

## SCIENTIFIC REPORT

# Serious eye injuries caused by bottles containing carbonated drinks

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**Aim:** To analyse serious eye injuries caused by bottles containing pressurised drinks.

**Methods:** Retrospective review of the databases of US, Hungarian, and Mexican eye injury registries.

**Results:** In the combined database (12 889 injuries), 90 cases (0.7%) were caused by bottle tops or glass splinters. The incidence varied widely: 0.3% (United States), 3.1% (Hungary), and 0.9% (Mexico), as did the agent. Champagne bottle corks were responsible in 20% (United States), 71% (Hungary;  $p < 0.0001$ ), and 0% (Mexico). Most eyes improved, but 26% remained legally blind.

**Conclusions:** The presence of warning labels on champagne bottles appears to reduce cork related eye injuries, as does using plastic bottles and caps.

Bottles containing pressurised fluid are potentially hazardous, even under normal circumstances.<sup>1–3</sup> We present data on 90 such injuries from standardised surveillance systems in three countries—United States, Hungary, and Mexico.

## PATIENTS AND METHODS

We retrospectively reviewed the databases of the US eye injury registry (USEIR, surveillance arm of the American Society of Ocular Trauma), and two of its international affiliates, the Hungarian (HEIR) and the Mexican eye injury registries (MEIR). In the USEIR model, initial and 6 month follow up information on both outpatients and inpatients is collected electronically (useironline.org and weironline.org) on all types of serious trauma<sup>4–5</sup> using the Birmingham Eye Trauma Terminology (BETT) system.<sup>6</sup>

Only unintentional injuries occurring under “normal circumstances” were included in this study. Fischer’s two sided exact test was used for statistical analysis.

## RESULTS

Results are presented in table 1.

## DISCUSSION

The first report<sup>7</sup> on unintentional eye injuries from bottles containing pressurised drinks was followed by many from several countries from Sri Lanka to the United States,<sup>1–3 7–23</sup> but no population based study is available. One review from India found that 15% of inpatient trauma cases were the result of bottle explosion.<sup>2</sup> In a hospital based study 1.2% had such an aetiology in Kuwait,<sup>1</sup> while a 2% rate was found in a 19 hospital survey in Israel.<sup>14</sup> In our databases, 0.23% (USEIR) to 0.9% (HEIR) to 0.5% (MEIR) of cases had such an aetiology. The true incidence is thought to be much higher.<sup>11 23</sup>

The material used for packaging pressurised fluids determines the injury risk. Glass is breakable, especially after wall

thinning,<sup>19</sup> and is responsible for the most severe cases. In our study, 38% of injuries, and almost all open globe trauma, were caused by glass splinters. Conversely, plastic and metal cans pose little danger: we found no related injury among the 12 889 cases. Use of plastic bottles and screwcaps helps reduce the incidence of bottle related injuries: their annual number and rate gradually decreased in the USEIR from seven (0.9%) in 1991 to one (0.2%) in 1997, and we noticed similar trends in Hungary and Mexico. The US Consumer Product Safety Commission (CPSC) estimated that 32 000 people were treated in emergency rooms for bottle related trauma in 1974; a recent search conducted at our request on the CPSC database found only 12 such injuries in 1990 and five in 2000. A similar search of the National Electronic Injury Surveillance System database identified 22 cases in 1990 and seven in 2000.

The pressed metal top with corrugated edge, however, remains a threat, especially if the opener is not readily available.<sup>2</sup> Roll-on caps reduce the risk of injury.

The proportion of trauma caused by cork/cap versus glass varies by country. Glass was responsible for 87% in Kuwait,<sup>1</sup> as opposed to 24% in Germany<sup>21</sup> and 20% in Israel.<sup>18</sup> Based on available data, it is impossible to determine the causes of this disparity, although we suspect higher glass use in Kuwait.

Among bottle tops, the champagne bottle cork<sup>8 13 18–20</sup> remains the main culprit. A 750 ml champagne bottle contains 4.125 litres of carbon dioxide with a pressure of 6.2 bar—almost three times higher than a typical car tyre’s (Champagne France Information Bureau, 2002); this can shoot the 30 g cork up to 13 metres. The blinking reflex offers no help: from the typical opening distance of 60 cm, the cork needs less than 0.05 seconds to reach the eye. We found no champagne bottle cork related injury in the MEIR, a 0.06% rate in the USEIR, and a 2.2% rate in the HEIR ( $p < 0.0001$ ). Since Hungarians do not drink disproportionately more champagne than Americans, there must be another explanation for this disparity.

In the United States, most champagne bottles carry conspicuous warning labels (fig 1), explaining the dangers to the eye and showing the correct way of bottle opening. Even if a bottle has no such warnings, the person is likely to be aware of the threat from previous occasions. No champagne bottle in Hungary has a warning label.

The ocular impact from the cork occurs at approximately 100 atm at 60 cm.<sup>8</sup> Since the energy is transmitted by a blunt object, contusion or rupture may ensue.<sup>6</sup> Among the 23 cases we identified in the literature<sup>8 20</sup> no rupture was reported; we found two ruptures among the 43 injuries in our series. Three of our 66 cases (5%) resulted in penetrating injury caused by shattered prescription glass.

Among 37 eyes in the HEIR, 71% had injury involving the posterior segment, and of those with adequate follow up, 17% remained legally blind with only 54% reaching 20/40 or greater final vision. These numbers underline the need to prevent champagne bottle cork injuries.

**Table 1** Findings in the US (USEIR), Hungarian (HEIR), and Mexican (MEIR) eye injury registries

	USEIR	HEIR	MEIR
Study period	1 January 1982– 31 December 1999	1 January 1989– 31 December 1995	1 June 1992– 31 May 2002
All cases in database	10 310	1664	915
Bottle related	30 eyes of 30 patients (0.3%)	52 eyes of 52 patients (3.1%)	8 eyes of 8 patients (0.9%)
Men (%)	67	53	86
Age (years)	24 (2–53)	36 (2–70)	29 (11–55)
Bystanders (%)	26	22	50
Agent	Glass: 24 (80%); champagne bottle cork: 6 (20%)	Glass: 5 (10%); cap: 10 (19%); champagne bottle cork: 37 (71%)	Glass: 5 (63%); cap: 3 (38%)
Injuries occurring at home (%)	43	61	75
Left eye (%)	60	34	50
Open globe injury (%)	80	17	75
Retinal injury (%)	50	42	38
Number of surgeries performed	None: 13%, one: 44%, two: 30%, three or more: 13%	None: 62%, one: 29%, two: 5%, three or more: 3%	None: 25%, one: 63%, two: 13%
Initial visual acuity	NLP to 20/20; median: HM	NLP to 20/25; median: HM	HM to 20/30; median: 20/70
Final visual acuity	NLP to 20/20; median: 20/70	NLP to 20/20; median: 20/70	LP to 20/30; median: 20/50
Improvement (%)	50	68	57
No change (%)	38	22	29
Deterioration (%)	12	11	14
Eyes remaining legally blind (%)	43	16	29

NLP = no light perception; HM = hand movements; LP = light perception.

In conclusion, bottles containing carbonated drinks can cause severe ocular trauma. Among patients with adequate follow up in the combined USEIR/HEIR/MEIR database, 26% of eyes remained legally blind. Injuries occur even if the bottle is handled properly,<sup>19</sup> but the risk markedly increases if the bottle is not chilled or is improperly handled.<sup>1–3</sup> The risk of

ocular trauma is not restricted to the person handling the bottle: more than one fourth of patients in our combined database were bystanders. Trauma caused by the broken glass typically results in more severe damage, requires more surgical interventions, and has worse prognosis than that caused by flying bottle tops. Open globe injury can also result from broken prescription glasses.

There are several ways to reduce the injury risk. School campaigns should be waged since children are the most susceptible.<sup>1–14</sup> The use of plastic bottles, metal cans, and plastic screws, rather than glass and pressed metal caps, is crucial. Conspicuous warning labels should be placed on all champagne bottles. Based on this study, we plan to approach manufacturers—or legislators if need be—in Hungary and request label placement, which serves the interest of the industry as well by reducing liability. The use of specialised opening tools (such as the PerfectPop, [www.perfectpop.com](http://www.perfectpop.com)) should also be encouraged since these also decrease the risk.

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**Figure 1** Following removal of the wrapping foil, warning cartoon and label on the top of the champagne bottle cork become visible, reminders of the risk of and the need to prevent eye injuries.

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