Identifying causal and contributing mechanisms and risk factors of fire deaths and injuries

– research in Sweden 2014-2019

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Why do not all residential fires cause people to die?

With whom do fires occur? (Incidence)

Safety equipment

Capability

Who die in fires? (Mortality)

Knowledge

Injury (Morbidity)
The public health approach to prevention

1. Define and analyze the problem
2. Develop interventions
3. Implement interventions
4. Evaluate and refine

Facts
Evidence
1) database on fatal fires held by MSB
2) database on forensic medical examinations held by the National Board of Forensic Medicine
3) cause of death register held by the Swedish National Board of Health and Welfare
Results

• 75 % of the fatalities were found in all three sources

• The national database on fatal fires, serving as the principal source for policymaking on fire prevention matters, underestimates the true situation by 20 %
Fatal fires in Sweden

- Residential fires
- Fires after traffic incidents
- Fires in parked cars
- Fires in person
- Other fires (e.g., grass fires)

n = 830 (78%)
Fatal fires - materials

1999-2007

1 2 3

= Residential fires

893 fatalities
830 fires

Analyses performed by the forensic toxicology laboratory
Rescue service incident reports
Eight variables were included in a cluster analysis

- residential category
- cause of fire
- room of origin
- object of origin

- age
- gender
- presence of alcohol in blood
- primary injury diagnosis
Typical scenarios - fatal residential fires

- Smoking-related, fire in clothes (17 %)
- Smoking-related, fire in bed/sofa (30 %)
- Kitchen, cooking appliances (8 %)
- Deliberately set fires (7 %)
- Houses, electrical fault (13 %)
- Houses, unknown cause (25 %)
<table>
<thead>
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<th>Smoking-related, fire in clothes (17 %)</th>
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<tr>
<td>+ Smoking</td>
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<td>✤ Bed/sofa/armchair</td>
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<td>✤ 45-64 years</td>
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<td>✤ Bedroom or livingroom</td>
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**Deliberately set fires**  
(7 %)

- Deliberately set
- Flammable substances
- Men
- 20-64 years
**Houses, electrical fault (13%)**

- Electrical fires
- Single family homes
- 5-19 years
- 80+ years
<table>
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Fire fatalities in Sweden 1999 to 2007
n=1172

= residential fire
n=893

≥ 20 years old
n=861

= non-residential fire
n=279

1 Four randomly selected controls matched by gender and year of birth from Total population register (TPR)

n=3400

= match in TPR on PIN
n=850

Total study population
n=4250

Sociodemographic variables
- Real Estate Tax Assessment Register
- Longitudinal Integrated databases on the Insurance and Labor Market (LISA)
Case-control study:
-Fatalities versus general population (matched)
Smoking-related, fire in clothes (17 %)

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- Alcohol
- Intoxicated

**Fatalities**
- 90 % living alone
- 68 % living in rented housing
- 83 % under median income
- 6 % living in rural area

**Controls**
- (58 %)
- (42 %)
- (69 %)
- (15 %)
Why do not all residential fires cause people to die?

- With whom do fires occur? (Incidence)
  - Safety equipment
  - Knowledge
  - Injury (Morbidity)

- Who die in fires? (Mortality)
  - Capability
Material/Method

- A stratified sample (n = 20,000) of the Swedish population regarding if the household had experienced a fire during the past 5 years (2008)

- Respons rate = 70%

- Log-binomial regression models were applied to obtain covariate-adjusted risk ratios
Results

**Increased risk of residential fires**

- having a high education level
- being born outside of the Nordic countries
- having children 6–12 years living at home

**Decreased risk of residential fires**

- elderly
- living in rented houses
- living in multi-family houses
## Risk factors – residential fires

### Approx 20,000 residential fires per year.

**Risk factors:**

- High education
- Families with children
- Born in non-Nordic European country
- Being old
- Living in rented housing
- Living in multi-family home

### Approx 85 residential fire fatalities per year.

**Risk factors:**

- Being old
- Being male
- Living alone
- Low income
- Health-related early retirement
- Social allowance
- Tertiary education
- In employment
- Living in urban area

**Observations:**

+ Smoking
+ Alcohol
Characteristics of household
(some possible explanations?)

High level of fire protection equipment:
- House
- Living with partner

Fires not attended by rescue service:
- Born in Sweden
- House
- High income

High fire-safety knowledge:
- Born in Sweden
- House
- High income
- 30-64 years old
- Male
- Living together with child
Why do not all residential fires cause people to die?

Safety equipment

Capability

With whom do fires occur? (Incidence)

Knowledge

Injury (Morbidity)

Who die in fires? (Mortality)
The injury pyramid - residential fires in Sweden

- **Fatal injury**
- **Inpatient care**
- **Treatment at emergency dep.**
- **Treatment on the scene of the accident**

### Relation | Age (Median) | Abs. number
--- | --- | ---
1 | 65 | ≈ 80
2.4 | 55 | ≈ 200
5 | 44 | ≈ 900
6 | | ≈ 20 000

Residential fires without injuries
Factors contributing to survival and evacuation in fires involving older adults (2019)

Marcus Runefors, Anders Jonsson & Carl Bonander
Evacuation - Flow-model for older adults (65+) injured by residential fires

- Evacuation by neighbors (15%)
  - N=453
  - n=61

- Evacuation by first-responders (23%)
  - N=363
  - n=94

- Self-evacuation (34%)
  - N=589
  - n=136

- Evacuation by homecare (7%)
  - N=392
  - n=29

- Fatality (20%)
  - N=269
All ages and both gender: 43 %

**Alcohol ≥0.2 %**

![Bar chart showing alcohol consumption by age group and gender](image)

- Males
- Females

Percent

- **0-19 years**
- **20-59 years**
- **60+ years**

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**0-19 years**

- Males: 10%
- Females: 20%

**20-59 years**

- Males: 70%
- Females: 60%

**60+ years**

- Males: 30%
- Females: 20%
Alcohol ≥0.2 ‰
Five chances to avoid dying or getting seriously injured from fire

Preventing → Responding → Escaping → Rescuing → Curing

Outcome: Deaths
Serious injuries
“mortality at hospital (after burns) was almost two times higher at the beginning of the period than that at the end of the period”