# A Prospective Analysis of Trash, Brush, and Grass Burning Behaviors

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**Burn injuries sustained during residential trash, brush, and grass burning cause significant morbidity and mortality in rural areas. To further prevention efforts, we surveyed individuals who incurred injuries from residential burning. Thirty-six individuals injured while burning trash, brush, or grass from June 2003 through September 2005 were asked to respond to a self-administered written survey. Injury related questions revealed that the majority of those injured were burning brush (21 of 35, 60.0%) in an open space (19 of 35, 54.2%) with the addition of accelerants (27 of 36, 75%). Survey questions regarding usual burning practices revealed almost two-thirds burned either brush or a mixture of brush and trash (23 of 36, 63.9%). Eighty percent of those who were injured desired to change their behavior (25 of 35, 80%). Approximately two-thirds would consider asking for help with burning if it were provided (22 of 34, 64.7%). Our survey shows that acceptable alternatives to burning varied depending on the material that was burned. As the majority of respondents usually burned brush or a mixture of brush and trash, an acceptable trash removal system should also include brush pickup. As residential burning continues presently, injury prevention efforts are essential and should focus on the misuse of gasoline, uniform safety standards for gasoline cans, and dissemination of safe burning practices. (J Burn Care Res 2008;29:441–445)**

Injuries sustained while burning trash, brush, and grass remain an underappreciated mechanism of burn injuries in rural communities. We have previously shown that these injuries, along with open fire injuries from other causes, are the leading causes of flame burns seen in rural emergency rooms (ER) and account for 20% of our burn center's annual admissions.[1,2] These injuries are associated with significant morbidity and mortality. Although young men aged 25 to 45 years are predominately affected, the elderly have the worst outcomes. One third of those admitted to our burn unit who were more than 60 years of age did not return to independent living. The mean age of those dying from their injury was 80 years of age.[1]

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Little research on the causes and potential prevention of trash, brush, and grass burning injuries has been conducted. Most of the published studies have focused on injuries sustained from the use of accelerants in open fires of all types.[3–6] Moreover, we are not aware of any active prevention studies. Furthermore, public access to literature on safe burning practices is limited and usually requires a high level of literacy to access. A search of the internet showed a disappointingly small number of sites that addressed safe burning practices and often this material was buried within municipality web sites.[7,8]

In an effort to develop targeted prevention, we conducted a survey of individuals who sustained burns while burning trash, brush, or grass. We sought to determine who burned, how they burned, and their willingness to change their behavior.

## METHODS

A convenience sample of 36 individuals injured while burning trash, brush, or grass was performed from June 2003 through September 2005. Patients being

treated for a burn that met the study criteria were asked to respond to a self-administered written survey, either during admission or during a follow-up visit to the clinic. The survey took approximately 5 minutes to complete, and asked questions about their general burning practices, their knowledge, and the particular circumstance leading to the current burn. Time to completion of their survey was 39.7 ± 79.1 days following their injury. Charts were reviewed for demographic data, county of residence, burn injury data, and outcome. Types of burning were defined as trash (burning involved only common household trash), brush (burning involved only brush), grass (burning involved only grassy areas or fields), and a combination of trash and brush (burning involved both household items and brush).

All patients admitted to our regional burn center underwent resuscitation per Parkland Formula adjusted to adequate perfusion endpoints when necessary. Wounds were cleansed daily and topical antimicrobial cream was used. Operative debridement was performed after resuscitation for obvious full-thickness wounds or within two weeks for open partial wounds that failed to heal.

All statistical analyses were performed using SAS version 9.1 (SAS Institute Inc. Cary, NC). As not every respondent answered every survey question, the number responding to the question and the percentage are given in the results section. The Student's *t*-test and Fisher's exact test were used when appropriate. Data is presented as mean ± the standard deviation with the range given in parenthesis when appropriate. Significance was determined at $P < .05$. The study was approved by our institutional review board.

## RESULTS

### Demographics of Those Injured While Burning Trash, Brush, or Grass

The demographics of those injured are listed in Table 1. Urine drug screens were performed in only approximately one half of the survey respondents (20, 55.5%). Of those drug screens performed, three were positive for illicit substances; two were positive for methamphetamines; and one was positive for tetrahydrocannabinol. Patients aged more than 60 years had longer lengths of stay, underwent more operative therapy and were more likely to be discharged to a facility or die (Table 1). The only death occurred in the over 60 age group.

Over half of the respondents were high school graduates (21, 58.3%) and one-third were college graduates (12, 33.3%). One-third was retired or disabled (13, 36.1%). As our center is a regional burn unit, the patients came from 23 different counties; the most patients from any single county were four.

The majority of those injured were burning brush (21 of 35, 60.0%) in an open space (19 of 35, 54.2%). Accelerants were used by three quarters of those injured (27 of 36, 75%). Most poured the accelerant over the burning material (19 of 25, 76%) or threw it on the burning material (2 of 25, 8%). When asked why the burn happened, accelerant use was blamed by over 58% (20 of 34). Five felt that carelessness played a role (of 34, 14.7%), and four reported that miscellaneous items caused explosions (of 34, 11.8%).

Over one-third blamed extraneous factors such as the wind (11 of 36, 30.6%).

**Table 1.** Demographic and injury characteristics

| Characteristics | Age 15–60<br>24 (66.7%) | Age >60<br>12 (33.3%) | *P* |
|---|---|---|---|
| Sex* | | | .691 |
| Male | 18 (75.0%) | 10 (83.3%) | |
| Female | 6 (25.0%) | 2 (16.7%) | |
| Admitted* | 19 (79.2%) | 12 (100%) | .113 |
| Length of stay (continuous)† | 6.4 ± 7.0 d (1–29 d) | 17.9 ± 14.6 d (2–52 d) | .0001, .001, respectively |
| Length of stay (categorical)* (d) | | | .035 |
| 0–3 | 12 (50.0%) | 2 (16.7%) | |
| 4–7 | 4 (16.7%) | 1 (8.3%) | |
| 8–14 | 5 (20.8%) | 2 (16.7%) | |
| 15+ | 3 (12.5%) | 7 (58.3%) | |
| Surgical intervention* | 5 (20.8%) | 9 (75.0%) | .003 |
| Discharged to a facility* | 1 (4.2%) | 41.7 (50.0%) | .003 |

* Characteristics of burn patients were measured using Fisher's exact test and compared between age groups.

† Student's *t*-test used to measure difference in length of stay between age groups.

### Reasons for and Usual Practices Involved in Residential Burning

The reasons for and usual behavior involved in habitual residential burning are listed in Table 2. Although trash pickup was available for 28 (of 35, 80%) of those surveyed, they preferentially chose to burn their own trash, brush, or grass. One third of respondents burn weekly (13, 37.1%) and another third burn greater than every other month (12, 34.3%, see Table 2). Almost two-thirds burn either brush or a mixture of brush and trash (23 of 36, 63.9%). Patterns of burning vary depending on the material being burned. Trash is usually burned in an enclosed space. The majority burn trash in a pit or a barrel (16 of 24, 66.7%). Over one half of the respondents burn brush in an open space (15 of 27, 55.6%).

### Acquisition of Trash, Brush, and Grass Burning Behavior

The majority of respondents started burning at a young age. Seventy percent started burning between the ages of 5 and 24 years (23 of 33). Almost half reported that their parents instructed them in burning (16 of 35, 45.7%). However, 13 of 35 (37.1%) were self-taught. Only one respondent reported that written information influenced his burning practices (1 of 35, 3.9%).

Knowledge regarding accelerant use and its properties was acquired in a similar manner. The majority of the respondents reported knowing the difference between the flammability of gasoline vs the other liquids with accelerant properties (33 of 36, 91.7%). The family was most often cited as the source of this knowledge (24 of 34, 70.6%). Only two (of 34, 5.9%) reported that they learned about the different properties of accelerants in school.

**Table 2.** Reasons for and behavior involved in residential burning of trash, brush, and grass

| | Participant Identified N (%) |
|---|---|
| Reasons for burning | |
| Cost | 6 (18.8) |
| Convenience | 9 (28.1) |
| Brush or other item not picked up | 13 (40.6) |
| Unclear response | 4 (12.5) |
| Burning behavior | |
| Frequency of burning | |
| Weekly | 13 (37.1) |
| Monthly | 10 (28.6) |
| Bimonthly | 12 (34.3) |
| Materials usually burned | |
| Brush | 15 (41.7) |
| Trash | 9 (25.0) |
| Combination of brush and trash | 8 (22.2) |
| Miscellaneous objects | 3 (8.3) |
| Weeds | 1 (2.8) |
| Frequency of accelerant use | |
| Seldom | 7 (31.8) |
| Occasionally | 2 (9.1) |
| Every time | 11 (50.0) |
| Unclear response | 2 (9.1) |
| Usual method of trash burning | |
| In barrel or pit | 16 (66.7) |
| Open space | 1 (4.2) |
| Unclear response | 7 (29.2) |
| Usual method of brush burning | |
| In barrel or pit | 10 (37.0) |
| Open space | 15 (55.6) |
| Unclear response | 2 (7.4) |

### Alternatives to Residential Burning

Eighty percent of those who were injured desired to change their behavior (25 of 35, 80%). The remainder of those injured believed that their injury was a freak accident and indicated that they would not change their burning behavior (7 of 35, 20%). The majority of the respondents reported that they would change their burning behavior by discontinuing the use of flammable fluids (13 of 32, 40.65). Twenty-two percent reported that they would abstain from residential burning (22 of 32). However, the current alternatives to burning such as trash pickup, using the dump, or composting were unacceptable to approximately two thirds of the respondents (17 of 26, 65.4%). Approximately two-thirds would, however, consider asking for help with burning if it were provided (22 of 34, 64.7%).

## DISCUSSION

Injuries from trash, brush, and grass burning continue to be a largely unrecognized problem in rural areas. In our previous studies, we have shown that injuries from such residential burning result not only in lost manpower hours, but additionally can be life altering in the elderly. Many municipalities have banned such burning in an effort to control pollution, as backyard burning is now the largest source of dioxin emissions.[9] However, without acceptable alternatives, illegal burning would most likely continue. Enforcement of any laws may then be costly and time consuming. Development of acceptable alternatives would end the need for residential burning and stop the injuries from such behavior.

Our survey shows that acceptable alternatives to burning varied depending on the material that was burned. In general, the majority felt that the current alternatives, such as using trash pickup, the local

dump, or composting, were not acceptable. Although the reasons varied, the majority stated that these alternatives were either too costly or inconvenient. As many of the respondents burned either weekly or greater than bimonthly, the frequency of trash pickup would be a factor in compliance of a nonburn law.

Brush, unlike trash, is particularly difficult to discard, and some of our participants cited that their current trash removal system excludes brush. As the majority of respondents usually burned brush or a mixture of brush and trash, an acceptable trash removal system should also include brush pickup. This is particularly critical as the majority were injured while burning brush, which could be due to more frequent burning of brush or that the majority burned brush in an open space (as opposed to trash burning in which they more often used a barrel or pit). Unlike trash or brush, grass or field burning cannot be replaced by waste removal and strategies to reduce burns may be different. An acceptable strategy for both waste burning and field burning might be the implementation of burn assistance programs, such as from the local fire fighters. Participants of our survey responded positively to this strategy.

As residential burning remains legal in many municipalities, strategies to reduce injuries are imperative. Possible prevention strategies are listed in Table 3. As the majority of respondents blamed their injury on the use of gasoline as an accelerant, possible prevention efforts might focus on increasing public knowledge regarding the hazardous nature of gasoline. Gasoline, with its low flash point and high vapor density, is considered a flammable liquid and is particularly dangerous when it is used as an accelerant. Kerosene and diesel fuel, on the other hand, with higher flash points, are considered combustible rather than flammable.[10] Previous studies on open fire injuries report that gasoline use is involved in 14.5 to 23.3% of the injuries annually.[3,5,6] The majority of these injuries were secondary to the inappropriate use of gasoline including its use as an accelerant. Relatively stable injury rates in two 10-year studies indicate little change in community awareness concerning the dangers of inappropriate use of gasoline.[4,6]

Knowledge, however, may not be sufficient to change behavior. The majority of our respondents stated that they were aware of the different properties of gasoline and other fuels with accelerant properties. However, out of habit, past positive experience or ready availability, they chose to use gasoline as an accelerant at the time of their injury. Restrictions on the sale of gasoline are probably not practical. Clear labeling on gasoline containers warning of the dangers of the use of gasoline as an accelerant may be a deterrent to such use. Labels on plastic containers are difficult to read. Although there are uniform guidelines for gasoline storage cans (Occupational Safety and Health Administration's and National Fire Protection Association's guidelines), these are followed on a state-by-state basis.[11] In Iowa, gasoline cans do not have to meet the Occupational Safety and Health Administration guidelines. Establishing uniform safety standards for gasoline containers may also decrease the incidence of burn injuries when gasoline is used as an accelerant. These standards should include making the can vapor and liquid leak proof, equipping it with a fixed spout, a spring-loaded self-sealing cap closure device, a flame arrester. In addition, each can should have a large, easily readable warning label.[12] Alternatively, some burning modifications such as providing knowledge regarding the proper aeration of the burn barrel may obviate the use of an accelerant at least in the case of trash burning.[8]

More effective dissemination of safe burning practices is also needed. Such knowledge is particularly beneficial in the case of grass or brush burning which was frequently done in open spaces by our respondents. In these cases, knowledge of environmental conditions that are conducive to open burning is essential. Readily available and updated fire hazard ratings and wind charts providing physical descriptors of wind speed could facilitate safer burning behavior.[8] Other knowledge of appropriate times of the day to burn, establishing a fire-proof boundary and having a readily available water source may also decrease injuries from backyard burning.[7,8]

**Table 3.** Possible prevention strategies to reduce residential burning injuries

| Problem | Intervention Strategy |
|---|---|
| Removal of trash and brush | Frequent trash and brush pickup |
| Large brush or grass/field clearance | On site burning help |
| Gasoline used as accelerant | Advertisements in popular farming journals or easily accessible web sites regarding information on appropriate use of flammable liquids; gasoline can modifications |
| Unsafe burning practices | Advertisements in popular farming journals or easily accessible web sites regarding information on appropriate burning practices; school programs |

Finally, school programs focusing on safe burning practices would be beneficial to help highlight the dangers of inappropriate accelerant use. It may be more lasting to educate children before behaviors became habit. From our population-based epidemiology study of ER admissions for burn injuries, we suspected that residential burning was learned and practiced at an early age.[2] In that study, open burning injuries, the majority of those secondary to trash burning, were the most common cause of flame injuries in children aged 5 to 14 years presenting to local ERs. We suspected that the parents were often the teachers. Our current study verifies that backyard burning knowledge usually comes from parents and is acquired at an early age. The school could discuss and disseminate literature on safe open burning practices. Concurrently run public service announcements involving those injured while burning trash could help reinforce the dangers to those adult residential burners and educators of future burners.

This study was limited secondary to its small size, convenience sample, and lack of detail about burn etiology. To determine acceptable alternatives and effectively disseminate safe burning practices, plans are underway to conduct a larger survey of those who burn trash, brush, and grass. This survey will focus on the different disposal needs of each material. Additionally, we will determine the current knowledge of safe burning practices and means of effective dissemination of the knowledge. As the best prevention strategies are often passive, legislation to prevent residential burning will be most successful at curbing the injury rate. However, to effectively prevent the residential burning, municipalities will need to meet the trash, brush, and grass disposal needs of their residents.

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