

Smoke alarms: evaluating effectiveness

Evaluating effectiveness

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Fire research is challenging our beliefs about smoke alarms or smoke detectors by showing that socio-economic status (SES), age and other variables can significantly affect the efficacy of the devices.

Smoke alarms are often touted as the most effective device to save lives in the event of a fire, but the actual extent of their efficacy is as yet unknown. This article delves into the issue by examining research into smoke alarms and other factors that contribute to fire-related fatalities.

These are some of the factors considered by studies of how smoke alarms impact fire-related injury and mortality in urban homes:

- The effect of socio-economic status on fires and fire-related injury and death.
- The link between fire-safety consciousness and the changes in fire mortality and fire injuries.
- The effectiveness of smoke alarms to wake up children in the event of an emergency.

Socio-economic status

Based on numerous studies, it is apparent that people of a low SES are more likely to be involved with a residential fire. But in what way does low SES impact fire risk?

One study, by Duncanson et al. in the *Fire Safety Journal* in 2002, found that 40 per cent of the unintentional fatal domestic fires from 1993 to 1998 occurred in the most socio-economically deprived 20 per cent of the population.

The study obtained its data from the New Zealand Fire Service's Fire Information Recording System. The dataset only contained unintentional residential fires with fatalities. The researchers combined New Zealand census data with a socio-economic deprivation index to determine which areas had the lowest SES. This data was then geo-coded with the address of the fatal fire injuries.

In the study by Duncanson and colleagues, it is noted that the results are consistent with international findings, which suggest that those who live in more deprived areas are more likely to be at risk of fire-mortality.

Another study, by DiGuseppi et al. in the *British Medical Journal* in 2002, analyzed the benefits of giving smoke alarms to people in deprived areas in the United Kingdom. One group of people in a deprived multi-ethnic urban area received no smoke alarm intervention, while another group was given free smoke alarms with installation kits and educational brochures. Over 20,000 smoke alarms were distributed in total. Changes in fire incidents and fire-related injuries for both groups were monitored over a two-year period.

The study authors found only a minimal decrease in fire-related injuries among the smoke detector group, while, astonishingly, the group that was not given smoke alarms displayed a much larger reduction. These findings differed greatly from a similar U.S. study by Mallonee et al. (1996) that had shown a 74 per cent reduction in the injury rate per 100 residential fires.

Mallonee's study in the *New England Journal of Medicine* found that giving away smoke alarms actually reduced the rate of fire-related injuries in residential homes. Working in areas of Oklahoma City with the highest rate of fire-related injury, the researchers gave away over 10,000 smoke alarms and conducted follow-ups to ensure the alarms were installed correctly and still operating. The data was collected from three years prior to the give-away program and for four years after.

As mentioned previously, the researchers found a 74 per cent decrease in the injury rate per 100 fires compared to a 32 per cent increase in the rest of the city. The decrease, however, cannot be attributed solely to the give-away program. Other considerations must include the decrease in the number of fires, the increase in fire-educational efforts, publicity about the program and the overall decline in injury rates in the area.

It is important to note that neither of these studies accounted for the age of the home that was on fire. We know those of a lower SES usually live in older, less expensive homes. Perhaps the age of the home plays a role in fire in the communities with low SES. Further research should be taken to explore age of home as a factor.

Fire safety and fire injury rates

In a similar vein, researchers have studied the difference in fire rates and fire injury/mortality rates between those with a working smoke alarm, a

disabled smoke alarm or no smoke alarm. In an article published in *Fire Engineering* in 2000, Crapo argues that perhaps people with working smoke alarms are more fire-conscious and therefore are not at as high a risk of being injured or killed in a house fire.

According to Crapo's article, the National Fire Prevention Association claims that smoke alarms are 40 to 50 per cent effective in preventing fire mortality. But these numbers are based on the actual number of fire-related deaths before smoke alarms were introduced in 1977 (5,856) compared to the number of deaths in 1997 (3,360). As well, the NFPA claim does not consider that there were also nearly half as many fires in 1997 (395,500) as in 1977 (723,500). When looking at the number of deaths per 1,000 fires, the number drops from 8.11 to 8.5 when smoke alarms are present -- a 4.8 per cent increase in fire-related deaths, not a 40 to 50 per cent decrease, as the NFPA claims.

While only seven per cent of the homes do not have smoke detectors installed, amazingly, over 40 per cent of the fires occur in the homes without fire alarms, meaning they are at a higher risk of fire. These homes also had a fire-mortality rate 24 per cent above the national average, while homes with non-working alarms had a mortality rate 11.5 per cent below the average.

Homes with non-working alarms should, in theory, yield the same results as homes with no alarms at all, however, there is a lower mortality rate in homes with alarms that do not work, which lends credibility to Crapo's assertion that fire-safety consciousness may be the true reason for a reduction in fire mortality.

Smoke detector efficacy and children

Still another study has raised the issue that smoke alarms may not be as effective in waking sleeping children as one would hope. In a 1999 *Fire Safety Journal* article, Bruck found that only 5.6 per cent of children aged 6 to 15 reliably woke up from smoke alarms reaching 60 decibels (considered the normal level of smoke alarms) at their pillow. Comparatively, all the adults in the study reliably awoke from the same alarms.

While the sample in this study is small and thus conclusions can't be generalized to all populations, it does indicate that smoke alarms are not as effective as we would like them to be. Bruck suggests that installing inter-connected alarms in each room of the home would increase their efficacy, as would raising their volume up to 85 decibels.

Conclusions

We can see that existing research is inconsistent and conflicting. Concrete conclusions cannot be drawn. Further research into smoke detector efficacy is needed, but these studies offer some thought-provoking theories to those in the fire safety business:

1. Homes without alarms, usually associated with lower socio-economic status, are at a higher risk of fire and fire-mortality. Merely giving smoke alarms to them, however, is futile without increasing their level of fire safety consciousness. The research suggests this is as important as alarms in saving lives.
2. Louder, inter-connected alarms in every room may do a better job of waking up children as well as adults and getting them out of the house faster.

Future research

As previously mentioned, it may be of value to look at the age of the home burned in conjunction with SES. This will be insightful because, as mentioned by Crapo, homes without smoke alarms account for over 40 per cent of fires, despite only seven per cent of homes being without alarms.

Perhaps the fires are occurring in homes built prior to smoke alarms becoming mandatory in newly built homes.

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