



University academics frequently find their research being sensationalised in the press, with scant reference to the facts originally reported in academic journals. Professors **Shah Ebrahim** and **George Davey Smith**, from the Department of Social Medicine, give us an insight into the science behind some recent headlines.

Penalty shoot-outs, stress and heart attacks: Is watching England a heart-sickening experience?

"Soccer shoot-out stress increases heart attack rate", headlined *The Times*. This followed our report in the *British Medical Journal* that heart attacks resulting in hospital admissions increased by 25 per cent on the day of, and following two days after, England's world cup defeat in 1998 by Argentina in a penalty shoot-out. But how did we arrive at this startling conclusion and what are the facts behind the headline?

In 1994 the Medical Research Council created a new initiative in Health Services Research, bringing together expertise from several universities. Bristol University's Department of Social Medicine acts as the hub of this consortium and, for research purposes, has obtained the Hospital Episodes Statistics database from the Department of Health. For the period 1991 to 1999 there were approximately 97 million entries on the database. Each record in the database relates to one 'Finished Consultant Episode', which is the period of time an individual spends under the care of one NHS consultant. The information held includes the age and sex of the patient, the area of usual residence and the reason for admission to hospital,

In collaboration with colleagues at Birmingham University, we examined the daily number of hospital admissions in England for heart attacks, strokes, deliberate self-harm and road traffic injuries during the period of the World Cup (June 1998) among men and women aged 16-64 years. We calculated the expected numbers of admissions for each day of the week using data of admissions for the same causes over the same time period in 1997 and 1999, and in the month prior to the World Cup. We then compared the observed to expected ratios of admissions and demonstrated that heart attacks, but none of the other causes of admission, were increased by 25 per cent for the day (30 June), and the following two days after, the loss to Argentina.

Can the risk factors be tested in a randomised controlled trial?

Epidemiology is the study of the distribution and determinants of health-related states and events in populations. Epidemiologists deal predominantly with observational data and attempt to make inferences about associations between potentially important risk factors such as

demonstrate the associations we make are truly causal.

The most powerful means of testing that such conclusions are truly causal is to randomly allocate people to a control group and to a group exposed to the effects we are trying to measure, as such factors should be evenly distributed between the exposed and unexposed groups. In this case, however, it seems unlikely that international football associations would be willing to randomly allocate the use of penalty shoot-outs for the sake of such tests. Thus the inability to randomise for practical, ethical and logistic factors is one of the major reasons that observational epidemiological methods remain of value in uncovering causal factors in disease.

In this case we had a prior hypothesis as investigators in the Netherlands had also examined the effects of penalty shoot-outs on deaths. In the European Cup of 1996, Holland met France in the quarter finals. This finely balanced contest had to be resolved by a penalty shoot-out. France won. It was estimated that over 60 per cent

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but it is completely anonymised so no one individual can be identified. The database is of major value when examining the distributions of disease and treatment, and the soccer analysis is just one example of how it can be used to illuminate patterns of disease.

smoking and inactivity. This has resulted in some concern that epidemiological findings are spurious and simply the result of 'data dredging', and that the findings have no real significance. Consequently, to avoid the opprobrium of the scientific community, epidemiologists are careful to use tools which attempt to fulfil criteria that

of the Dutch population watched the match. There was a 50 per cent increase in mortality in men, although not women, from heart attacks and stroke combined, on the day of the match compared to appropriate control days, which was attributed to the stress associated with penalty shoot-outs. →

→ Is the finding coherent with other evidence?

Stress has long been considered an important cause of heart attacks but remarkably the evidence to support this contention is slim. In the case of penalty shoot-outs, stress is acute but its effects, if real, are likely to be short-lived. In other words, such stress may be considered to *trigger* a heart attack, particularly in susceptible individuals who already have some evidence of heart problems, but it is not considered to be the *cause*. To support this, environmental catastrophes such as earthquakes have been followed by an increase in heart attacks of up to 50 per cent in Athens, in Southern California, and in Japan. Episodes of war in Croatia, in Lebanon and during Iraqi missile attacks on

not itself causally related to disease, is associated with a range of other factors that are known to increase disease risk. For example, exposure to the stress of a penalty shoot-out might be confounded by social class as people from lower social classes might be expected to be more interested in watching football and certainly more of them smoke – another cause of heart attacks. Our data did not permit any adjustment for smoking but it was possible to adjust for the effects of socio-economic deprivation using the postcode addresses of people admitted to hospital. However, since 24 million people tuned in to the match – making it the most watched TV programme of 1998 – it seems that any social patterning would have been modest.

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Israel during the Gulf War were also associated with increases in heart attacks. The acute stresses of intense physical activity and sexual intercourse have also been shown to act as triggers of heart attacks.

Are the findings real?

While consistency between findings from the Netherlands and England, as well as a plausible biological mechanism – a stress-related increase in various hormones – provide some confidence that the effect is real, in epidemiology we require additional safeguards, owing to the limited control we can apply to human beings in free range conditions. The most important issue is that of confounding – literally, mixing together – where one factor (the confounder) that is

In order to provide at least a partial test for other stress-related causes of heart attacks, hospital admissions for traffic injuries and self-harm were also analysed. Since psychological stress and upheaval increase the propensity to engage in unhealthy and risky behaviour, the increase in the incidence in heart attacks might have stemmed from binge drinking, smoking and other acts of distracted carelessness. The absence of an increase in these incidents suggests that the match did not inspire pervasive recklessness. Indeed, the very specific nature of all the effects we have identified increases the likelihood that our findings are real and that, sometimes, you can believe what you read in the papers. ■

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