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Analysis of fire deaths in Poland and influence of smoke toxicity

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ABSTRACT

Dwelling fires have changed over the years because building contents and the materials used in then have changed. They all contribute to an ever-growing diversity of chemical species found in fires, many of them highly toxic. These arise largely from the changing nature of materials in interior finishes and furniture, with an increasing content of synthetic materials containing higher levels of nitrogen, halogen and phosphorus additives. While there is still a belief that carbon monoxide is the major lethal toxic agent in fires, the hydrogen cyanide and acid gases released from these additives are now well-recognised as major contributory causes of incapacitation, morbidity and mortality in domestic fires.

Data for the total number of 263 fire death cases in the Mazowieckie region (mainly Warsaw area) of Poland between 2003–2011 for dwellings fires were obtained from pathologists, forensic toxicologists, fire fighters and analysed. Factors contributing to the death such as the findings of the full post mortem examination (age, sex, health status, burns), the toxicological analysis (carbon monoxide, alcohol etc.), and a thorough investigation of the scene (fire conditions, fuel, etc.) were taken into account and are summarised.

1. Introduction

Dwelling fires have changed continuously since the 1950s, mainly because the composition of the materials used in buildings and their contents have changed. These changes contribute to an ever-growing diversity of chemical species found in fires, many of them highly toxic [1,2].

These arise largely from the changing nature of materials in interior finishes and furniture, with an increasing content of synthetic materials containing higher levels of nitrogen, halogen and phosphorus additives. While there is still a belief that carbon monoxide is the major lethal toxic agent in fires, the hydrogen cyanide, acid gases and organic environmental contaminants released from these additives are now well-recognised as major contributory causes of incapacitation, morbidity and mortality in domestic fires [3–5].

According to the UK fire statistics [1,6] a progressive shift in the main cause of death from 'burns' to 'overcome by toxic gas or smoke' is clearly demonstrated for dwelling fires over the period from 1955 to the present. While the incidence of burns has remained stable, a very large rise in the fire toxicity deaths and injuries is demonstrated up to the late 1980s (Fig. 1) and a much higher proportion suffering from toxic gas inhalation than burns is evident (note that from 1980 a new data scoring category "smoke and burns" was introduced for fatalities with both severe smoke exposure and burns, rather than assigning them to one category or the other, as in previous years. Where subjects survive long enough to suffer a near fatal or fatal smoke exposure, burns tend to occur towards the end of the exposure or after death). In the UK, since the introduction of the furniture flammability regulations in 1988, and the increasing use of domestic smoke alarms in the early 1990s, there has been a progressive decline in fire deaths and injuries [7]. In the UK the years following the introduction of the furniture flammability regulations coincided with a large increase in the use of domestic smoke alarms (from 15% of dwelling in 1980 to 75% in 1994). During the period up to 1999 the annual number of deaths decreased but the numbers of fires and numbers of smoke injuries continued to increase. From around 1999, by which time the

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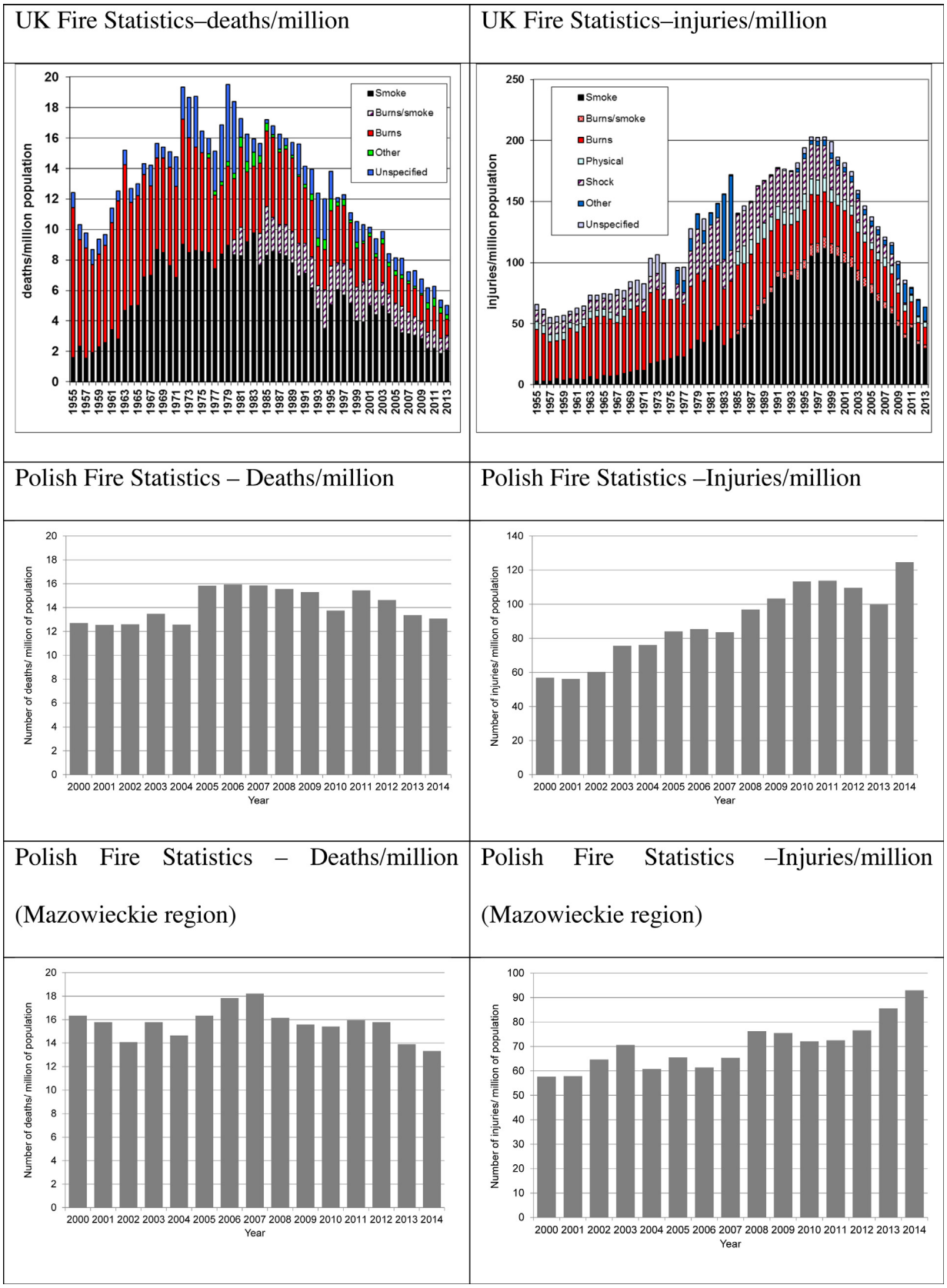

Fig. 1. Comparison of the number of fire deaths and injuries in UK and Poland.

post-regulation furniture and bedding had made a significant market penetration, deaths continued to decline, while injuries and numbers of fires also started to decline. It is considered that the initial decrease in death rate most likely resulted from earlier fire discovery due to smoke alarms. The later improvements resulted from a beneficial combination early warning from smoke