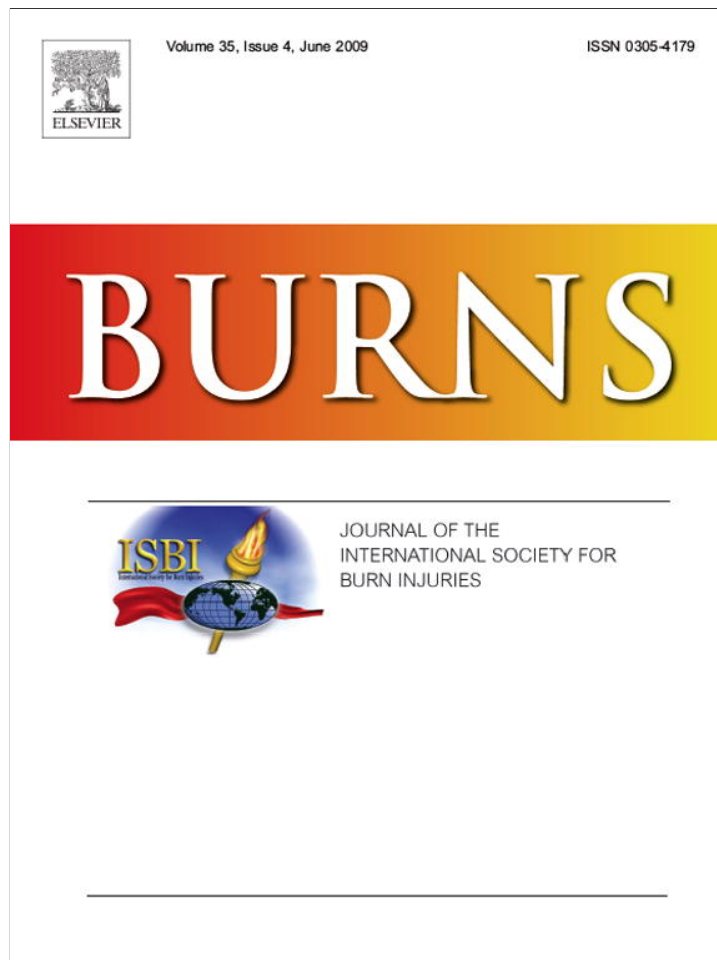


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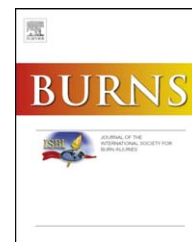


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The first 1000 patients treated in Kuopio University Hospital Burn Unit in Finland

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ABSTRACT

An epidemiological study on burn patients treated in a Finnish burn center has not been published before in international literature. This study reports the results of a retrospective study on the first 1000 patients treated in Kuopio University Hospital Burn Unit (KBU) in Finland.

Subjects: First consecutive 1000 patients treated in KBU January 1994–April 2006.

Results: The incidence of burns treated in our burn center was 6.8 patients/100,000/year. The median (iq-range) age of patients increased by 10 years during the study period to 39 (13–54) years. The median TBSA was 3.5 (1.5–10)% and 78% of burns were smaller than 10%. The male:female ratio was 2.64:1 and it also increased during the study period. Female predominance was found only in >80 years old patients. Most burns were scalds (34%) but flame was the major etiological factor in ICU and lethal burns. Every fourth burn occurred in a sauna. Inhalation injury was diagnosed in 2.7% of patients. Most patients (60%) underwent surgical therapy and 14.3% needed intensive care. The hospital stay was 1.4%/TBSA. The overall mortality was 4% but only 2.4% in those patients who were treated actively.

Conclusion: The median age and male predominance have increased during the study period. Every fourth burn is sauna-related therefore a target for prevention strategies.

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1. Introduction

Burn is a devastating injury which can lead to long hospitalization, multiple operations, painful dressing changes and permanent scarring. Optimal care for severe burns is provided in specialized burn units. There are two national burn centers in Finland. The Burn Unit in Kuopio University Hospital (KBU) was founded in January 1994. The extensive burns, patients with inhalation injury and/or respiratory compromise which require intubation and septic patients are treated in a general ICU in specially equipped rooms by specially trained nurses. The patients not needing intensive care are treated within the traumatology ward in isolated

rooms or in the pediatric surgery ward, depending on their age.

Patients are referred to KBU from all over Finland which is divided into 5 university hospital districts. The university hospitals serve as tertiary care facilities. However, burn patients can be sent from any university hospital district to either KBU or the other national burn unit in Helsinki, depending on the referring hospitals' preference. The burn unit in Helsinki receives patients mostly from the southern and western part of Finland whereas the KBU receives patients from the northern and eastern parts of Finland. If one burn unit is unable to admit severely burned patients, the other burn unit is most likely able to do so.

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As the incidence of severe burns is decreasing together with lower mortality and shortening of hospital stay [1] it is important to analyze the patient material treated over the years. The purpose of this study is to analyze the first 1000 burn patients treated in KBU.

2. Subjects and methods

This is a retrospective study on the first consecutive 1000 burn patients treated in KBU during January 1994 and April 2006. All patient charts were reviewed upon discharge and data entered in a computerized database. The recorded data included demographics, burn etiology, time of referral, referring units, length of hospital (LOS) and ICU stay, length of ventilator support, data regarding operations, skin grafting techniques, the relation to alcohol abuse, the presence of sepsis or organ failure, the use of inotropic medication, the need for renal replacement therapy, patterns of discharge and mortality. The results are presented as median (iq-range).

3. Results

The data regarding age, TBSA, length of stay in ICU and hospital and the use of alcohol and patients' origin (within or outside Kuopio University Hospital (KUH) district) are presented in Table 1.

The median age of all patients was 39 (13–54) years. The biggest age groups were children <10 years old (23.1%) and 40–49-year-old adults (16%) (Fig. 1). Pediatric patients (0–15 years) constituted a total of 27.4% of all patients. The majority of the patients were male (72.5%) giving a male:female ratio of 2.64:1. The male predominance and the median age of patients have increased during the study period (Fig. 2a and b) and the male predominance was evident in all age groups except in patients >80 years old.

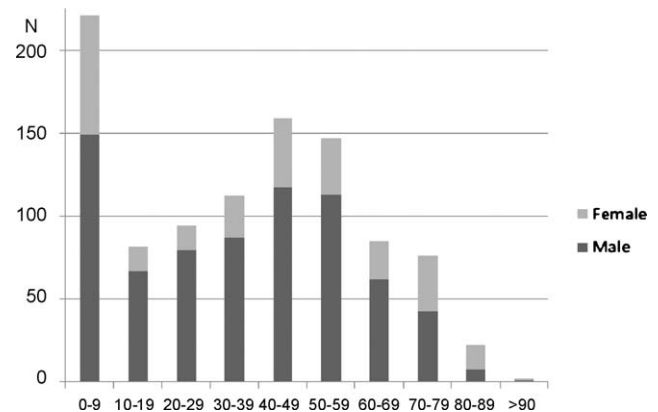


Fig. 1 – Age and sex distribution of patients.

Most burns were small with 78.3% having a TBSA smaller than 10%. The median TBSA was 3.5% (1.5–10%). Alcohol was associated in 18.1% of all burn injuries and in 15.1% of burns requiring intensive care. However, the data regarding alcohol consumption was absent in 181 patients (18.1%). There was a tendency of decline in the total number of burn admissions but not in burn patients requiring intensive care. The annual median TBSA has remained very constant (3–4.5%) (Fig. 3). The length of stay was 7 (3–13) days and 1.4 (0.8–3) days/% TBSA. There was a decrease in the median length of stay but not in the LOS/TBSA (Fig. 4) over the study period.

The majority of the patients (72.3%) came from the KUH district with an annual incidence of 59 patients from a population of 870000 people (6.8/100,000/year). The severe ICU burn patients (ICU stay >2 days) came mainly (78%) from outside the KUH district. Patients were referred to the burn unit 0 days after the accident (=on the day of the burn) and most (44.2%) patients were referred from a local health center (Table 2).

Almost 60% of burns (59.7%) happened at home or during leisure time activities. Additionally, there were 104 work-related burns (10.4%), 29 suicide attempts (2.9%), 10 assaults

Table 1 – Data regarding demographics, length of stay (LOS) in the hospital and intensive care unit (ICU) and where patients were referred from.

	All patients, N = 1000				ICU patients, N = 186			
	Median	iq-range	N	% (of all)	Median	iq-range	N	% (of ICU patients)
Male			725	72.5			143	77
Female			275	27.5			43	23
TBSA (%)	3.5	1.5–10			37	15–44		
Age (year)	39	13–54			40	24–54		
Baux index	47	18.5–66			73	49–90		
LOS (days) hospital/ICU	7	3–13			7	2–16		
LOS/TBSA	1.4	0.8–3			0.3	0.13–0.6		
LOS ICU >2 days							138	74
Alcohol			282	28.2			28	15.1
From within own university hospital district			723	72.3			51	27
From outside own university hospital district			277	27.7			135	73
From within own university hospital district (ICU >2 days)							30	22
From outside own university hospital district (ICU >2 days)							108	78

Data are presented as median (iq-range)

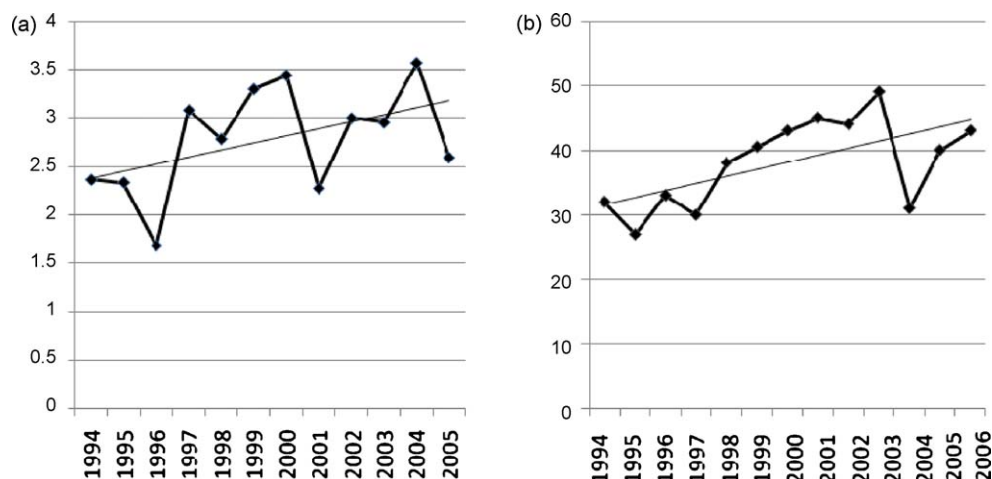


Fig. 2 – The (a) male:female ratio and the (b) median age of patients during the study years with trendlines.

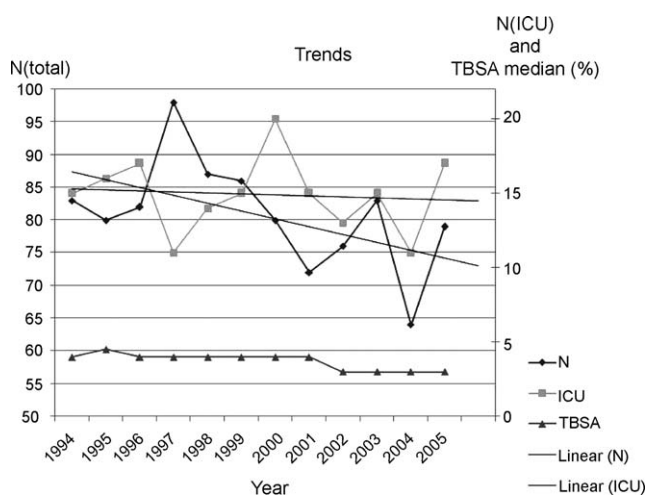


Fig. 3 – Numbers of annual burn admissions, ICU admissions and median TBSA (%) with relating trendlines.

(1%), and as many as 260 burns (26.0%) occurred in a sauna. Burn etiology is presented in Fig. 5a–c with scalds (33.9%), flame (31.1%) and contact burns (24.6%) being the most common factors in all burns. The incidence of flame as an

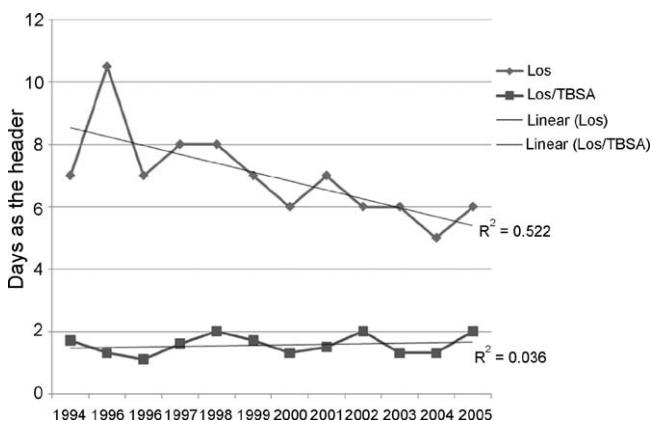


Fig. 4 – Median length of stay (LOS, days) and LOS/TBSA (days/%) with trendlines.

etiological factor increased in ICU burns (73.1%) and furthermore in burns leading to death (80%) (Fig 5b and c). The etiology of sauna-related burns is presented in Table 3.

Most patients (59.5%) underwent surgical therapy (Table 4) and as much as 87.6% of the ICU burns required excision and skin grafting. Sepsis was identified in 6.5% of patients and 7.9% of all patients required inotropic medication due to either sepsis or hypotension. Renal replacement therapy was initiated to 15 (1.5%) patients out of whom all patients who survived [10] regained normal renal function. Inhalation injury was diagnosed with bronchoscopy in 27 patients (2.7%) and ventilator support was required in 148 ICU patients with a median length of 8 (3–15) days. The length of ventilator support (days)/TBSA was 0.25 (0.1–0.45) days/%.

The detailed data of deceased patients is presented in Table 5. The annual mortality ranged from 0 to 6.4% and the overall mortality was 4.0% (40 patients) out of whom palliative care was initiated upon arrival to 16/40 patients (40%) due to poor prognosis. Hence, the mortality in patients with active treatment was 2.4%. The data showing the correlation between age and TBSA on mortality is presented in Fig. 5.

4. Discussion

The purpose of this study was to describe and evaluate the results of the first 1000 patients treated in Kuopio University Hospital Burn Unit in Finland (KBU). The burn unit consists of treatment units in different wards, including ICU, wards of traumatology and pediatric surgery, operating theatres and outpatient clinic. The outpatients and patients treated only in the emergency department are not included in this study (Fig. 6).

This study showed, as many previous studies [2–7] that the most common etiological factor in burns is scald representing 34% of all burns. However, as the burns became more serious in nature involving intensive care and further leading to death, flame became the most important etiological factor causing 73% and 80% of these burns, respectively. This is not surprising as flame causes in general deeper and more serious burns than scalds leading thus to more operations and a bigger need for intensive care. Scalds are not always the most common factor

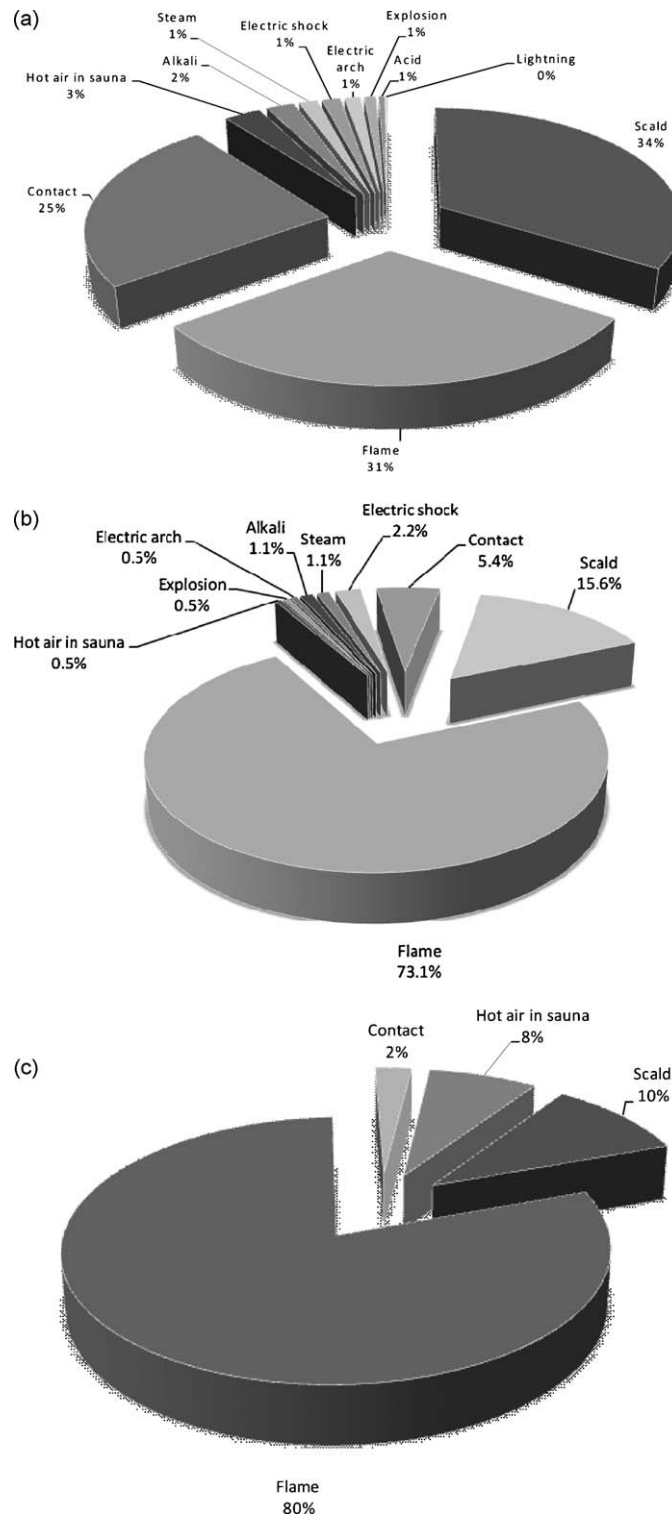


Fig. 5 – Burn etiology in (a) all burns, (b) ICU burns and (c) burns leading to death.

causing burns, as in Shanghai [8] and United States [9], for example, burns are most typically caused by flame.

The unique entity of this series is the very high number of sauna-related burns (26%) which has remained the same over the years. The report of our first 154 sauna-related burns was published 2002 (10). In that material 71% of patients were male and 40% were under the influence of alcohol. More

than 50% required operative treatment and it was calculated that there is 1 sauna-related burn per day requiring hospitalization in Finland. In this new material the majority of patients was still male (72%) and 32% were under the influence of alcohol, although that data was not known in 47 patients. Contact burns comprised 51% of these burns, scalds 34% and hot air 10%, which is almost identical to the

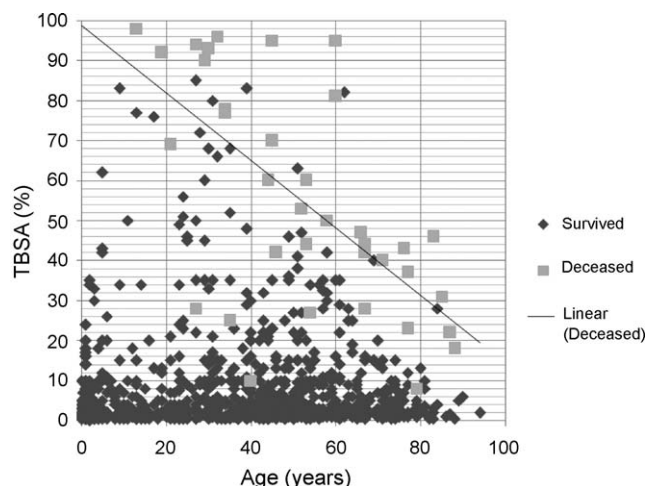


Fig. 6 – Distribution of survived and deceased burn patients in regards of age and TBSA (%) burned.

Interestingly, we found that the male:female ratio in our unit increased during the 12 years and 4 months study period. This is in contradiction to a recent finding from Sweden [1], where there was a more pronounced decrease in the number of admitted male patients 1987–2004 than in females. In fact, the male:female ratio (2.64:1) in our study is close to that mentioned in the American Burn Association National Burn Repository (9) from 2005 (2.3:1) but it was higher than most of the previous reported studies [1–5,7,11] and has remained almost the same as in our previous survey from 1994 to 2000 (2.7:1) [12]. The reason for this remains unclear. The work-related burns, which typically involve male patients, accounted for a smaller than usual portion of burns, only 10.4% in this material, when it has been reported to be as high as 58% (8), 32.3% (3) and 33.4% (5) in some other countries and as low as 8% in the United States [9]. The work safety is a very seriously taken issue in Finland with strict guidelines and restrictions and is likely to contribute to the low number of work-related burn injuries.

Identically with the increase in the male:female ratio there was a trend of increase in the median age of patients. The increase found was as much as 10 years. This must at least partly be explained by the population getting older in general. Altogether, the age pattern showed a typical bi-modal distribution where the biggest age groups were the 0–9-year-old children and 40–59 years old adults. The median age of patients was 39 years, which is more than in Iran (22 years) (9), Iowa (28 years) (3), Taiwan (29 years) (4) and specifically in Hong Kong (13 years) (2), but more similar to reports from Singapore (32.5 years) (5).

The number of annual burn admissions decreased during the study period as seen elsewhere, also [1]. However, the ICU admissions have remained stable meaning that the amount of smaller, non-severe burns has decreased as the criteria for ICU admissions have no changed. The incidence of burns (6.8/100,000/year) found in this population is very similar to the finding in Norway (7/100,000/year) but significantly smaller than in Sweden (15.5/100,000/year) (1). This difference is explained by the variance in patient materials (see below).

The median length of stay was relatively low being 7 days or 1.4 days/% TBSA in the hospital and 0.3 days/% TBSA in the ICU. Reports from other countries present with both longer median hospital stays, like Hong Kong 9 days (2), Taiwan 12 days (4), Singapore (mean) 10.8 days (5) and Israel (mean) 13.7 days (6) and shorter stays in Sweden with median 3 days (1) but this patient material consists of all burn patients treated in all hospitals in Sweden, not only in specialized burn centers and is therefore incomparable with data coming from burn units, only. Unfortunately, the LOS is scarcely reported as days/% TBSA burned as it gives a better description of the overall hospital stay related to the patient material than LOS only.

Inhalation injury was diagnosed via bronchoscopy in 28 patients. The median Baux index for these patients was 89, flame was the etiological factor in 96% of cases, 29% were suicide attempts and the mortality rate was 34.5%. Although the Baux index was not very high, inhalation injury seems to be a very important prognostic factor in mortality. The high number of suicide attempts by flame partly explains the reason for inhalation injury in these burns as the injury was intentional. The psychiatric illnesses behind these events must be taken in account in the treatment plans of these patients.

There were some deaths in this material that were not expected considering their low Baux index. There were 3 patients whose Baux index was 50–60. The first patient (40 year male, 10% TBSA) was unconscious upon arrival (etiology unknown, not CO poisoning) and died of multi organ failure on post-burn day (PBD) 15. The second patient (27-year male, TBSA 28%) died on PBD 6 of acute cardiac failure of unknown reason and the third patient (35 year female, 25% TBSA) had a brain tumor, massive intestinal bleeding, DIC and metabolic acidosis upon arrival and died on the day of injury. Additionally, a 54-year-old male with a 27% full thickness burn (Baux index 81) and a history of intracerebral haemorrhage, died PBD 30 due to pneumonia. A total of 78% of deceased patients had a Baux index > 100 and the overall survival rate for those patients with Baux index > 100 was 23% (10/43). On the other hand, the survival for patients with Baux index < 100 was 99%.

According to the World Fire Statistics Center, the number of fire-related deaths in Finland (not reaching the hospital) is 1.85/100,000/v and has been 70–118 annually 1981–2006. During the last 2 years the number has increased despite considerable efforts in education and safety protocols. This is extremely alarming despite the fact that the number of both smoke and CO alarms in private houses has increased. The increase of deaths before reaching hospital, on the other hand, distorts the numbers of ICU burns. Had some of the deaths been prevented, the numbers of ICU burns would have increased. This again could have altered our mortality rate, also.

In conclusion, this material showed that the patient material in KBU has some differences compared to other international reports with the increase in male predominance, the high number of sauna-related burns and low incidence of work-related burns, to mention a few. The increase in the median age of patients (10 years in 12 years) and the decrease in the admission numbers mean that in the

future we will have fewer and older patients with more comorbidity to treat. This emphasizes the need for centralization of burn care.

Conflict of interest

The author warrants that he has any conflict of interest in this study.

REFERENCES

- [1] Akerlund E, Huss F, Sjoberg F. Burns in Sweden: an analysis of 24538 cases during the period 1987-2004. *Burns* 2007;33:31-6.
- [2] Ho W-S, Ying S. An epidemiological study of 1063 hospitalized burn patients in a tertiary burns centre in Hong Kong. *Burns* 2001;27:119-23.
- [3] Wibbenmeyer L, Amelon M, Torner J, Kealey G, de Mola R, Lundell J, et al. Population-based assessment of burn injury in southern Iowa: identification of children and young-adult at risk groups and behaviors. *J Burn Care Rehabil* 2003;24:192-202.
- [4] Chien W-C, Pai L, Lin C-C, Chen H-C. Epidemiology of hospitalized patients in Taiwan. *Burns* 2003;29:582-8.
- [5] Song C, Chua A. Epidemiology of burn injuries in Singapore from 1997 to 2003. *Burns* 2005;31S:S18-26.
- [6] Haik J, et al. Burns in Israel: demographic, etiologic and clinical trends 1997-2003. *Isr Med Assoc J* 2007;9(9):659-62.
- [7] Hove L, Lindtjorn B. Epidemiology of burns in Bergen, Norway. *Scand J Plast Reconstr Surg Hand Surg* 1999;33(2):225-9.
- [8] Tang K, Jian L, Qin Z, Zhenjiang L, Gomez M, Beveridge M. Characteristics of burn patients at a major burn center in Shanghai. *Burns* 2006;32:1037-43.
- [9] American Burn Association, National Burn Repository (1995-2005 report).
- [10] Papp A. Sauna-related burns: a review of 154 cases treated in Kuopio University Hospital Burn Center 1994-2000. *Burns* 2002;28:57-9.
- [11] Maghsoudi H, Pourzand A, Azamir G. Etiology and outcome of burns in Tabriz, Iran. An analysis of 2963 cases. *Scand J Surg* 2005;94(1):77-81.
- [12] Papp A, Harma M, Ruokonen E, Alhava E. Palovammat KYS:n palovammakeskuksessa 1994-2000. *Duodecim* 2001;117:1637-40 [Finnish].