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Incidence of medically treated burns in The Netherlands

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During the period January 1988 to December 1989, medically treated burn injuries in The Netherlands were recorded prospectively by three registration systems. These systems cover patients treated in burn units, in general and university hospitals, and by general practitioners. Incidence rates and 95 per cent confidence intervals were calculated, and basic epidemiological data about severity and localization of the burns and about accident circumstances were collected. The overall incidence rate of medically treated burns over all levels of medical care is estimated to be about 280 per 100 000 persons per year. This overall incidence figure appeared to be about three times as high for 0–4-year-old children: 775 per 100 000 per year. At all levels of medical care, scalds are the most frequent type of burn, resulting in an overall incidence rate among 0–4-year-old children of 430 per 100 000 per year. Incidence rates are lowest among the elderly (55 years and over), but this age group suffers a higher mortality from burns. Furthermore, it appeared that males are more prone to serious burns than females, whereas female are more often treated for less severe burns. Most of the accident circumstances for serious burns were related to professions, whereas most of the circumstances for less severe burns were related to household activities.

Introduction

Primary and secondary prevention of burn injuries requires information on the severity of burn injuries derived from all levels of medical care (burn units, general and university hospitals,* emergency departments, and general medical practitioners (GPs)). In The Netherlands, information about the incidence of fatal burn injuries can be derived from the mortality registration of The Netherlands Central Bureau of Statistics (CBS) which registers burns as a cause of death (CBS, 1989), and the greater incidence of burn injuries from the registration of hospital admissions of the National Medical Surveillance (LMR) (LMR, 1990). These registration systems cover, in principle, the entire Dutch population. The same holds for burn patients treated as inpatients or outpatients in the three burn units in The Netherlands (Rotterdam, Groningen, Beverwijk), which participate in a registration network of the Consumer Safety Institute (SCV) (Mulder, 1989). An estimation of the incidence of burn injuries in hospitals (inpatient or outpatient) caused by accidents (other than road and industrial accidents) can be derived from the Home and Leisure Accident Surveillance System (PORS) of the SCV (PORS, 1989). This system covers 10 per cent of those hospitals in The Netherlands which have an accident and emergency department offering a 24-hour service ($n = 139$) (PORS, 1989). Burns treated by GPs are registered by some local registration systems, such as the Continuous Morbidity Registration Nijmegen (NUHI, 1985), the Monitoring Project (Lamberts, 1984) and the Transition Project (Lamberts, 1990). Apart from these local sentinel systems, The Netherlands Institute of Primary Health Care (NIVEL) collects, via its Continuous Morbidity Registration (CMR) network, morbidity data over a network of 51 GPs, which covers a representative sample of 1 per cent of the total population.

This article provides information on the magnitude of the burn injury problem in terms of recent incidence data for The Netherlands, from all levels of medical care, over a period of 2 years (1988–89). These Dutch figures will be compared with incidence rates from other countries. Furthermore, the article presents basic epidemiological data on severity, localization and accident circumstances of all types of (registered) burn injury patients.

Methods

Information on cases of burn injury was mainly drawn from the burn unit and hospital registration system (of the SCV) and the GP registration system (NIVEL), over the past 2 years (1988–89). Incidence rates were calculated by relating these numbers of the (relevant subgroup of) Dutch population (CBS, 1989, 1990). To indicate the degree of precision of the incidence estimates, 95 per cent confidence intervals (CI (95 per cent)) were calculated. A confidence interval, which provides lower and upper bounds for the true value of the incidence rate, is based on a Poisson distribution of the number of burns. The 95 per cent confidence interval for the incidence rate (I) is calculated as follows (Kahn and Sempos, 1989):

*In this article 'hospitals' will refer to both general and university hospitals.

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Table I. Incidence rates of medically treated burns in The Netherlands (1987, 1988, 1989)

Level of medical care (registration source)	*No. of burns**	*Incidence rate†*	*CI (95%)‡*	*Period of observation*
Burn as a cause of death (CBS))	85	0.6	(0.5–0.7)	1987
Admission to hospital (LMR)	3512	11.9	(11.6–12.4)	1987–88
Burn units, all burns (SCV)	2401	8.1	(7.8–8.4)	1988–89
Inpatient treatment	844	2.9	(2.7–3.1)	1988–89
Outpatient treatment	1557	5.3	(5.0–5.5)	1988–89
Hospital, all burns (PORS)	2519	85.3	(81.9–88.6)	1988–89
Inpatient treatment	206	7.0	(6.1–7.9)	1988–89
Outpatient treatment	2307	78.1	(75.0–81.3)	1988–89
General practitioners (NIVEL)	543	185.3	(169.6–200.9)	1988–89

*Number of patients registered.
†Number of burns per 100 00 persons per year.
‡95 per cent confidence interval.

$$\hat{I}(1-1.96/\sqrt{N}) < I < \hat{I}(1+1.96/\sqrt{N})$$

$\hat{I}$ = observed incidence rate
I = true value of the incidence rate
N = number of burns

Basic epidemiological data about the accident circumstances and severity of the burn injuries were collected. The burn unit registration system gathers information on, for instance, demographic characteristics of the victim, the type of burn injury, the severity of the burn injury and the activity of the patient at the time of the accident leading to the injury. The coded forms are regularly mailed to the SCV, where the data are added to the burn unit data base (Mulder, 1989). For the collection of the data of burn patients treated in a hospital, the general PORS coding forms were used (PORS, 1989) collecting, for instance, information concerning the type of accident, the part of the body involved and the accident circumstances. All GPs participating in the GP registration system (NIVEL, 1989) receive a weekly form, on which certain illnesses, occurrences and actions are reported. In addition to some permanent items, some temporary items are added to this form each year. At our request, burn injuries were added to the form for a period of 2 years (1988–89). For the participating practitioners this implied that they had to fill out a questionnaire for every burn injury patient who consulted them. This questionnaire consisted of nearly the same questions as those used for the burn unit and hospital registration. The differences in questionnaires were that the burn unit and hospital registration did not ask about ethnicity and about background information concerning the accident circumstances, and that the hospital registration did not ask about the severity of the burns.

Results

Incidence

Table I shows the crude incidence rates for burn injuries for all age categories, based on the registration of burns as a cause of death (CBS, 1990) and as a reason for admission to hospital (LMR, 1989, 1990) for the most recent registration period over which data were available. Furthermore, this table provides information on the incidence rates of burn injuries, treated as inpatient or outpatient cases, based on registration by the burn units (Mulder, 1989, 1990), hospitals (PORS, 1989, 1990) and GPs (NIVEL, 1989, 1990) for the period 1988–89. For all incidence rates, the corresponding CIs (95 per cent) are given

As shown in *Table I*, the death rate from burns is relatively low; less than 1 per 100 000 persons per year. The LMR has a complete overlap with the inpatients from the burn unit registration and with those from the hospital registration. However, it should be mentioned that PORS registers home and leisure accidents only as inpatient treatment if the patient is admitted immediately after treatment at the emergency department. Thus, PORS records patients only at the time of first admission (because for a second admission they do not pass the emergency department) (PORS, 1990), whereas the LMR records these patients separately each time (LMR, 1990). Furthermore, PORS does not include burns due to road and industrial accidents, or burns due to non-accidental causes.

The incidence rates for burn injuries appear to be lower at higher levels of medical care. The incidence rate for burns treated by a GP is about twice the rate for burns in hospital and more than 20 times the rate for burns treated in a burn unit. Burn patients in burn units are relatively often treated as inpatients compared to patients who seek care in a hospital.

Table II shows the incidence rates for various types of burn, by level of medical care over the same 2-year period. Because the major causes of burns were restricted to two origins, scalds and flame, only these types of burns are described explicitly in the table. The other origins are categorized as 'other' burns.

Table II shows that at all levels of medical care, scalds are the most frequent type of burns. In burn units, scalds are reported twice as often as flame burns, while hospitals and GPs report scalds, respectively, about five and six times as often as flame burns. The high incidence of other burns reported by GPs consists mainly of contact burns (51 per 100 000 persons per year).

Table III shows the age-specific burn incidence rate by level of medical care. This table shows that, over all levels of medical care, the incidence among 0–4-year-old children is much higher than that among the other age categories. The burn injury incidence rate for treatment in a hospital for this age category is almost eight times the rate for persons aged 55 years and over (243 versus 32 per 100 000 persons per year). The incidence rates are lowest among the elderly (55 + years), but this age group suffers a relatively high mortality rate due to burns (8.5 per 100 000 persons per year; CBS, 1990).

Combining the data in *Tables II* and *III*, it appears that, over all levels of medical care, scalds are the most common type of burns in all age categories, except for that of patients aged 15–54 years and treated by GPs. In this age category other burns, mainly contact burns, predominated. Assuming that the incidence rates may be added over the three levels

Level of medical care (source)	Type of burn: Scald Incidence rate* (CI(95%))†	Scald N‡	Flame Incidence rate* (CI(95%))†	Flame N‡	Other§ Incidence rate* (CI(95%))†	Other§ N‡
Burn unit (SCV)	3.8 (3.6–4.0)	1116	2.3 (2.2–2.5)	691	2.0 (1.9–2.2)	594
Hospital (PORS)	52.5 (49.9–55.1)	1551	9.7 (8.6–10.8)	287	23.1 (21.3–24.8)	681
General practice (NIVEL)	86.0 (75.4–96.6)	252	14.7 (10.2–19.1)	43	84.6 (74.0–95.2)	248

*Number of burns per 100 000 persons per year.
†95 per cent confidence interval.
‡Number of patients registered.
§Contact burns, flash burns, chemical burns, electric burns, sunburns.

Table III. Burn incidence rates in The Netherlands by age and level of medical care (1988–89)

Level of medical care (source)	Age category (yr): 0–4 Incidence rate* CI(95%))†	0–4 N‡	5–14 Incidence rate* (CI(95%))†	5–14 N‡	15–54 Incidence rate* (CI(95%))†	15–54 N‡	55+ Incidence rate* (CI(95%))†	55+ N‡
Burn unit (SVC)	23.6 (21.3–25.8)	426	5.5 (4.7–6.2)	198	8.5 (8.1–8.9)	1494	4.1 (3.6–4.6)	269
Hospital (PORS)	243.2 (220.5–265.9)	440	75.2 (66.2–84.1)	272	90.8 (86.3–95.2)	1596	32.4 (28.0–36.8)	211
General practice (NIVEL)	512.0 (397.7–626.4)	77	132.6 (95.0–170.1)	48	188.2 (168.0–208.6)	331	133.6 (105.5–161.7)	87

*Number of burns per 100 000 persons per year.
†95 per cent confidence interval.
‡Number of patients registered.

Table IV. Burn incidence rates in The Netherlands by sex and level of medical care (1988–89)

Level of medical consumption (source)	Male Incidence rate* (CI(95%))†	Male N‡	Female Incidence rate* (CI(95%))†	Female N‡
Burn unit (SCV)	10.6 (10.1–11.1)	1548	5.4 (5.0–5.7)	802
Hospital (PORS)	87.1 (82.3–91.9)	1271	83.5 (79.7–88.1)	1246
General practitioner (NIVEL)	154.3 (133.9–174.7)	220	190.0 (168.0–212.1)	286

*Number of burns per 100 000 persons per year.
†95 per cent confidence interval.
‡Number of patients registered.

of medical care, then scalds appear to account for almost 60 per cent of all burns in the 0–4-year-old category, resulting in an overall incidence rate of 430 per 100 000 persons per year.

Incidence rates for males and females are shown in *Table IV*. The sex-specific burn injury incidence rates in *Table IV* show that males are more prone to serious burn injuries treated in burn units than females, whereas females are more frequently treated by a GP for burn injuries than males. The incidence for patients treated in a hospital seems to be somewhat higher for men than for women. Combining the types of burns with the sex-specific data it appears that scalds and contact burns are more common types of burns for women than for men. In contrast, flame, chemical and flash burns were more common types of burns for men than for women.

The registration by the GPs showed that 11 per cent of the burn injury patients were not of Dutch ethnicity (Turkish 6 per cent, Moroccan 2 per cent, Chinese and other 3 per cent), while only about 4 per cent of the Dutch population

are not of Dutch ethnicity (CBS, 1988). The numbers of allochthonous versus Dutch 0–15-year-old children among the total Dutch population are 4 per cent versus 6 per cent, whereas the present study showed that about 55 per cent of the allochthonous patients and 20 per cent of the Dutch patients were below the age of 15 years. This finding indicates that, relatively speaking, more young allochthonous than Dutch patients are treated by GPs. Data about ethnicity are not available from the burn unit and hospital registration.

The burn injury

Burn injuries can be described in terms of depth (degree), extent (percentage of body surface area (BSA) involved), and agent involved (nature of the burn) (Bouter et al., 1989; van Rijn et al., 1989). The latter is often described in relation to the circumstances leading to burn injuries.

Severity of the burn injury In the literature, three different categories for severe burn injuries are used which, respectively, define severe burn injuries as:

1. Partial skin thickness burns in which more than 15 per cent of the body surface area is affected.
2. Full skin thickness burns in which more than 2 per cent of the body surface area is affected.
3. All burns in which more than 10 per cent of the body surface area is affected (van Rijn et al., 1989).

Applying these categories to our own data, the following results emerge. About 60 per cent of the patients treated at burns units had a burn injury which covered more than 10 per cent of the BSA (criterium 3). About 30 per cent of the patients treated in burns units had a partial skin thickness burn injury covering more than 15 per cent of the BSA (criterium 1), while 15 per cent of the patients in burns units had a full skin thickness burn injury in which more than 2 per cent of the BSA was affected (criterium 2).

As expected, it can be concluded that the percentage of patients with full skin thickness burn injury treated by GPs is very low (about 4 per cent). Most burns seen by the GP are only superficial or partial skin thickness loss. The percentage BSA affected varied from 1 to 10 per cent. Data about the severity of the burns in the patients treated in hospital are not available.

Accident circumstances The most important accident circumstances for serious scalds and flame burns treated in burns units were related to professions (causing the so-called occupational injuries) (26 per cent), household activities (23 per cent) or to playing (22 per cent). For scalds and flame burns treated in a hospital, the most important origin was related to household activities (25 per cent), personal care (16 per cent) or to playing (13 per cent). (It should be noted here that burn injuries treated in hospital could not be related to 'professions' because PORS only registers home and leisure accidents.) For the scalds and flame burns treated by a GP, the main causes were household activities (35 per cent), activities of a professional-kind injuries (15 per cent), and playing (14 per cent). For burns treated by a GP it appeared that 80 per cent of all scalds among 0–4-year-old children occurred while they were trying to get hold of an object filled with a hot liquid, which was standing on the stove, or because they spilled hot beverages from cups standing on low tables. This finding is in accordance with the literature (Klasen, 1980; Boxma et al., 1984; van Rijn et al., 1989). As for flame burns, 35 per cent of those treated by a GP were due to children playing with fire, 10 per cent for smoking in bed and 5 per cent because clothes caught fire (5 per cent). The background information about the other 50 per cent of the flame burns treated by the GP is not available. The same holds for the background information about the accident circumstances for burn patients treated in a hospital or in burn units.

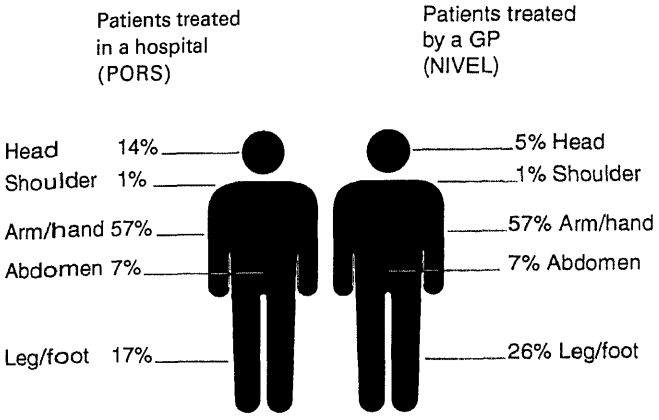

Figure 1. Localization of the burn injuries treated in a hospital or by a GP.

In some cases of severe burn injuries, contributing factors were identified. Alcohol was incriminated in 3 per cent of the cases treated in burn units (because alcoholic drinks had been consumed before getting burned), followed by disability (2 per cent), suicide (2 per cent), and criminal assault or child abuse (1 per cent). These factors were not registered for patients treated in hospital or by a GP.

Location of the burn injuries Concerning the location of the burns, only data of patients treated in hospital or by a GP are available. It was found that, for these two levels of medical care, the arms and/or hands are the parts of the body most frequently affected, followed by the legs and/or the feet. Burn injuries of the head are more often treated in hospital than by a GP (14 per cent of the patients in hospital versus 5 per cent of the patients seen by a GP have a burn injury of the head). *Figure 1* presents the location of burn injuries for patients treated in hospital and by a GP. (It should be noted that the registration forms for hospital patients allow two locations to be marked, whereas those for the patients seen by a GP only one (the most important) location of the burn injuries to be marked).

Data compared with that from other countries

Assuming that the incidence figures presented for the various levels of medical care may be added, the overall incidence rates for medically treated burns in the Netherlands is estimated to be about 280 per 100 000 persons per year. For other countries, several estimates of the incidence of medically treated burns have been reported in the literature. Published incidence rates for medically treated burns in Denmark and the USA are given in *Table V*.

Although the incidence rates presented in *Table V* are not completely comparable, because of the use of different registration systems, the use of different definitions for the severity of the burn injuries, and the fact that they deal with various levels of medical care, some cautious conclusions can be drawn. Compared to the Dutch incidence figures, some

Table V. Reported incidence rates of medically treated burns

Author	Country	Year of publication	Incidence rates*	N†	Remarks
Sørensen	DK	1976	350	2900	All burns treated by GPs
Thomsen et al.	DK	1978	400	2200	All burns over all levels of medical care
Lyngdorf et al.	DK	1986	300	1424	All burns over all levels of medical care
Feck et al.	USA	1979	30	5791	All hospitalized burn injuries
MacKay and Rolhman	USA	1982	200	562	All hospitalized burn injuries
Glasheen et al.	USA	1982	1100	1552	Scalds in children over all levels
Locke et al.	USA	1990	20	2750	All hospitalized burn injuries
This study	NL	1990	280	5463	All burns over all levels of medical care

*Number of burns per 100 000 persons per year.
†Number of patients registered.

substantially different results have been found. An example is the high incidence rate for scalds in children shown by Glasheen et al. (1982), which appears to be about 2.5 times higher than the corresponding rate for The Netherlands. Sørensen (1976) found an incidence of burns treated by GPs which was about twice as high as the Dutch incidence rate (185 versus 350 per 100 000 persons per year). The other incidence, for patients treated in hospital, was between 20 and 30 per 100 000 persons per year; the corresponding figure for The Netherlands is about four times higher: 93 per 100 000 persons per year. Looking at the incidence figures reported over all levels of medical care, we find the overall incidence rates vary from 200 to 400 per 100 000 persons per year.

Discussion

The results of this study suggest an overall incidence rate of medically treated burns in The Netherlands of about 280 per 100 000 persons per year. This finding is about the same as an earlier survey-based estimate of the Dutch incidence figure, which amounted to 300 per 100 000 persons per year (van Montfoort et al., 1988). The overall incidence rate for 0–4-year-old children appears to be almost three times as high (775 per 100 000 persons per year). Over all levels of medical care, scalds are the most frequent type of burns, with an overall incidence rate among 0–4-year-old children of 430 per 100 000 persons per year. In burn units, scalds are reported twice as often as flame burns, while hospitals and GPs report scalds to be, respectively, about five and six times as frequent as flame burns. The incidence rates are, relatively speaking, lowest among the elderly (55 + years), but this age group suffers a higher mortality rate due to burns (CBS, 1990). Furthermore, it appears that males are more prone to serious burns than females, whereas females are more often treated for less severe burns.

Over 50 per cent of the burn injuries were located on the arm and/or the hand. Most of the accident circumstances for serious burns were related to profession, whereas most of the circumstances for less severe burns were related to household activities. In accordance with other studies (e.g. Klasen, 1980; Boxma et al., 1984; van Rijn et al., 1989), most accidents among children were found to occur because they spilled hot beverages from overturned cups. Comparing the Dutch incidence figures with data from other countries, overall incidence rates are found to be roughly the same, while individual figures with respect to particular levels of medical care were rather different. The most plausible explanation seems to be the use of different registration systems and the use of different definitions for the severity of the burn injuries.

In addition to the remarks about the results, some remarks about the validity of our study should be made. First, our overall incidence rate, which is an addition of three incidence rates based on registration of burns treated in burns units, in hospitals and by GPs, should be interpreted cautiously. The main reason is the overlap between the various registration systems. Data concerning the magnitude of this overlap are not available. Logically, the overall incidence rate must therefore be regarded as an upper limit.

Furthermore, the rate of underreporting by the PORS, which probably also holds for its burn injuries registration, is assumed to be 10 per cent, (PORS, 1989). This rate however is low, compared with that of a similar surveillance system in Great Britain, which has an underreporting rate of about 30 per cent (PORS, 1989). The validity of the data from the burn units and hospitals is safeguarded as much as possible by sustaining the motivation of the staff of the participating hospitals, by making unambiguous arrangements concerning the codes to be used and by cross checking the data (PORS, 1989). As for the data gathered by the burn unit registration and by the registration of burn patients treated by a GP, no information about the amount of underreporting is available.

Other surveillance systems for GPs in The Netherland estimate predominantly higher incidence rates for bur injuries. The incidence rates for burn injuries estimated b the Continuous Morbidity Registration Nijmegen, th Monitoring Project and the Transition Project are, respec tively, 570, 440 and 350 per 100 000 persons per ye (Lamberts, 1984; NUHI, 1985; Lamberts, 1990), while th incidence from the NIVEL registration amounted to 185 p 100 000 persons per year. The explanation for the diffe ences between these incidence rates seems to be the use c different registration strategies and different definitions fo burn injuries. Moreover, the total number of participatir GPs and the distribution of these GPs over The Netherlan differ substantially between these registration systems. Th network of the NIVEL registration is the biggest, allowi extrapolations to national incidence figures which are r possible from the other, local networks (Grol et al., 1990,

An unambiguous answer to the question why th estimation of the incidence rate by the NIVEL differs fro that provided by the other systems is not available. A investigation of the validity and reliability of all registratio networks for GPs would provide more information abou this.

This study has provided information about incidence rates over all levels of medical care, indicating the 0–4-year-

old age category to be the most important risk group for burn injuries. Furthermore, the conclusion can be drawn that at all levels of medical care, scalds are the most frequent type of burns, again resulting in the highest incidence rate among 0–4-year-old children. For health educators this implies that they might be justified in concentrating on the development of educational programs directed at the prevention of scalds in 0–4-year-old children, in order to reduce the incidence of burn injuries.

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