

Article

Burden of fire injuries in Finland: lost productivity and benefits

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There is little scientific knowledge about fire-related injuries and their consequences. This study addresses this public health problem and yields results potentially useful for designing preventive measures where costs are weighed against the benefits especially when augmented with direct costs.

Abstract

Background: The aim of this study was to assess the economic burden of fire-related injury from two perspectives: post-injury social security compensations and also productivity losses due to the lost productive time from a societal perspective induced by the injury.

Design and methods: A cohort of 1503 inpatients who sustained fire-related injury during the period 2001–2005 was retrospectively followed up for 5–10 years until the end of 2010, using linkages between several administrative registers. The study process was started in 2015 and finalized on March 2016.

Results: Annual productivity loss was on average EUR 5.72 million, giving a total for the five-year study period of EUR 28.6 million, with a mean value of EUR 19,070 per person. Mean/median disability time for those who received benefits was 572/63 days, ranging from 3 days to 36.5 years. Total average cost of benefits to the injured annually during the study period was EUR 1.03 million. This equates to EUR 3430 per patient for the whole cohort or EUR 14,860 for those who received benefits.

Conclusions: The burden of fire-related injuries in terms of payment transfers and lost productivity due to periods of disability as indirect costs is high; in a population of 5.4 million, the annual loss exceeded EUR 5.7 million. The results could be used in planning preventive measures and therefore yield savings.

Introduction

This study is part of a larger study looking at the costs and consequences of fire-related injuries nationwide. The aim of this particular study was to assess the indirect economic burden of fire-related injuries in terms of productivity losses due to time spent impaired and social security benefits received as payment transfers. Prior to the study rescue services and safety authorities did not have the information they needed about fire-related injuries. This study is to remedy the situation.

Injuries play a major role in premature deaths and morbidity overall. A non-negligible part of injuries, fire-related injuries, cause great suffering and a number of premature deaths. The incidence of fire-related deaths in Finland has been mostly higher than in other Nordic countries.¹ Circumstances of fire-related deaths in Finland have been

reported thoroughly by Kokki.² The annual number of deaths has been around 80–100. Additionally, there are approximately 300 severe fire-related injuries that lead to inpatient care annually in the Finnish population of some 5.4 million. The main fire-related injury is burn injury (77%), followed by combustion gas poisoning (17%). Burn cases require much more care resources than combustion gas poisonings. However, it is important to note that the majority of fire-related deaths are attributable to combustion gas poisonings.³

The direct health care costs of these injuries in Finnish settings are well-known and have been reported earlier. Using incidence-based methodology, treatment costs were estimated to be approximately EUR 6.2 million annually. Of these, burn injuries cost approximately EUR 5.9 million, while those with only combustion gas poisoning cost some EUR 0.2 million. The mean cost per fire-related burn patient was EUR 25,000 and for those with combustion gas poisoning EUR 3600.⁴ Therefore, the direct costs are not assessed in this study.

Many studies have focused on burn injuries in general, but a between-country or -community comparison that considers fire-related injuries in particular is difficult, due to a lack of specific research. However, Sanchez *et al.*⁵ published a rigorous burn injury study *Socio-economic cost and health-related quality of life of burn victims in Spain* in which they found that the majority (80%) of costs were indirect costs, such as from early mortality and productivity losses due to disability.

Finland has an extensive social security system. The Ministry of Social Affairs and Health is responsible for implementing government policy on social security. Entitlement to services and benefits is universal for all people resident in the country. The system is funded primarily through taxation and employment-related contributions. In Finland, there are two main public administrations responsible for implementing benefits; the Finnish Centre for Pensions (ETK) for earnings-related benefits and the Social Insurance Institution (Kela) for other national benefits. ETK's register includes both private and public sector pensions, but not basic pensions granted by Kela. Kela's register covers old age, unemployment, disability and family benefits for those who have not been working with pension insurance or who have accumulated only very low amounts of pension in addition to the Kela pension and are not able to manage otherwise.

The study protocol was approved by the Ethical Review Board of the National Institute for Health and Welfare (1/2011: §279/2011, 27.01.2011). Informed consent was not required since the data were anonymous register data.

Design and methods**Source of data**

The cohort of inpatients injured during the period 2001–2005 was determined from the Finnish Hospital Discharge Register.¹ Register data concerning disability pensions, rehabilitation, disability and sickness allowances were obtained from the Social Insurance Institution

of Finland and the Finnish Centre for Pensions. The number of work-related injury compensated days were obtained from the Statutory Accident Insurance. These data were issued to us by both of the aforementioned institutes as being potentially relevant to injuries. Sickness and rehabilitation allowances, funds for rehabilitation services, disability allowances (given separately for children under 16 and for those aged 16 and over), disability pensions, benefits for pensioners and work accident data were linked by the unique encrypted personal identity number for cohort members. Work accident data did not contain monetary information.

Methods and assumptions

Social security benefits (as recorded in registers) were considered as relating to the injury if there was a diagnosis indicating a burn injury or combustion gas poisoning (ICD-10:⁶ T20-T32, T58-T59). Additionally, if the benefit receipt began closer than one week to the beginning of inpatient care or earlier than one week after the end of inpatient care it was considered to be injury-related. Exceptionally, those with a recorded diagnosis implying mental illness (ICD-10: F20-F39) were excluded, since it is not declared whether it is a condition aggravated by the injury or more likely a pre-existing morbidity that would need care regardless of the fire injury.⁷ Benefit records were considered as on-going benefit episodes if the end date of the former record was less than one week before the latter record. Benefits occurring during the period 2001–2010 were assessed. The benefit records were fetched from the benefit registers for all patients (which were identified by the Finnish Hospital Discharge Register) who were injured during 2001-2005.

We calculated lost productivity during the time of illness. Productivity loss was considered to consist of two components: labour force productivity and household work. Labour force losses were calculated from the time of the inpatient admission until the end day of the last benefit payment. It requires a person to have received an income prior to the allowance, although it includes students studying for a degree and those registered at the Employment and Economic Development Offices as a job seeker available for employment promotion activities). If a person had sustained an injury at work, the compensation will come from statutory work injury insurance. Therefore, we calculated the lost labour productivity for the length of the period from the beginning date of the first inpatient admission to the end date of the last benefit thus covering the continuum of incapacity to work. This means that we used the duration of benefit episode as a proxy for the duration of disability as a fraction of a year.

Income distribution was assumed to be according to the private sector median salaries inflated by a factor of 1.3 (given by Statistics Finland, to account for workforce costs). Productivity losses were assumed to equal workforce costs.⁸ Income losses and other issues due to fire-related deaths were excluded from this study as they have been published in a separate study.³

Lost household work was calculated during inpatient time and also after discharge from a ward as the functional capacity after inpatient care may continue to be reduced for a period of time. During inpatient time full household work loss was imposed as it's not possible to be productive during the hospital stay. Post-discharge household work loss was adjusted by a factor of 0.24, which is the average burn injury disability weight reported in a Global Burden of Disease 2013 study.⁹ The monetary loss distribution for household work was assumed to be the same as used with fire-related deaths.³

For those having no identified benefits (73%), we defined the duration of disability by using the mean disability times according to those, who had recorded sickness allowance benefits.

Productivity losses due to injuries were valued using a standard Human Capital method.¹⁰ The lost productive time due to the injury was valued by age- and gender-specific workforce cost. Additionally, the

lost productive time was also valued by age- and gender-specific household work cost.³ Together these accumulate the productivity losses attributable to the injuries.

Monetary values used were year 2010 euros, while using a three per cent yearly discount rate for disability periods lasting longer than a year.

The follow-up time for each patient was 5-10 years depending on the year they were injured; those injured at the beginning of 2001 had a 10-year follow-up and those at the end of 2005 a 5-year follow-up. This is because the last register year was 2010. Patients with on-going disability receipt without a further expiration notice were assumed to be disabled for 10 years (*i.e.* the same as the maximum observable follow-up time for those injured during 2001).

Statistical methods

Arithmetic means, medians and percentages were used as basic descriptive measures to characterize the quantities of interest. R software version 3.2.2 was used for the data analyses.¹¹

Results

Study population characteristics

Nationwide we identified 1503 inpatients who sustained fire-related injury leading to inpatient care during the period 2001-2005. The majority were males (74%). The mean age for males was 39 years and for females 48 years. Eighty per cent had sustained a burn injury, while 14% had combustion gas poisoning without a burn injury. A small fraction of other miscellaneous injuries were present in the data.

Some 5% of the cases were work-related, with compensation paid from the Statutory Accident Insurance.

Disability duration

In determining the duration of disability we used the time lapse between the beginning of the first inpatient care and the end of the last relevant benefit.

Strictly for those who had recorded benefits, the mean/median period of disability was 572/63 days, ranging from 1 day to 36.5 years. Six per cent (25 out of 410) of those who received benefits or 2% of all the cases (25 out of 1503) had disability episodes declared or were prospectively expected to last for 10 years or more. Hospital mortality was 6% among inpatients. Mean/median inpatient time for the deceased was 36/4 days.

For those who had no records of benefits, imputed mean values based on existing duration values were used due to missing data on post-discharge contingency. Among these the mean/median period of disability was 63/36 days.

Benefits and allowances

According to the registers, 27% (410 out of 1503) of cohort patients received some social, work-related or health care benefit that could plausibly be related to the injury. Twenty-one per cent received sickness allowance, while 6% received other benefits without sickness allowance. Among working age persons, 35% received allowances, which implies the employment rate could be at least around 35%.

Total benefits paid to annual incident cases with burn injury or combustion gas poisoning ranged from EUR 699,000 to EUR 1.35 million annually, with an overall annual average per year of EUR 1.03 million (Table 1). The total amount for the five-year cohort reached EUR 5.15 million. This is EUR 3430 per person among all patients and EUR 15,940 among those who received benefits (other than work injury insurance compensation).

Productivity losses

The annual burden of fire-related injuries was estimated using the Human Capital approach for productivity losses to measure potentially lost productivity and household work. Annual average losses for the injured during the period 2001-2005 ranged from EUR 3.50 million to EUR 9.23 million. Total productivity losses for the entire cohort of 2001-2005 yielded EUR 28.6 million, giving a mean/median loss of EUR 19,070/585 per person. Among working age persons the figures were EUR 25,590/761 per person.

Discussion

The aim of the study was to estimate the burden of fire-related injuries in terms of lost productivity due to periods of disability as indirect costs. Secondly, payment transfers were noted. Lost productivity gives a societal perspective on the issue. Lost productivity includes lost labour production and lost/diminished household work.

To our surprise, only 27% of patients could be identified as receiving some benefits post-injury. Among working-age people, the number was 35%, which is similar to the employment rate for the victims of fire-related deaths in our previous study.³ As we identified the related benefits by strictly relevant diagnoses and/or plausible temporal connections, it is possible that even several injury-related episodes were assigned with different diagnoses and thus have been overlooked. Sickness allowance was the most common benefit (21% in receipt). A person can be granted sickness allowance on condition that they earned income pre-injury. It often happens that the injured tend to be socially disadvantaged and outside the labour force.^{2,3} However, it is unrealistic to assume that all those not receiving benefits would have no period of disability post-injury. Disability in this case manifests as household productivity loss. Therefore, while having no further information, an imputation of the expected period of disability was applied. Mean imputation for cases with unknown values was based on the relationship between inpatient time and disability time, according to known values (Table 2).

Little research exists on fire-related injuries and specifically on the costs and burden of such. Our earlier research involved direct inpatient care costs among all inpatients due to fire-related injury in Finland.⁴ This present study attempts to estimate indirect costs of these injuries in addition to the previously obtained direct costs. When broadening the scope to concern any kind of burn injuries instead of strictly limiting to the fire-related aspect, few studies emerge. A Dutch study included all eligible working-age patients (n=104) admitted to the burn centre of Rotterdam during August 1, 2011 to July 31, 2012.¹² Of the patients (n=104) 66 were pre-employed and 70% was back at work after 3 months, 92% after 12 months while 8% had not returned to work at the final follow-up time of 24 months. They calculated loss in productivity to be some EUR 11,916 per employed patient. In our current study a half of the assumingly pre-employed had recovered within two months. In another study from the Netherlands a three month follow-up study on economic burden of burn injuries was conducted.¹³ They found that flame burns were significantly more costly than other types of burns. It was observed that 69% of employed in a paid job pre-injury had returned to work during the three month follow-up and lost productivity due to the injuries during this period exceeded EUR 5000 per patient on average. This is naturally smaller than our estimates as the follow-up time was only 3 months (*vs.* 5-10 years by us). Even though the majority of workers return to work, there is some evidence that their quality of life post-injury in many cases is lower than pre-injury as long as after 12 months follow-up.¹⁴ Polinder *et al.*¹⁵ studied costs and productivity losses due to various injuries in Netherlands. They obtained

the total annual cost of unintentional and intentional injuries to be EUR 3.5 billion. The mean cost per injured patient was EUR 4300 in which EUR 2500 was direct health care cost and EUR 1800 due to productivity cost. These figures include ER visits without inpatient care therefore partly consisting of less severe injuries. They found the highest cost associated with hip fractures of which majority were hospitalized. Mean care cost was EUR 19,717 and productivity loss EUR 34,518 which implies burn injury is not uniquely expensive. Additionally, a Dutch study on traumatic brain injuries (bicycle accidents) yielded mean care cost of EUR 4940 and productivity loss of EUR 14,680.¹⁶ The result is quite similar to ours.

Our study has weaknesses that need to be considered. To obtain monetary estimates for the economic burden of fire injuries, we used the human-capital (HC) method to obtain a value for productivity losses due to productive time loss, which has been criticized for not capturing all aspects of lost life.¹⁰ However, our rationale was to approach the economic burden from a tangible point of view using concretely measurable quantities. Therefore, any measures of intangible costs of suffering were omitted and these results could be considered as lower limits. More importantly, due to the lack of information on the period of disability for the majority of patients, we were constrained to using approximations. We used mean approximations. Regarding precision, the disability time was based on dividing the observed lost time in days by 365, therefore not taking account of possible holidays. Although intended to cover the whole country, the hospital discharge register is not perfect.¹⁷ There is still some minor underreporting of external causes of injuries. Among all burn injuries the portion of missing causes was 5-10%, similar to the fraction of unspecified causes during the period 2000-2009. A portion of these likely consist of flame burns. Therefore, our analyses are likely to underestimate the total losses by a few per cent as a result of missing/unspecified causes. Finally, some of the benefit records may have been declared with a diagnosis other than burn or combustion gas poisoning, hence not being captured in the calculations. Therefore, the values we report can be considered as the very minimum values.

Table 1. Payment transfers for those injured 2001-2005 from Social Insurance Institution (Kela) and Finnish Centre for Pensions (ETK).

	Overall	Per year	Source
Disability pensions, rehabilitation support, sickness allowances	2,266,035	453,208	Kela
Disability pensions, rehabilitation support, survivors' pension	2,890,796	578,159	ETK
Overall	5,156,830	1,031,366	Both

Table 2. Mean disability times for imputation according to the duration of inpatient care with the known values and number of cases of the known values.

Inpatient duration, days	Mean disability time	No.
1	36	38
2-7	36	65
8-14	80	56
15-21	73	40
22-30	117	22
31-50	128	19
51+	156	19

Conclusions

The burden of fire-related injuries in terms of payment transfers and lost productivity due to periods of disability as indirect costs are high. In a population of 5.4 million, the annual productivity loss was on average EUR 5.72 million and benefits paid were on average EUR 1.03 million per year. Sickness allowance was the most common benefit, although the injured seemed often to be socially disadvantaged and outside the labour force. Aside of direct costs indirect costs of these injuries are considerable. Preventive measures should be explored accordingly as there are costs to be curbed by prevention.

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References

- Haikonen K, Lillsunde PM, Lunetta P, et al. Fire-related injuries with inpatient care in Finland: a 10-year nationwide study. *Burns* 2013;39:796-802.
- Kokki E. Palokuolemat ja ihmisen pelastamisesta tulipaloissa 2007-2010. B-sarja: tutkimusraportit 3/2011. Kuopio: Pelastusopisto; 2011.
- Haikonen K, Lillsunde PM, Lunetta P, Kokki E. Economic burden of fire-related deaths in Finland, 2000-2010: Indirect costs using a human capital approach. *Burns* 2016;42:56-62.
- Haikonen K, Lillsunde PM, Vuola J. Inpatient costs of fire-related injuries in Finland. *Burns* 2014;40:1754-60.
- Sanchez JL, Bastida JL, Martínez MM, et al. Socio-economic cost and health-related quality of life of burn victims in Spain. *Burns* 2008;34:975-81.
- World Health Organization. International statistical classification of diseases and related health problems. 10th revision. Geneva: WHO; 1992.
- Palmu R, Suominen K, Vuola J, Isometsä E. Mental disorders among acute burn patients. *Burns* 2010;36:1072-9.
- Official Statistics of Finland. Private sector monthly salaries [e-publication]. Helsinki: Statistics Finland. Available from: http://www.stat.fi/til/yskp/tau_en.html
- Salomon JA, Haagsma JA, Davis A, et al. Disability weights for the Global Burden of Disease 2013 study. *Lancet Glob Health* 2015;3:e712-23.
- Landefeld JS, Seskin EP. The economic value of life: linking theory to practice. *Am J Public Health* 1982;72:555-66.
- R Development Core Team. R: a language and environment for statistical computing. Vienna: R Foundation for Statistical Computing; 2010. Available at: <http://www.R-project.org/>.
- Goei H, Hop MJ, van der Vlies CH, et al. Return to work after specialised burn care: a two-year prospective follow-up study of the prevalence, predictors and related costs. *Injury* 2016;47:1975-82.
- Hop MJ, Wijnen BF, Nieuwenhuis MK, et al. Economic burden of burn injuries in Netherlands: a 3 months follow-up study. *Injury* 2016;47:203-10.
- Wasiak J, Paul E, Lee SJ, et al. Patterns of recovery over 12 months following a burn injury in Australia. *Injury* 2014;45:1459-64.
- Polinder S, Haagsma J, Panneman M, et al. The economic burden of injury: Health care and productivity costs of injuries in the Netherlands. *Accid Anal Prev* 2016;93:92-100.
- Scholten AC, Polinder S, Panneman MJ, et al. Incidence and costs of bicycle-related traumatic brain injuries in the Netherlands. *Accid Anal Prev* 2015;81:51-60.
- Haikonen K, Lunetta P, Lillsunde PM, Sund R. Methodological challenges in using the Finnish Hospital Discharge Register for studying fire-related injuries leading to inpatient care. *BMC Med Inform Decis Mak* 2013;13:36.