Aetiology of burn injuries among children aged 0–4 years: results of a case-control study

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During the year 1987/1988 a case-control study was conducted, by means of a postal questionnaire, among parents of children aged 0–4 years. Cases (n = 122) were 0–4-year-old Dutch children who visited emergency departments with burn injuries. Controls (n = 213) were a sample of the Dutch population of 0–4-year-old children without burn injuries. Odds ratios based on logistic regression (OR–LR) and 90 per cent confidence intervals (CI 90 per cent) were calculated for a number of putative risk factors. The risk of burns was higher for children with other than Dutch (e.g. Turkish) ethnicity (OR–LR = 5.6; CI 90 per cent = 2.6–11.9). Children who lived in relatively small houses turned out to have a higher risk of burns (OR–LR = 2.5; CI 90 per cent = 1.3–4.7). To our surprise, children belonging to lower socioeconomic classes were found to have a decreased risk of burns (OR–LR = 0.3; CI 90 per cent = 0.1–0.6). Furthermore, among several manipulable risk factors, the use of an oven with a glass door (OR–LR = 2.6; CI 90 per cent = 1.2–3.1). Cooking on a gas stove was found to be another risk factor (OR–LR = 2.5; CI 90 per cent 1.1–10.0).

Introduction

An extensive burn is a catastrophic injury because its severity and long-term effects are often considerable (Artz, 1979; Feck et al., 1979; Hermans and Olthuis, 1984; Van Rijn et al., 1989). In 1988 the incidence of burns treated by general practitioners (for all age categories) amounted to two per 1000 per year in the Netherlands (Grol et al., 1991), while the total incidence of medically treated burns was estimated at three per 1000 per year (Montfoort et al., 1989). For children aged 0–4 years, the incidence of burns treated by general practitioners is as high as six per 1000 per year (Grol et al., 1991). A number of studies have reported scalds to be the most frequent type of burns, accounting for more than 50 per cent of all burn injuries among children aged 0–4 years (e.g. Thomas et al., 1984; Van Rijn et al., 1989; Bouter et al., 1989, 1990). This high incidence in combination with the fact that burns are more often life threatening in young children than in other age categories (e.g. Spijker et al., 1980), lead us to study the aetiology of burns in this population.

A review of studies on the aetiology of burn injuries (Van Rijn et al., 1989) showed that there is no consensus with respect to the most important risk factors for burn injuries: several studies have yielded conflicting results (e.g. Noyes et al., 1979; Libber and Stayton, 1984; Davies, 1985). Furthermore, most of these studies had severe methodological limitations (Van Rijn et al., 1989). Measures of association (such as odds ratios or risk differences) between putative risk factors and the risk of burn injury are usually not presented in these publications. Moreover, most of the studies did not adequately control for confounding (Rothman, 1986). This makes it impossible to estimate the independent contributions of the individual risk factors to the injury risk. Consequently, we decided to perform a new study into the aetiology of burn injuries, in which we tried to overcome most of the methodological problems of earlier publications on this subject.

Methods

A case-control study was conducted among the parents of children aged 0–4 years in the Netherlands. The study population consisted of 0–4-year-old children. The parents of these children were the actual respondents, because they completed the questionnaire.

Cases

Cases were children aged 0–4 years who presented with burn injuries at the emergency department of one of 14 Dutch general or university teaching hospitals between September 1987 and August 1988. Burn injuries were defined as injuries caused by hot liquids, flames (and smoke inhalation), hot objects, electricity, chemical reaction or ultraviolet radiation. These cases were obtained from the ‘Home and Leisure Accident Surveillance System’ (PORS) of the Dutch Consumer Safety Institute (PORS, 1989). This system registers home and leisure accidents in 14 Dutch hospitals, which form a sample of the 139 general and university teaching hospitals in the Netherlands with an accident and emergency department offering a 24-h service. This sample is representative with respect to size of hospital and level of urbanization (PORS, 1989).

Controls

The control group consisted of a sample of the Dutch population within the same age category. For every case of injury selected, two uninjured children were chosen. The control population was recruited through maternal and child health centres in four places in the Netherlands. Dutch parents of young children can easily be contacted through
these centres because practically all visit them regularly, e.g. to have their children vaccinated. Over a 2-week period all parents of children aged 0–4 years who visited the health centre were asked to participate in the study. If the parents had more than one child, they were asked to answer the questionnaire for their oldest child in the 0–4-year age category.

Questionnaire
The questionnaire was handed out to the parents of the control group in the child health centres and was sent to the parents of all cases registered in the above-mentioned surveillance system. It consisted of 113 items for the cases and 70 items for the controls. Identical questions for both groups inquired about demographic characteristics of the child and the parents, the design of the house, risk taking and risk perception and other putative risk factors mentioned in the scientific and popular literature. In addition to this, cases were questioned about the circumstances of the accident and the subsequent burn injury.

Statistical analysis
The association of putative risk factors with burn injuries was expressed as odds ratios (OR), which can be interpreted as relative risks (Rothman, 1986). If there is no association the OR equals 1, while for an elevated risk the OR is higher than 1, and an OR between 0 and 1 indicates that this level of the risk factor is associated with a reduced risk of burn injuries.

Control for confounding is necessary to estimate the independent contribution to the burn injury risk of the separate risk factors of interest. This was achieved by means of stratification and multivariate analyses. Therefore, the statistical analysis was performed in two stages. First, ORs were calculated with adjustment for potential confounding by age. This adjustment was necessary since the age distribution of the controls deviated markedly from that which had been expected (CBS, 1990). The adjustment was performed by taking the Mantel-Haenszel (MH) weighted averages of the ORs (OR–MH) over the three age strata (0, 1, 2–4 years). Tests based 90 per cent confidence intervals which reflect the precision of the estimated ORs were obtained using the Miettinen method (Kleinbaum et al., 1982). A confidence interval gives the lower and upper bounds for the true value of the association. Thus, we can be reasonably confident that a factor is associated with an elevated risk if the lower bound of the confidence interval is higher than 1. This also implies that the association is statistically significant at a 5 per cent level (one-sided test). Figures on the prevalence of the putative risk factors among cases and controls are adjusted for differences in age by means of standardization. As a standard the age distribution among the total 0–4-year-old Dutch population of 1988 was used.

In the second stage of the analysis, a multiple logistic regression (LR) model (Kleinbaum et al., 1982) was used to obtain ORs (OR–LR) for each of the factors included in the model, while adjusting for all the other factors. All potential confounding factors were included in the model as dichotomous or categorical variables. Furthermore, in order to check the uniformity of stratum-specific ORs, all first-order interaction terms were entered into the model and tested for significance (Kleinbaum et al., 1982). The estimated ORs (OR–LR) reflect the relative burn injury risk for the risk factor at issue, while the levels of all other factors in the model remain constant. In addition to this, 90 per cent confidence intervals were calculated, based on the asymptotic standard error of the estimated log OR (Kleinbaum et al., 1982).

Results
Response
The response was 62 per cent for the cases (n = 124) and 89 per cent for the control group (n = 217). Six respondents were excluded from the analyses because they did not complete the questionnaire. In the end, data on 335 0–4-year-old children were analysed, including 122 cases and 213 controls.

The mean age of the injured children was 1.3 years (the distribution over the 0, 1 and 2–4 years age categories being, respectively, 17 per cent, 53 per cent and 30 per cent), while that of the uninjured children was 0.8 years. The lower mean age in the control group is probably due to the fact that children aged between 0 and 1 year have to visit the maternal care centres twice as often as the other age categories. The distribution of 0-, 1- and 2–4-year-old children in the Dutch population is, respectively, 20 per cent; 20 per cent, 60 per cent (CBS, 1990), while in our control population it was 55 per cent, 23 per cent, 22 per cent. This makes it clear that children aged 0 year are overrepresented in the control group. As a consequence, the risks associated with age could not be estimated directly in this study. To avoid confounding due to these differences in age, all data on the prevalence of risk factors among cases and controls were adjusted by standardization for age in three categories (0, 1, 2–4 years), and every odds ratio presented was adjusted for confounding by age.

Injuries
In the literature, burn injuries are generally categorized on the basis of the nature of the burn (e.g. Hermans and Spijker, 1977; Van Rijn et al., 1989). The most common type of burns is the scald burn (n = 77), which is typically caused by hot water or hot liquids like coffee, tea, soup or oil. The second commonest type was contact burns (n = 37), which are caused by touching hot objects like the gas stove (n = 9), the oven door (n = 10), the (electric) heater (n = 13) or the iron (n = 5). The remaining eight cases consisted of flame burns (n = 3), electric burns (n = 2) or sun burns (n = 2). Most of the scalds were located on the arm (39 per cent) or on the chest (29 per cent) of the child, while almost all contact burns were located on the hand or fingers of the child (82 per cent).

In assessing the severity of the burns, the extent of body surface affected can be expressed as a percentage of the total body surface area (BSA). In addition to this, three degrees of depth are usually distinguished. A severe burn injury is: (a) a burn which, independently of the depth of the injury, covers more than 10 per cent of the BSA (criterion 1; see Van Rijn et al., 1989), or (b) a partial skin thickness burn injury which covers more than 15 per cent BSA (criterion 2), or (c) a full skin thickness burn injury which covers more than 2 per cent BSA (criterion 3). According to these criteria, about 14 per cent (n = 17) of the cases had a severe injury. About 63 per cent (n = 77) of the cases had a relatively small partial skin thickness burn injury (<9 per cent of the BSA), while the remaining 23 per cent (n = 28) had a superficial injury only, involving less than 10 per cent of the BSA.

Accident circumstances
Among the 77 scalds, 38 involved spillage of hot beverages
from overturned cups. In most of these cases (n = 29) the cup containing the hot beverage was standing on a low table, so that the child could reach it very easily. Nine children had pulled down a hot liquid container with the tablecloth. Other common situations included overturning kettles, jugs or teapots by pulling at the flex. Most of these accidents happened while the parents were near or even in the same room as the child.

Among the 37 contact burns, 13 occurred because the child had touched a hot oven, an electric fire, a room heater or other hot objects. These contact burns often seemed to be related to the motor development of the child; children who have only recently begun to walk can easily get burned because they may lose their equilibrium and fall onto a hot object. Four children had burned their hands by touching a hot iron.

**Risk factors for burn injuries**

Putative risk factors for burn injuries can roughly be divided into two groups. The first group consists of safety behaviours on the part of the parents, such as the way in which they prepare and drink coffee and tea, or make the surroundings of their children safer. These factors are referred to as 'manipulatable factors' because they can theoretically be changed by means of health education. The second group, the 'poorly manipulatable factors', consists of non-behavioural risk factors which can occasionally be changed by regulation or legislation, but more often cannot be changed at all. Examples of these factors are socio-economic factors (education and housing circumstances), gender and number of children.

**Manipulatable factors**

To our surprise we found that more parents of uninjured children cooked on an electric stove compared to those of injured children. Thus, cooking on a gas stove turned out to be a risk factor for burn injuries (OR−MH = 2.5, see Table 1). Furthermore, it was found that the use of an oven with a window which gets hot is associated with a higher risk of burns (OR−MH = 2.0), since fewer parents of uninjured children used such an oven in comparison with those of injured children. Keeping hot drinks in their original pot instead of in a vacuum flask also turned out to be associated with a higher risk of burn injuries (OR−MH = 1.6).

In addition to these statistically significant findings, there seemed to be a difference in the way that parents brew and drink coffee and tea. Fewer parents of uninjured children reported preparing coffee manually compared to those of injured children. (Making coffee manually means that the coffee is prepared by pouring boiling water onto ground coffee in a filter.) Making coffee manually turned out to be weakly associated with a higher risk of burns when compared to making coffee with an electric coffee maker (OR−MH = 1.5). However, inspection of the confidence intervals in Table 1 shows that this association did not reach statistical significance at the 5 per cent level. The same holds for the other associations in Table 1, which are discussed below.

The type of coffee filter was investigated as a putative risk factor for burn injuries only among parents who prepared their coffee manually. Four types of filters are shown in Figure 1. Fewer parents of uninjured children used the unsafe coffee filter B (OR−MH = 2.3). Furthermore, the use of separate hot and cold taps, not turning pan handles away and not having adjusted the temperature of the water, all appeared to be associated with a slightly higher risk of burn injuries.

For the statistically significant risk factors, Table 1 also presents the aetiological fractions (AF). This is an estimate of the theoretical maximum reduction of burns that could result from a total elimination of the risk factor at issue (Rothman,

![Figure 1. Types of coffee-filters. Source: Sørensen (1976).](image)

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Cases (%)</th>
<th>Controls (%)</th>
<th>OR−MH</th>
<th>CI(90%)</th>
<th>Aetiological fraction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas stove vs electric stove</td>
<td>91</td>
<td>80</td>
<td>2.5</td>
<td>1.1−10.0</td>
<td>57</td>
</tr>
<tr>
<td>Oven window gets hot vs remains cold during use</td>
<td>51</td>
<td>35</td>
<td>2.0</td>
<td>1.2−3.3</td>
<td>26</td>
</tr>
<tr>
<td>Hot drinks in original pot vs in a vacuum flask</td>
<td>64</td>
<td>53</td>
<td>1.6</td>
<td>1.1−2.6</td>
<td>24</td>
</tr>
<tr>
<td>Making coffee manually vs with coffee maker</td>
<td>18</td>
<td>12</td>
<td>1.5</td>
<td>0.8−2.8</td>
<td></td>
</tr>
<tr>
<td>Use of an unsafe filter vs safe coffee filter</td>
<td>50</td>
<td>33</td>
<td>2.3</td>
<td>0.6−9.3</td>
<td></td>
</tr>
<tr>
<td>Separate hot and cold taps vs mixing tap</td>
<td>13</td>
<td>12</td>
<td>1.5</td>
<td>0.7−3.0</td>
<td></td>
</tr>
<tr>
<td>Not turning pan handles vs turning them away</td>
<td>14</td>
<td>15</td>
<td>1.2</td>
<td>0.6−2.3</td>
<td></td>
</tr>
<tr>
<td>Temperature of water &gt; 60°C vs &lt; 60°C</td>
<td>53</td>
<td>47</td>
<td>1.2</td>
<td>0.6−2.2</td>
<td></td>
</tr>
</tbody>
</table>

\[n=122; n=213; \#n=28; \#n=34.\]
Table II. Poorly manipulatable risk factors for burn injuries

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Cases* (%)</th>
<th>Controls† (%)</th>
<th>OR–MH</th>
<th>CI (90%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity: other than Dutch vs Dutch origin</td>
<td>13</td>
<td>3</td>
<td>4.5</td>
<td>1.8–10.9</td>
</tr>
<tr>
<td>Low education level parents vs high education level</td>
<td>70</td>
<td>85</td>
<td>0.4</td>
<td>0.2–0.7</td>
</tr>
<tr>
<td>Housing: small house vs large house</td>
<td>16</td>
<td>9</td>
<td>2.1</td>
<td>1.1–4.4</td>
</tr>
<tr>
<td>Unable to walk vs able to walk</td>
<td>67</td>
<td>35</td>
<td>1.8</td>
<td>0.9–3.3</td>
</tr>
<tr>
<td>Mother with a (part-time) job vs without job</td>
<td>27</td>
<td>23</td>
<td>1.5</td>
<td>0.9–2.6</td>
</tr>
<tr>
<td>Mother aged 18–30 yr vs 31–48 yr</td>
<td>48</td>
<td>38</td>
<td>1.3</td>
<td>0.9–2.1</td>
</tr>
<tr>
<td>Family with one child vs more than one child</td>
<td>41</td>
<td>47</td>
<td>0.9</td>
<td>0.6–1.4</td>
</tr>
<tr>
<td>Gender of the child: boy vs girl</td>
<td>52</td>
<td>51</td>
<td>1.0</td>
<td>0.7–1.6</td>
</tr>
</tbody>
</table>

* n=122; †n=213.

Table III. Odds ratios from the logistic regression model

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>OR–LR</th>
<th>CI (90%)</th>
<th>OR–MH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity: other than Dutch vs Dutch origin</td>
<td>5.6</td>
<td>2.6–11.9</td>
<td>4.5</td>
</tr>
<tr>
<td>Low education level parents vs high education level</td>
<td>0.3</td>
<td>0.1–0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>Gas stove vs electric stove</td>
<td>2.6</td>
<td>1.1–10.0</td>
<td>2.5</td>
</tr>
<tr>
<td>Housing: small house vs large house</td>
<td>2.5</td>
<td>1.3–4.7</td>
<td>2.1</td>
</tr>
<tr>
<td>Oven window gets hot vs remains cold during use</td>
<td>2.1</td>
<td>1.3–3.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Hot drinks in original pot vs in a vacuum flask</td>
<td>2.0</td>
<td>1.2–3.1</td>
<td>1.6</td>
</tr>
<tr>
<td>Separate hot and cold taps vs mixing tap</td>
<td>1.6</td>
<td>0.8–3.1</td>
<td>1.5</td>
</tr>
<tr>
<td>Mother aged 18–30 yr vs 31–48 yr</td>
<td>1.5</td>
<td>0.9–2.5</td>
<td>1.3</td>
</tr>
<tr>
<td>Temperature of water &gt;60°C vs &lt;60°C</td>
<td>0.7</td>
<td>0.4–1.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Making coffee manually vs with coffee maker</td>
<td>1.3</td>
<td>0.6–2.4</td>
<td>1.5</td>
</tr>
<tr>
<td>Family with one child vs more than one child</td>
<td>1.3</td>
<td>0.7–2.5</td>
<td>0.9</td>
</tr>
<tr>
<td>Not turning pan handles away vs turning them away</td>
<td>1.2</td>
<td>0.7–2.6</td>
<td>1.2</td>
</tr>
<tr>
<td>Mother with a (part-time) job vs without job</td>
<td>1.2</td>
<td>0.7–2.1</td>
<td>1.5</td>
</tr>
<tr>
<td>Gender of the child: boy vs girl</td>
<td>0.9</td>
<td>0.6–1.4</td>
<td>1.0</td>
</tr>
</tbody>
</table>

1986). Aetiological fractions should be looked upon as rough indicators of the importance of a factor from a preventive point of view, assuming that the association has indeed a causal nature (Bouter et al., 1990).

Poorly manipulatable factors
As Table II shows, our results suggest a more than four-fold risk for children of other than Dutch (mainly Turkish) origin*, in comparison to children of Dutch origin (OR–MH = 4.5). To our surprise, a low level of education seemed to have a protective effect against burn injuries (OR–MH = 0.4). Living in a small house† was found to be associated with an increased risk of burn injuries (OR–MH = 2.1).

Furthermore, children who were able to walk seemed to have (almost) twice as high a risk of burns compared to

*Ethnic origin was determined by the ethnic origin of the father.
†Whether housing was classified as small or large was based upon the subjective evaluation of the respondents.
children who were not yet able to walk. Here again, however, it must be kept in mind that inspection of the confidence intervals shows that only the first three associations mentioned in Table II reached statistical significance at the 5 per cent level (one-sided test). Furthermore, it seemed that children whose mothers have a (part-time) job ran a slightly increased risk of burns (OR=MH=1.5). The same holds for children whose mothers are under the age of 30 years (OR=MH=1.3). No difference in risk was found between families with only one child compared to families with more than one child (OR=MH=0.9). The OR for gender was 1.0, indicating no differences in burn injury risk between boys and girls.

Logistic model

In order to control for mutual confounding among risk factors, the independent contribution of each putative risk factor was calculated by means of a logistic regression analysis. All the risk factors mentioned in Tables I and II were included in the logistic model, with the exception of the variable "type of coffee filter" and the variable "able to walk". These two variables were not included for reasons of collinearity (Kleinbaum et al., 1982): the variable "type of coffee filter" was strongly correlated with the method of making coffee and the variable "able to walk" with the age of the child. The assessment for interaction among the factors included in the model by checking for heterogeneity among stratum-specific ORs revealed no important variation in the estimated effects over the strata. Thus, in the final model no interaction terms remained. The variable "age of the child" was entered into the logistic model as a potential confounding variable because of the selection bias described above. Thus, the logistic model in the end consisted of 15 variables: 14 putative risk factors and one potential confounding variable.

The results of this logistic model (Table III) indicate again that children with other than Dutch (mainly Turkish) ethnicity ran a higher risk of burn injuries (OR=LR=5.6). As for housing situations, it can be concluded that living in a small house is associated with a higher risk (OR=LR=2.5) of burns. A low level of education of the parents is associated with a lower risk of burns in their children (OR=LR=0.3). Furthermore, it appeared that the use of an oven window which gets hot during use is associated with a higher risk (OR=LR=2.1). The same holds for the storage of hot drinks in their original pots (OR=LR=2.0). Cooking on an electric stove seems to reduce the risk of burn injuries (OR=LR=0.4). The correlations between the coefficients of these six (statistically significant) variables were not strong (r<0.20), which implies that there is no substantial mutual confounding among these variables.

All the other associations calculated did not reach statistical significance. The odds ratios with their corresponding 90 per cent confidence intervals from the logistic model are shown in Table III. The ORs-MH are shown once more in this table to enable comparison with the ORs-LR.

When the logistic regression analysis was restricted to cases of scalds only (n=77), approximately the same results emerged (although not statistically significant, due to the smaller number of cases involved).

Discussion

Before discussing the results, the validity of our study deserves some attention. In a case-control study the major potential threats to validity relate to the choice of the study population, the comparability of information gathered from cases and controls, and the presence of confounding factors (Rothman, 1986).

First of all the study might be biased in favour of the more severe cases, because cases were recruited at emergency departments. However, it is our impression that less severe burn patients are also treated in outpatient departments. This impression is supported by the fact that only 14 per cent of the cases were identified as severe burn injury patients, while 23 per cent of the cases only had superficial burn injuries which affected less than 10 per cent of the BSA. Therefore, the cases did not seem to be substantially selective in this respect.

Furthermore, the controls were selected by their attendance at the maternal and child health centre during a 2-week period of time while the cases were selected by their being treated for a burn injury over about a 12-month interval. Consequently, our study design would miss any effects associated with seasonal variation, and thus the study results may be biased by seasonal effects.

There was almost certainly selection bias for age due to the way the controls were selected. In the first stage of our analysis we adjusted for the latter by means of stratification, and in the logistic model by including this variable as a potential confounder. As was mentioned above, this implies that the risk associated with age could not be calculated directly in this study. However, it was possible to estimate the risk associated with the variable 'age of the child' indirectly, by using all 0–4-year-old children in the Dutch population (CBS, 1990) as a control group and by comparing them with the cases in our study. Using children aged 0 as the reference category, it was found that those aged 1 year run a three-fold risk of burns (OR=3.1), while the 2–4-year-old category shows a decreased risk of burns (OR=0.6).

We are not sure whether selection for ethnicity has played a part in the constitution of the control population, because we did not know whether Turkish parents visit the maternal and child health centres as often as the Dutch parents do. However, data on the total population in the Netherlands (CBS, 1990) show that the division of Turkish versus Dutch children aged 0–4 years was 3.5 per cent vs 96.5 per cent. For our control group these figures were 3 per cent vs 97 per cent. Thus, with respect to the attendance at health centres, it can be concluded with some caution that the percentage of Turkish children is not substantially different from that among the Dutch population as a whole (Kuiper et al., 1985). Hence, our controls were probably not substantially selective with regard to ethnicity.

The relation between putative risk factors and burn injury risk might have been obscured because we mixed different types of burn injuries, which possibly have their own specific aetiology. However, when the logistic regression analysis was confined to scalds only, the results which emerged were almost the same as those presented in Table III. When we used variable selection procedures based on statistical algorithms (Kleinbaum et al., 1982) for deciding which manipulatable factors to include in the final logistic model, we found, in the case of scalds, that the 'use of a vacuum flask' was the only variable which contributed statistically significantly to the final model. When we did the same analysis for contact burns it appeared that the variable 'oven window which gets hot' was the only statistically significant variable in the logistic model. Information about putative selection bias due to non-response is not available.
Information bias relates to the question whether the information obtained for cases and controls is comparable. This type of bias occurs if either cases or controls overreport (or underreport) risk factors. Because the study is retrospective, the parents of the cases may have given biased answers if they felt guilty about the circumstances of the injury. Another variety of information bias is recall bias, which can arise if the parents of the cases remember exposures more accurately than those of the controls (Rothman, 1986). The reason for this could be that the accident leading to the burn injury probably serves as a stimulus in recalling all the events that might have played a role. However, less subjective items such as the type of housing and the motor development of the child are less susceptible to this type of bias.

Another problem is connected with the imprecise (or even biased) measurement of the risk factors which could result from the fact that we used structured questionnaires, in which we relied on the opinions of the parents themselves. For some of the factors, such as the housing situation, different measurement procedures (e.g., observation) might have been more appropriate.

To control for confounding, multiple logistic regression analysis was performed. In this analysis every known potential confounder was adjusted for. Consequently, confounding was probably not a serious threat to the validity of the study. However, this procedure does not exclude bias due to unmeasured confounders or confounding due to imprecision and bias in the measurements.

It is important to note here that, although we are sure we have studied many important qualitative risk factors for burn injuries, completeness with respect to all the putative risk factors can never be guaranteed.

Another limitation of our study was the rather small size of the study population. This influences the precision of the study. Only a relatively large difference between cases and controls would attain statistical significance. Furthermore, statistical significance does not always imply relevance or causality. For that reason it is doubtful whether a strict interpretation in terms of significance is justified (some instances of significance might be due to chance). Thus, the results of this study must also be interpreted in the context of preventive relevance and plausibility of causality.

With regard to the manipulative risk factors, the results of this study confirm an elevated risk resulting from the use of an oven window which gets hot (OR–LR = 2.1) and from not keeping coffee or tea in a vacuum flask (OR–LR = 2.0). Cooking on a gas stove appeared to increase the risk for burns in comparison with cooking on an electric stove (OR–LR = 2.5). However, this finding conflicts with our initial idea that electric cooking would increase the risk of contact burns. Thus, we did not expect the electric cooker to have a preventive effect. An explanation for this discrepancy might be that parents who used an electric cooker were more cautious while cooking than other parents because they recognized the dangers (see Wilde, 1982). For this reason we do not feel sure that electric cooking does indeed prevent burns.

As in other studies, a weak, statistically non-significant, elevated risk was found for making coffee manually (see e.g., Klasen, 1986). Another result which is consistent with other studies is the (statistically non-significant) finding that the use of a mixing tap (Klasen and ten Duijs, 1986) is associated with a protective effect against burns in young children (OR–LR = 0.6).

As for the poorly manipulatable factors, the most striking finding is that children of other than Dutch origin (mainly Turkish) ran an almost six-fold risk of burn injuries in comparison with Dutch children (OR–LR = 5.6). In contrast with earlier studies (e.g., Noyes et al., 1979; Libber and Stayton, 1984; Van der Maas et al., 1987), no evidence could be found in our data that children belonging to the lower socioeconomic classes run an elevated risk of burns. Our results even provide some evidence for the contrary; children belonging to a lower socioeconomic class appeared to run a decreased risk of burns (OR–LR = 0.3). However, socioeconomic class was operationalized as the level of education of the parents only and not by level of income or profession. Another possible explanation for this surprising result of the association with socioeconomic class might be due to differences in response rate and the resulting selection bias. Response rates were very different for cases (52 per cent) compared with controls (89 per cent). Controls probably felt less free to decline participation in the study. Children who were living in small houses appeared to have a more than two-fold risk of burns compared to those living in large houses (OR–LR = 2.5).

From a preventive point of view these poorly manipulatable risk factors cannot be changed by means of health education. Moreover, even regulations or legislation could probably not change these risk factors. As for the manipulatable risk factors, health education may be a promising tool in the prevention of burn injuries among young children, since such burn injuries seem to have at least some specific behavioural causes. From our study it appears that the use of a safe oven window which remains cold while in use, the use of a vacuum flask for the storage of hot coffee and tea and cooking on an electric stove have a substantial preventive effect on the risk of burn injuries. The aetiological fractions of these factors (Table 4) indicate that these factors are important from a preventive point of view. Some other factors studied, which did not reach statistical significance, but which are easy to manipulate (e.g., making coffee with a coffee maker, adjusting the temperature of the water) may also be tentatively interpreted in the context of preventive relevance. The effectiveness of subsequent health education will also depend on the knowledge about the main determinants of these behavioural risk factors. Thus, before starting health education directed at primary prevention of burn injuries among young children, research on the determinants of these risk factors will first be performed (Van Rijn et al., 1990; Bouter et al., 1990). Only then will we reach the stage of the development and implementation of a health education programme, and know more precisely what to advise people in order to protect their children against burn injuries.

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