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# Kitchen Scalds and Thermal Burns in Children Five Years and Younger

Dorothy A. Drago, MA, MPH

**ABSTRACT.** *Objective.* The current study was undertaken to describe patterns of kitchen burns and scalds to young children to understand better why such injuries continue to occur despite intervention efforts.

*Methods.* Emergency department-treated thermal burns and scalds associated with nonelectric cookware were examined from a national sample, collected by the US Consumer Product Safety Commission's injury surveillance system over a 6-year period, 1997–2002. Data extracted from the cases included age, gender, body part, disposition, case weight, causal substance, and injury pattern. Data were analyzed using Epi Info 2002, with significance assessed by  $\chi^2$  test.

*Results.* Scalds were approximately twice as common as were thermal burns. Hot water was the chief causal agent for scalds. The 2 most common scald injury patterns were (1) the child reached up and pulled a pot of hot water off the stove or other elevated surface and (2) the child grabbed, overturned, or spilled a container of hot water onto him- or herself. One-year-olds were at highest risk for scalds and thermal burns. Scalds resulted in significantly more hospitalizations than did thermal burns. In nearly all injury patterns, more boys than girls were injured, but the ratio varied depending on the injury pattern.

*Conclusions.* Although the kitchen is recognized as a room that is hazardous for young children, parents seem not to recognize or anticipate the risk for burns and scalds. The ability of children, especially toddlers, to reach containers of hot liquids on elevated surfaces is reflected in the injury data and is explained by anthropometry data, yet there is an apparent failure on the part of parents to recognize children's ability to gain access to the hazard and a failure to recognize the potential severity of resulting injury. These failures might explain why behavioral interventions (eg, place pots on back burners of stove) have been nonmotivating and ineffective. A multifaceted spectrum of prevention that has individual, community, and organizational components may prove to be more useful. *Pediatrics* 2005;115:10–16; *burns, injury patterns, injury prevention and control.*

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ABBREVIATION. CPSC, Consumer Product Safety Commission.

**B**urns are among the most devastating injuries because they can have long-term physical, psychological, and economic ramifications. Children, especially those aged 0 to 2 years, are at risk for

scald and thermal burn because of their natural curiosity, impulsiveness, mode of reaction, and lack of experience in assessing danger and risk.<sup>1</sup> Nonfatal burn injuries vastly outnumber fatal injuries, yet their epidemiology is not well-defined.<sup>2</sup> Most household scald and thermal burn injuries occur in the kitchen<sup>1,3,4</sup> and involve kettles, pots, and pans. More scald injuries are associated with food preparation than with the bathtub.<sup>5</sup>

Although the age distribution for scald injury has changed little since 1956, the injury patterns have changed.<sup>4,6</sup> For example, after the tea bag was introduced into the United Kingdom in 1953, the number of scalds caused by cups of hot beverage increased, whereas the number associated with teapots decreased. Hot water used to be the most common cause of scalds in Denmark, followed by coffee, but tea replaced coffee as the second leading cause in the 1980s. With the increased popularity of the electric kettle in Denmark, a new pattern of childhood scalds was reported in 1991 associated with the child's pulling on the cord that dangled over the edge of a counter.

Although several studies<sup>1,5–10</sup> documented the types of containers, liquids, and room involved, few<sup>11</sup> provided any details on how the incident actually occurred. The purpose of this study was to describe the ways in which children aged birth through 5 years sustained household burns and scalds associated with nonelectric cookware. The study was limited to cookware because the highest frequency of burns occurs in the kitchen, related to food preparation. The study was limited to nonelectric cookware because the pattern of pulling on the cord of an electric product, resulting in overturning of the product and contents onto a child, has been widely recognized and has been addressed through design changes in cords.<sup>4</sup>

## METHODS

Hospital emergency department-treated injuries to children aged 5 years and younger for the period January 1, 1997, to December 31, 2002, that were associated with nonelectric cookware were requested from the US Consumer Product Safety Commission (CPSC). The CPSC gathers such data from its National Electronic Injury Surveillance System network of ~100 hospitals in a national statistical sample. Individual cases are assigned a weight to arrive at a national estimate. The National Electronic Injury Surveillance System uses 4-digit codes to categorize products. The product categories searched were 0460 (metal cookware [nonelectric]), 0461 (nonmetal cookware [nonelectric]), 0465 (other cookware), and 0466 (cookware, nonspecified). The data were reviewed to include only those cases with a diagnosis of thermal burn or scald that did not occur in a public place (eg, school, restaurant). The number of cases included for study was 704. The corresponding national weighted estimate was 17 237 (95% confi-

Product Safety Consultant, Wakefield, Massachusetts.

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Address correspondence to Dorothy A. Drago, MA, MPH, 127 Harrison Ave, Wakefield, MA 01880. E-mail: dadasafety@aol.com

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dence interval: 13 521–20 953). The results of this study are reported on the basis of this estimate, rather than on the actual number of cases.

For each case, data extracted were type of burn (thermal or scald), age, gender, body part (injured), case weight, and case disposition (treated and released, treated and transferred, admitted, or not recorded). Because body part categories were very specific (eg, ankle, toe, elbow), they were collapsed into 7 categories for convenience: head/neck, upper limb, lower limb, upper torso, lower torso,  $\geq 25\%$  body surface area, and not specified.

On the basis of the incident description in the CPSC-generated printout, 2 additional fields were created by the author: injury pattern and substance. Initially, 28 injury pattern categories were defined. When similar patterns were combined and when patterns with a frequency of  $<10$  actual cases were collapsed into "other," there were 7 total injury pattern categories for study: (1) reached up and pulled down pot from stove or other elevated surface; (2) grabbed, overturned, or spilled pot onto self; (3) collided with pot or with person holding pot; (4) put hands into pot; (5) pot contents splashed onto child; (6) other; and (7) unknown.

The patterns subsumed under "other" included used a chair or otherwise climbed to reach a pot; stepped/sat/fell into pot; fell or stepped into spilled liquid; stove tipped when child sat on open door, causing pot and contents to fall; took a cooking utensil out of a pot; being held by parent while parent cooked; pot handle broke, causing contents to spill; pulled pot off grill; lifted cover off a pot; and overturned pot while helping to cook.

Seven categories for the substance involved were water, grease (grease, oil, butter), soup/sauce (including syrup and gravy), food (pasta, vegetable, meat, etc), hot drinks (coffee, tea, hot chocolate, milk), steam, and not specified. Data were managed using Epi Info 2002 (version updated in February 2003), a database and statistics software program in the public domain.

## RESULTS

For the 6-year period studied, there were an estimated 17 237 emergency department–treated burns to children 5 and younger. A total of 65.7% were scalds and 34.3% were thermal burns. Table 1 shows the distribution of age, gender, and disposition for each type of burn. Age was significantly related to type of burn ( $\chi^2 = 852$ ;  $df = 5$ ;  $P = .000$ ), and 1-year-olds constituted the largest percentage for each burn type (38.7% scalds; 24.8% thermal burns). Gender was significantly related to type of burn ( $\chi^2 = 18.44$ ;  $df = 1$ ;  $P < .001$ ), with more boys injured in both burn types. Disposition was also significantly

related to type of burn ( $\chi^2 = 1658.05$ ;  $df = 3$ ;  $P = .000$ ), with more hospitalizations for scalds. Furthermore, 1-year-olds were much more likely to be hospitalized for a scald than were other-aged children ( $\chi^2 = 513.83$ ,  $df = 15$ ,  $P = .000$ ).

Table 2 lists the distribution of age, gender, and disposition for the 7 scald injury patterns. Two patterns ("reached up and pulled down pot from stove or other elevated surface" and "grabbed, overturned, or spilled pot onto self") accounted for half (52.2%) of all scald injuries. The third ranking pattern ("pot contents splashed onto child") accounted for 21.6% of scalds. "Collided with pot or with person holding pot" and "put hands into pot" accounted for 7.6% and 5.4%, respectively, of scald injuries.

The highest frequency of incidents for the 3 most common scald patterns ("reached up and pulled down pot from stove or other elevated surface"; "grabbed, overturned, or spilled pot onto self"; and "pot contents splashed onto child") occurred among 1-year-olds (46.4%, 44.9%, and 31.7%, respectively), followed by 2-year-olds (23.3%, 22.0%, and 19.4%, respectively). For "child put hand in pot," 1-year-olds accounted for 43.2% of cases, followed by children younger than 1 (34.6%). For "collided with pot or with person holding pot," 5-year-olds were at highest risk (32.9%), followed by 2-year-olds (23.95%).

In addition to significant differences in age for the 3 most common scald patterns ( $\chi^2 = 774.23$ ,  $df = 10$ ,  $P = .000$ ), there were significant differences in gender ( $\chi^2 = 41.23$ ,  $df = 1$ ,  $P < .001$ ), body part injured ( $\chi^2 = 568.62$ ,  $df = 12$ ,  $P = .0000$ ), and disposition ( $\chi^2 = 692.05$ ,  $df = 6$ ,  $P = .0000$ ). With the pattern "reached up and pulled down pot from stove or other elevated surface," there were more boys than expected, more injuries involving 25% or more body surface, and excessive hospitalizations/transfers for treatment. With the pattern "grabbed, overturned, or spilled pot onto self," there were more leg injuries than expected and fewer hospitalizations. With the

**TABLE 1.** Distribution of Age, Gender, and Disposition for Scalds and Thermal Burns

|                         | Estimated No. of Cases* |                 |               |
|-------------------------|-------------------------|-----------------|---------------|
|                         | Scald, %                | Thermal Burn, % | Total, %      |
| Age, y                  |                         |                 |               |
| <1                      | 812 (7.2)               | 1239 (20.9)     | 2051 (11.9)   |
| 1                       | 4376 (38.7)             | 1466 (24.8)     | 5842 (33.9)   |
| 2                       | 2538 (22.4)             | 1252 (21.2)     | 3790 (22.0)   |
| 3                       | 1422 (12.6)             | 734 (12.4)      | 2156 (12.5)   |
| 4                       | 1273 (11.2)             | 762 (12.9)      | 2035 (11.8)   |
| 5                       | 897 (7.9)               | 464 (7.8)       | 1361 (7.9)    |
| Total                   | 11 318 (100)            | 5917 (100)      | 17 235 (100)  |
| Gender                  |                         |                 |               |
| Male                    | 6615 (58.4)             | 3236 (54.7)     | 9851 (57.2)   |
| Female                  | 4704 (41.6)             | 2676 (45.3)     | 7380 (42.8)   |
| Not reported            | 0 (0)                   | 6 (0.1)         | 6 (0.03)      |
| Total                   | 11 319 (100)            | 5918 (100)      | 17 237 (100)  |
| Disposition             |                         |                 |               |
| Treated and released    | 8619 (76.1)             | 5913 (99.9)     | 14 532 (84.3) |
| Treated and transferred | 1360 (12.0)             | 0 (0)           | 1360 (7.9)    |
| Admitted                | 1322 (11.7)             | 5 (0.1)         | 1327 (7.7)    |
| Not reported            | 18 (0.2)                | 0 (0)           | 18 (0.1)      |
| Total                   | 11 319 (100)            | 5918 (100)      | 17 237 (100)  |

\* Differences are a result of rounding.

**TABLE 2.** Distribution of Age, Gender, and Disposition for Seven Scald Injury Patterns

| Pattern  | Age, y | n (%)*       | Gender | n (%)*       | Disposition  | n (%)*       |
|--|--------|--------------|--------|--------------|--------------|--------------|
| 1. Reached up and pulled down pot                | <1     | 89 (2.9)     | M      | 1975 (64.44) | Released     | 1756 (57.31) |
|  | 1      | 1423 (46.43) | F      | 1090 (35.56) | Transferred  | 667 (21.77)  |
|  | 2      | 714 (23.3)   |        |              | Hospitalized | 635 (20.72)  |
|  | 3      | 528 (17.23)  |        |              | Unknown      | 6 (0.2)      |
|  | 4      | 195 (6.36)   |        |              |              |              |
|  | 5      | 116 (3.78)   |        |              |              |              |
| Pattern total (% grand total†) 3065 (27.1)       |        |              |        |              |              |              |
| 2. Grabbed, overturned, or spilled pot onto self | <1     | 102 (3.5)    | M      | 1659 (58.4)  | Released     | 2148 (75.6)  |
|  | 1      | 1275 (44.9)  | F      | 1183 (41.6)  | Transferred  | 389 (13.7)   |
|  | 2      | 626 (22.0)   |        |              | Hospitalized | 299 (10.5)   |
|  | 3      | 294 (10.3)   |        |              | Unknown      | 6 (0.2)      |
|  | 4      | 474 (16.7)   |        |              |              |              |
|  | 5      | 69 (2.4)     |        |              |              |              |
| Pattern total (% grand total) 2842 (25.1)        |        |              |        |              |              |              |
| 3. Pot contents splashed onto child              | <1     | 324 (13.27)  | M      | 1378 (56.43) | Released     | 2099 (85.85) |
|  | 1      | 774 (31.7)   | F      | 1064 (43.57) | Transferred  | 47 (1.92)    |
|  | 2      | 474 (19.41)  |        |              | Hospitalized | 299 (12.23)  |
|  | 3      | 326 (13.35)  |        |              | Unknown      | 0 (0)        |
|  | 4      | 271 (11.1)   |        |              |              |              |
|  | 5      | 273 (11.18)  |        |              |              |              |
| Pattern total (% grand total) 2442 (21.6)        |        |              |        |              |              |              |
| 4. Collided with pot/person holding pot          | <1     | 0 (0)        | M      | 543 (63.14)  | Released     | 781 (90.81)  |
|  | 1      | 144 (16.74)  | F      | 317 (36.86)  | Transferred  | 61 (7.09)    |
|  | 2      | 206 (23.95)  |        |              | Hospitalized | 12 (1.4)     |
|  | 3      | 106 (12.33)  |        |              | Unknown      | 6 (0.7)      |
|  | 4      | 121 (14.07)  |        |              |              |              |
|  | 5      | 283 (32.91)  |        |              |              |              |
| Pattern total (% grand total) 860 (7.6)          |        |              |        |              |              |              |
| 5. Child put hand into pot                       | <1     | 211 (34.6)   | M      | 267 (43.7)   | Released     | 588 (96.4)   |
|  | 1      | 264 (43.2)   | F      | 344 (56.3)   | Transferred  | 22 (3.6)     |
|  | 2      | 71 (11.6)    |        |              | Hospitalized | 0 (0)        |
|  | 3      | 38 (6.2)     |        |              | Unknown      | 0 (0)        |
|  | 4      | 15 (2.5)     |        |              |              |              |
|  | 5      | 12 (2.0)     |        |              |              |              |
| Pattern total (% grand total) 610 (5.4)          |        |              |        |              |              |              |
| 6. Other   | <1     | 30 (4.0)     | M      | 321 (42.4)   | Released     | 529 (69.9)   |
|  | 1      | 234 (31.0)   | F      | 436 (57.6)   | Transferred  | 174 (23.0)   |
|  | 2      | 251 (33.1)   |        |              | Hospitalized | 53 (7.0)     |
|  | 3      | 69 (9.2)     |        |              | Unknown      | 0 (0)        |
|  | 4      | 52 (6.9)     |        |              |              |              |
|  | 5      | 120 (15.9)   |        |              |              |              |
| Pattern total (% grand total) 757 (6.7)          |        |              |        |              |              |              |
| 7. Unknown                                       | <1     | 55 (7.4)     | M      | 473 (63.7)   | Released     | 718 (96.6)   |
|  | 1      | 261 (35.2)   | F      | 270 (36.3)   | Transferred  | 0 (0)        |
|  | 2      | 197 (26.5)   |        |              | Hospitalized | 24 (3.2)     |
|  | 3      | 61 (8.2)     |        |              | Unknown      | 0 (0)        |
|  | 4      | 145 (19.5)   |        |              |              |              |
|  | 5      | 24 (3.2)     |        |              |              |              |
| Pattern total (% grand total) 743 (6.6)          |        |              |        |              |              |              |

\* Differences are a result of rounding.

† Grand total scalds: 11 319

pattern "pot contents splashed onto child," there were more girls than expected, more injuries to the head/neck, and fewer hospitalizations/transfers for treatment.

Table 3 lists the frequencies of the substances involved in scalds. Hot water was the scald agent in 48.5% of cases, followed by grease, soups, and food. Hot beverages were associated with 3.9% of scalds.

Thermal burns were primarily the result of the child's coming in contact with (usually touching) hot cookware. This is reflected in the significant differences ( $\chi^2 = 4864.5$ ,  $df = 6$ ,  $P < .001$ ) in body part injured between thermal burns and scalds (Table 4). The largest contribution to  $\chi^2$  came from the category upper limb, with an excess of cases for thermal burns and many fewer than expected for scalds. Of the 4626 upper limb injuries in thermal burns, 55% were to the hand and 26% were to the finger(s).

## DISCUSSION

This study focused on emergency department-treated childhood burns and scalds associated with nonelectric cookware. In the 6-year period covered, there were nearly twice as many scalds as contact burns. The greater number of scalds perhaps reflects injury severity; that is, the need for emergency treatment rather than the relative occurrence of these 2 burn patterns in the population, because one would intuitively expect contact burns to occur with much greater frequency than scalds do. Banco et al<sup>12</sup> reported contact burns as more numerous than scalds in their emergency department study, noting that they accounted for the majority of burns among children younger than 11 years and that 3.6 years was the mean age. Quayle et al<sup>13</sup> also reported contact with a hot object to occur more frequently than

**TABLE 3.** Frequencies of Substances Involved in Scalds

| Substance     | n      | %    |
|---------------|--------|------|
| Water         | 5485   | 48.5 |
| Grease        | 2206   | 19.5 |
| Soup/sauce    | 1442   | 12.7 |
| Food          | 1381   | 12.2 |
| Hot drinks    | 442    | 3.9  |
| Steam         | 114    | 1.0  |
| Not specified | 248    | 2.2  |
| Total         | 11 318 | 100  |

**TABLE 4.** Body Part Injured by Type of Burn

|              | Estimated No. of Cases |                 |              |
|--------------|------------------------|-----------------|--------------|
|              | Scald, %               | Thermal Burn, % | Total, %     |
| Head/neck    | 2249 (19.9)            | 583 (9.9)       | 2832 (16.4)  |
| Upper torso  | 2864 (25.3)            | 330 (5.6)       | 3194 (18.5)  |
| Lower torso  | 838 (7.4)              | 31 (0.5)        | 869 (5.0)    |
| Upper limb   | 2731 (24.1)            | 4626 (78.2)     | 7357 (42.7)  |
| Lower limb   | 1529 (13.5)            | 347 (5.9)       | 1876 (10.9)  |
| 25% or more  | 978 (8.6)              | 0 (0)           | 978 (5.7)    |
| Not reported | 130 (1.1)              | 0 (0)           | 130 (0.8)    |
| Total        | 11 319 (100)           | 5917 (100)      | 17 236 (100) |

scalds (38% vs 26%, respectively), with children aged 0 to 4 years at much higher risk for thermal burn than those aged 5 to 14 years.

Scald injuries have been reported to occur with greater frequency among boys.<sup>12,13</sup> In this study, the boy-to-girl ratio was 1.4:1 for scalds and 1.2:1 for thermal burns. Consistent with other studies,<sup>2,5,12</sup> 1-year-olds were found to be at the highest risk for scald injury, with ~5 times as many scalds compared with children younger than 1 and nearly twice as many compared with 2-year-olds. The high frequency of scalds among 1-year-olds can be related to their inherent nature to explore their environment. Their motor skill development outpaces their cognitive development, so they can perform physically, but do not understand the associated risks of injury.<sup>14</sup> Simon and Baron<sup>14</sup> attributed increasing motor skill with increasing ability to encounter hot liquids or solids.

For both scalds and thermal burns, children 3 through 5 years of age were involved in one third or fewer of the incidents. This trend is consistent with Simon and Baron's<sup>14</sup> findings and similarly suggests a role of increasing maturity and understanding in reducing the risk for burn injury. Simon and Baron<sup>14</sup> attributed their reported decrease in scalds and contact burns among older toddlers and preschoolers to increased awareness of the consequences of their actions as children develop intellectually.

In contrast to scalds, thermal burns presented with comparable frequency among those aged birth through 2 years (~21%–25%; Table 1), with a decrease in the older age groups. One explanation could be that learning to reach and grasp occurs in the first year of life, so touching hot surfaces begins to occur at a relatively early age. Often, scalds occur under circumstances that require more mobility, including standing and walking, making the toddler at particular risk.

Greater severity of injury was clearly associated

with scalds, as reflected in nearly 25% of cases being transferred or hospitalized, compared with 99.9% of thermal burn cases being treated and released. This finding, too, is consistent with previous reports<sup>12,14</sup> and makes sense because scalds tend to affect larger body surface areas, with deeper tissue injury than do thermal burns. As Table 4 showed, the head/neck, upper torso, and upper limbs were more likely to be involved in a scald, whereas the upper limb (primarily hand and fingers) was more likely to be involved in a thermal burn.

One-year-olds were much more likely to be hospitalized as a result of a scald compared with other age groups. In Simon and Baron's study,<sup>14</sup> which grouped all types of burns, 1-year-olds were also at highest risk for hospitalization. They reported an age-specific annual burn-related hospitalization incidence of 82.1 per 100 000 children for 1-year-olds, compared with 60.7 for children younger than 1. They noted that during the first year of life, burn hospitalization incidence increased with each 3-month age increment through 11 months of age, when it reached 118.2 per 100 000, then decreased with each successive year through age 4 years.

Although thermal burns were primarily caused by touching a hot pan, there were several different patterns that resulted in scald injury, with 2 patterns accounting for nearly half of incidents: "reached up and pulled down pot from stove or other elevated surface" and "grabbed, overturned, or spilled pot onto self." One-year-olds were overwhelmingly involved in each of these 2 patterns. Boys were nearly twice as likely as were girls to reach up and pull down a container of hot substance but only ~1.4 times as likely as girls to grab and overturn a container. More mobility and perhaps more motivation are associated with reaching up to a level that is above eye level but still within reach. This activity may be more characteristic of male than female exploratory behavior.

Age and gender distributions for the other scald patterns were different. For "pot contents splashed onto child," 1- and 2-year-olds made up half of the injured, and the male to female ratio was 1.3:1. In this pattern, the child is essentially a bystander, so one would not expect a huge variation in either age or gender involved. The gender difference is relatively slight. One explanation for the higher frequency among younger children is presence; that is, they are in the kitchen because they cannot be left unattended, whereas older children can be playing alone in other rooms. For "collided with pot or with person holding pot," 5-year-olds were the most frequently injured (32.9%) and the male:female ratio was 1.7:1. This injury pattern often involved running, which fits the developmental stage of 5-year-olds. Five-year-old boys would also be expected to be the tallest group, so collisions would be expected to affect the hands or upper body of the person carrying the pot, thereby increasing the likelihood for a spill. For "put hands into pot," nearly 80% of the injured were 1 or younger. This clearly reflects the absence of any perception of danger. Girls were only slightly more often involved than boys (1.3:1).

Body part injured differed with scald pattern. When  $\chi^2$  test was performed comparing body part injured in the 3 most common scald patterns, there was an excess of injuries affecting 25% or more body surface associated with the pattern "reached up and pulled down pot from stove or other elevated surface." This is not surprising, because this pattern results in a cascade of hot liquid falling onto a standing child. Because 1-year-olds made up 46.4% of the injured in this scald pattern, this may explain the high hospitalization rate among 1-year-olds. In contrast, there was an excess of injury involving the lower limb with the pattern "grabbed, overturned, or spilled pot onto self." This suggests that the child is seated, the lap/legs bearing the brunt of the hot liquid.

Hot water was the most common causative agent overall, accounting for nearly half of all substances, and the most common substance involved in the 3 scald patterns "reached up and pulled down pot from stove or other elevated surface"; "grabbed, overturned, or spilled pot onto self"; and "collided with pot or with person holding pot." Grease ranked second in frequency and was the substance most likely to be involved when "pot contents splashed onto child." Food and soups were more often involved when the "child put hands into pot."

Victims of scalds are able to reach a pot that contains the hot substance; therefore, it is appropriate when designing interventions to consider reach capability, especially of children 1 and 2 years of age. Reach data were available for 2-year-olds but not for 1-year-olds. Mean overhead standing reach (to grip) data for 2-year-olds were reported in 1993 from the Netherlands<sup>15</sup> as 106.5 cm (41.93 in) and in 1998 from the United Kingdom<sup>15</sup> as 104.5 cm (41.14 in). The 1977 US data<sup>16</sup> were grouped for children 2 to 3.5 years of age and reported as 107.3 cm (42.24 in). Overhead reach (to fingertip while on tiptoes) for 3-year-olds was reported in 1974 from Germany<sup>15</sup> as 136.9 cm (53.9 in) for boys and 135.5 cm (53.34 in) for girls. Mean forward reach (to grip) for 2-year-olds, achieved by stretching while sitting on a chair, was reported in 1989 from the Netherlands<sup>15</sup> as 67.7 cm (26.65 in).

In the United States, typical stove height from the floor is 36 in; the center of back burners is somewhere around 16 in from the edge. Typical table widths are 40 to 45 in. Stovetop pots and pans can be a range of heights, for example, as low as a few inches for a fry pan to several (8+ in) inches for a soup pot. The anthropometry data suggest that 1- and 2-year-olds are gaining access to pots on the front burners of stoves but not the back and that 2-year-olds can reach more than halfway across a table to grab containers of hot substances. Shubert et al<sup>17</sup> reported in 1990 that standard kitchen countertops are above the view but not out of reach of young children.

Coffman et al<sup>18</sup> stated that to emphasize prevention to parents, more emphasis needed to be placed on the link between child development and risks for injury. Zuckerman et al<sup>19</sup> stated that parents need to know specific cognitive and physical limitations in

children at different ages so that they can develop clear safety rules that can withstand children's pleas for involvement in situations or activities that have a high likelihood of injury. Furthermore, they emphasized how individual differences in a child's temperament, motivation, and capability can affect the likelihood of injury. Because of those individual differences, they encouraged safety counseling to be individualized.

Scald interventions strategies recommended in 1977<sup>3</sup> included turning pots on stoves so that handles faced the wall; placing hot beverages in the center of a table, out of toddler's reach; and removing tablecloths from tables. These were essentially active interventions, relying on parental behavior modification. The very same recommendations (among others) resonated in the 1980s<sup>20</sup> and 1990s<sup>21</sup> but have not been effective. Corrarino et al<sup>21</sup> conducted a pre-intervention survey of 49 parents in Suffolk County, NY, asking about current burn prevention practices. The survey was followed by in-home teaching of burn prevention practices by a visiting nurse. A post-teaching survey was conducted to assess changes. Preintervention safety practices that are most likely to be in place already focused on bathtub issues (water temperature, staying with child, etc). Kitchen issues (no tablecloths or placemats on table) were among safety practices least likely to be in use already. After the intervention, parents were least likely to make changes in dangling electric coffee pot cords and removing a tablecloth or place mat from the table and most likely to make changes in bathtub-related behaviors. Although 1 teaching point was to cook on back burners and turn pot handles toward the back, no results on this item were reported.

A more recent 12-year (1985–1996) intervention study in Harstad, Norway,<sup>11</sup> combined a national prevention program and a community-based intervention program. Both passive and active strategies were used. Passive strategies included the purchase and installation of cooker safeguards, essentially a guardrail around the edge of the stove, and lowering of tap water thermostat temperature. Active interventions were based on health education models and social learning theory. The authors reported a significant reduction in scald injury; however, the actual numbers reported were small. For example, there were 5 cases of "receptacles pulled down from stove" during 1985–1988, 3 during 1989–1992, and none during 1993–1996. Cases of "overturned cups" went from 12 to 9 to 6 in those same periods. Kopjar et al<sup>22</sup> found that the Harstad study had significant limitations in evaluation design, lack of appropriate controls, weaknesses in data collection systems, and problems with statistical methods. They concluded that the effectiveness of a "Safe Community" concept in reducing the incidence of injuries was still open.

Van Rijn et al<sup>23</sup> reported on the general failure of behavioral interventions in preventing burn injuries. Therefore, their study focused not on changing behavior but instead on getting parental information about the advantages and disadvantages encountered with implementing 9 safety measures. Four of their measures were relevant to this study: (1) place

cups filled with hot beverages where child cannot reach them, (2) keep child out of kitchen during food preparation, (3) avoid drinking hot beverages with child on your lap, and (4) place a guard in front of stove to prevent child's reaching the stove.

Advantages for the first 3 measures were that it was safer for the child and has become habitual; advantage for the fourth measure was that the parent could leave the room. Among the disadvantages to the first measure were that children could reach cups although placed in the middle of the table (consistent with the anthropometry data reported in this study), the measure is too difficult to implement, visitors do not adopt this behavior, and parents do not link this measure with the prevention of burns. Among the disadvantages to the second measure were that the child wants to be in the same room as the mother, the measure is too difficult to implement, and the parent cannot keep an eye on the child. Among the disadvantages to the third measure were that the child wants to sit on the mother's lap, and other people take the child on their lap while drinking. Among the disadvantages to the fourth measure were that parents were not familiar with this measure, did not know where to buy one, found the guard ugly, and found the guard too expensive.

For most parents in the van Rijn study, the reason that they did not implement a desired safety behavior was that they were not familiar with it, the behavior was not habitual, and they were not able to resist the pressure of others. Parents who did implement a safety behavior were able to associate the behavior with the prevention of burn injuries more than those who did not make the connection. The lack of awareness of the hazards of hot liquids has been reported<sup>2,10,17</sup> and may be related to the fact that the volumes of liquid involved in kitchen burns are relatively small, compared with, say, a tub of hot water. If a hazard is unrecognized, then it is unlikely that a parent will know what safety measures to use, contrary to what was suggested by Zuckerman et al.<sup>19</sup> Conversely, if a parent more fully recognizes the child's individual capabilities, then perhaps the hazards will also become more evident.

Sellstrom et al<sup>24</sup> reported maternal perception of a child's risk of injury to be significantly related to being able to attribute cause of injury to the child. Among the scenarios that they presented was a 3-year-old child's pushing a chair to the stove and climbing up because she wanted to cook. She pulled a pan of hot water over herself and had to be taken to the doctor. The authors concluded that safety education might increase risk perception if the child's role in events that result in injury were emphasized.

The most dramatic reductions in scald injury have been associated with bathtubs. Streeton and Nolan<sup>25</sup> reported an 83% reduction in hot bath or tap water scald admissions in a 25-year period but little change in scalds associated with hot beverages. They attribute the bathtub/tap water success to changes in standards and regulations. No such simple solution seems likely for kitchen scalds.

There seems to be a paradox surrounding the kitchen. It is a room filled with hazardous products

and substances, yet it is a place where family activity is focused.<sup>26</sup> Although the kitchen is perceived as dangerous for young children,<sup>27</sup> unanticipated injuries occurred most often in the kitchen.<sup>28</sup> More scalds occur in the kitchen than in the bathroom.<sup>4</sup>

If the kitchen hazard of hot liquids is not well recognized and the developmental capabilities of children are not well recognized, then the question is how to decrease the frequency of these devastating injuries. Cohen and Swift<sup>29</sup> reported on a "spectrum of prevention," composed of 6 interrelated action levels: (1) strengthen individual knowledge and skill, (2) promote community education, (3) educate providers to improve their understanding of prevention, (4) foster coalitions and networks, (5) change organizational practices, and (6) influence policy and legislation. Recognizing that effective prevention is not so simple as individual education, the spectrum approach moves prevention from an individually focused education effort to a systems approach.

If one were to follow this model, then 6 actions that could be undertaken to address burn injuries include

1. Have clinicians (as the authority most likely to be in direct, frequent contact with parents of young children) advise parents about the potential for kitchen scalds when children reach 9 months of age and continue until the child is 2 years of age.
2. Have communities institute a scald awareness day to increase awareness of the population at large (bike days, car seat checks, poison prevention weeks, and safety fairs are examples of community events that have been undertaken).
3. Require child care providers to have some injury prevention training that addresses all 5 energy sources of injury (mechanical, electrical, thermal, chemical, and radiation) so as not to focus on only the leading cause of injury (mechanical), omitting the less frequently occurring thermal injuries.
4. Develop a community coalition to build a partnership approach (Cool Kids Coalition<sup>30</sup> is a scald prevention program that was instituted in Brookhaven, NY, in the 1990s and used booklets, educational programs, school contests, newspaper articles, etc in a multipronged approach).
5. Encourage the media (newspapers, radio, and television) to offer a fixed slot (of time or space) for a regularly scheduled announcement of local injury incidents, using the actual injury event as an opportunity to teach preventive measures (real stories have power over statistics because human brains seem to be built to process stories better than any other forms of input<sup>31</sup>).
6. If a particular design of pot tended to be involved in scald incidents (information not available from this data set), then require (through standards or laws) manufacturers of those types of pots to seek design innovations to eliminate/reduce the hazard and to include special instructions and warnings about the use of those items around children.

## CONCLUSIONS

Previous intervention strategies have had little effect on reducing childhood kitchen burn and scald

injuries. Although the hazards of motor vehicles, poisons, and small parts seem to be well understood by parents, there seems to be no comparable understanding of the potential for kitchen burns and scalds. Kitchen burns and scalds involve a multitude of products, a variety of child-product interactions, and a broad range of child development stages. Prevention requires constant vigilance during a wide variety of circumstances. Perhaps that is what makes scalds and burns so intervention resistant.

A multispectral approach may offer promise over an individual-behavior-modification approach. Increasing parental knowledge of child development stages, accompanying skills' acquisition, and male/female behavior differences may help improve their ability to appreciate the risk of burns and scalds. Recommending the same strategies that have not worked in the past will not make them successful in the future. More studies aimed at finding out why certain prevention measures have not worked would help to redirect efforts.

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## Kitchen Scalds and Thermal Burns in Children Five Years and Younger

Dorothy A. Drago

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