim that the risk curves are statistical artefacts. Some support for these interpretations is found; however, this does not rule out that substantive interpretations, proposing causal mechanisms underlying the curves may also be correct. Unfortunately, there is insufficient evidence to assess the support for the substantive interpretations. There is, accordingly, a large element of uncertainty about how the inverse risk curves arise and whether they can be modified.

1. Introduction

Many studies have been made to assess the risk of traffic injury associated with the use of illicit drugs. For a few drugs, there are enough studies to synthesise their findings by means of meta-analysis (Elvik, 2013, 2015). Evidence from primary studies is then summarised in terms of a single, or a few, summary estimates of the risk of injury associated with using a drug.

One of the problems in trying to synthesise the findings of studies of the risk associated with illicit drugs is that estimates vary enormously. When there is great variation in estimates of risk, it may not be very informative to summarise them in terms of a single weighted mean estimate. In any meta-analysis, it is recommended to perform an exploratory analysis in order to test whether the distribution of estimates in primary studies is "well-behaved", i.e. unimodal, showing a bell-shaped distribution. A graphical tool, the funnel plot, can be employed to test whether the distribution of estimates of risk has this shape. In a funnel plot, estimates of risk are plotted on the abscissa and an indicator of their statistical precision on the ordinate.

Fig. 1 presents an example of a funnel plot. It shows estimates of the risk of fatal injury associated with the use of amphetamines. The abscissa shows the natural logarithm of the estimate of risk (values greater than 0 indicate an increase in risk), the ordinate shows the standard error of each estimate of risk, with the scale inverted so that estimates with small standard errors are plotted on top of the diagram.

The distribution of estimates of risk in a funnel plot should, ideally speaking, resemble a funnel turned upside down (i.e. with the narrow opening on top). The data points shown in Fig. 1 are spread all over the place and do not show a distribution resembling a funnel. Five data points to the right in the diagram are trimmed away when the trim-and-fill method is applied to test for the possible presence of publication bias (Duval and Tweedie, 2000a,b; Duval, 2005). Yet, even when these data points are trimmed away, no clear funnel shape emerges. Many analysts would conclude that the data points in Fig. 1 are too widely and unsystematically dispersed for a summary estimate of risk to make sense.

A completely different picture emerges in Fig. 2. Fig. 2 shows estimates of the risk of fatal injury as a function of the percentage of drivers testing positive for amphetamine in normal traffic. Fig. 2 includes 10 of the 13 estimates shown in Fig. 1.

A clear negative relationship is found: The higher the percentage of drivers testing positive for amphetamines in roadside surveys intended to represent normal traffic, the lower is the increase in risk associated with the use of amphetamines. Thus, the wide and unsystematic dispersion of estimates of risk in Fig. 1 hides a very clear relationship: the lower the share of drivers testing positive for amphetamine, the higher is their risk.

Similar patterns in the variation of risk have been observed for other illicit drugs, including cannabis and opiates (Elvik, 2015). This suggests that the association between the use of an illicit drug and the risk of traffic injury is best summarised by means of a function describing the relationship between the share of drivers testing positive for a drug in normal traffic and the increase in risk associated with use of the drug. Unfortunately, curves like the one shown in Fig. 2 can arise in many

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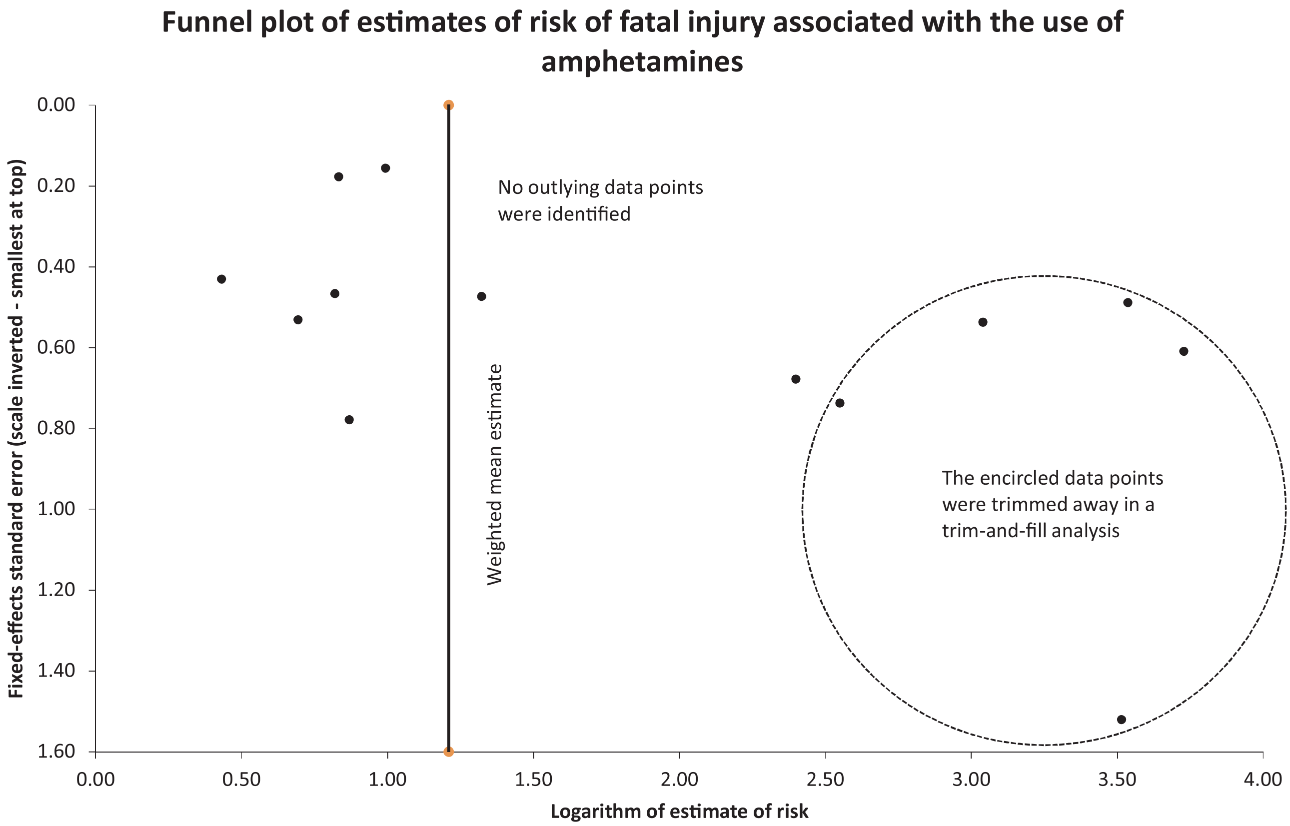

Fig. 1. Funnel plot of estimates of the risk of fatal injury associated with the use amphetamines.

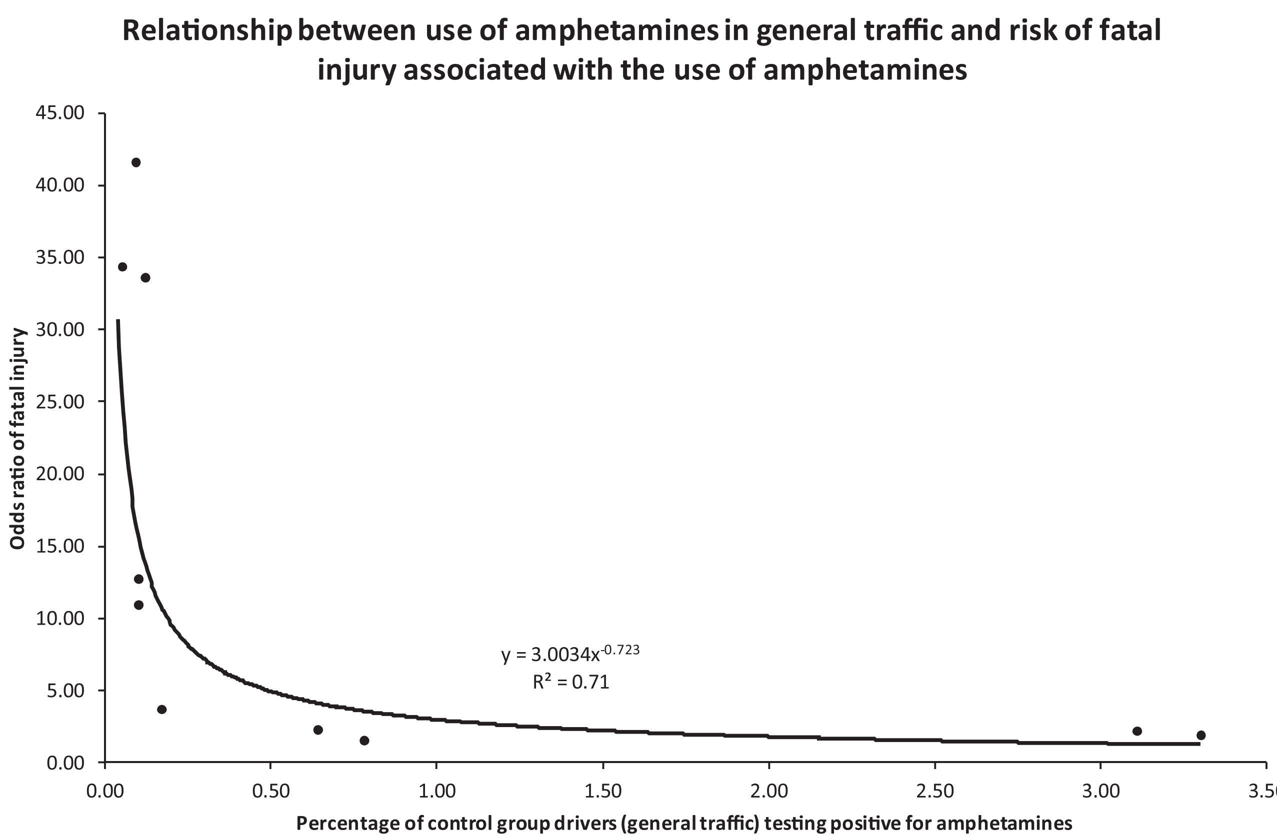

Fig. 2. Relationship between the use of amphetamines in general traffic and risk of fatal injury associated with the use of amphetamines.