



Oklahoma City Bombing Injuries

Sheryll Shariat, M.P.H.
Injury Prevention Service
Oklahoma State Department of Health

Sue Mallonee, R.N., M.P.H.
Chief, Injury Prevention Service

Shelli Stephens Stidham
Division Director

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For more information, please contact:

Injury Prevention Service
Oklahoma State Department of Health
1000 N.E. 10th Street
Oklahoma City, Oklahoma 73117-1299
(405) 271-3430 or 1-800-522-0204
www.health.state.ok.us/program/injury

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Background

On April 19, 1995, the worst terrorist bombing in United States history occurred in Oklahoma when the Alfred P. Murrah Federal Building was bombed. On April 21, 1995, bombing injuries were declared reportable conditions for special study. The Injury Prevention Service (IPS) conducted an investigation of physical injuries associated with the bombing. As a result of this investigation, an OSDH registry was compiled that included information for 1,259 injured and uninjured persons who were *directly* exposed to the bombing. Persons involved in search and rescue efforts were excluded.

Additionally, in October 1996, the IPS began a follow-up study of Oklahoma City bombing survivors to collect further information about the causes of bombing injuries, long-term health problems, and medical costs associated with the bombing. Telephone interviews were conducted with 494 survivors 18 years of age and older.

Persons included in the registry were identified by one of the following surveillance methods.

- **Hospital Medical Records.** Medical records were reviewed for persons who were admitted or treated and released in emergency rooms in all Oklahoma City metropolitan area hospitals.
- **Physician Survey.** Mail surveys were sent to selected physician specialties in a five-county area. Physicians reported information about patients they treated for bombing injuries in their offices.
- **Building Occupant Survey.** Agencies and businesses housed in the Murrah and adjacent buildings (Water Resources, YMCA, Journal Record, Athenian) were interviewed about all known occupants (survivors and decedents) and their locations at the time of the bombing.
- **Newspaper Survey.** The "Searching for Survivors" survey printed in the *Daily Oklahoman* called for survivors to report their injury status; all surveys were sent to OSDH.
- **Governor's Office Survey.** Personal stories of survivors that were submitted for the First Lady's book, *In Their Name*, were shared with OSDH.
- **Office of the Chief Medical Examiner.** Review of official Medical Examiner Reports.
- **Survivors' Survey.** Surveys requesting additional information were mailed to survivors and/or distributed through employers.

Bombing Injuries. A total of 851 persons were injured or killed as a *direct result* of the bombing or during escape.

- 167 persons (including 19 children) died;
- 447 persons were treated in area hospitals;
 - 83 were admitted to hospitals;
 - 364 were treated and released from emergency rooms;
- 237 persons were treated in a private physician's office;
- Over 80% of the injuries and deaths occurred among persons 20-59 years of age (Figure 1).

Eighty-one percent of all injured persons suffered soft tissue injuries, i.e., lacerations, abrasions, and contusions. Forty-six percent suffered auditory injuries; 40% smoke and dust inhalation; 17% head injuries; 14% fractures and dislocations, and 13% eye injuries.

Among persons who were hospitalized for bombing injuries (83 persons), 98% suffered soft tissue injuries. Nearly one-fourth (24%) incurred severe lacerations involving nerves, tendons, blood vessels, or vital organs. More than half (57%) were treated for fractures or dislocations and 53% were treated for head injuries (Table 1). Among persons who had been treated and released in emergency departments, 88% were treated for soft tissue injuries and 15% were treated for head injuries.

All Oklahoma City area hospitals and hospitals in Edmond, Norman, and Midwest City treated bombing patients. Hospitals in closer proximity to the downtown area received greater numbers of patients and more severely injured patients.

Figure 1. Physical Injuries* by Severity and Age Group, Oklahoma City Bombing

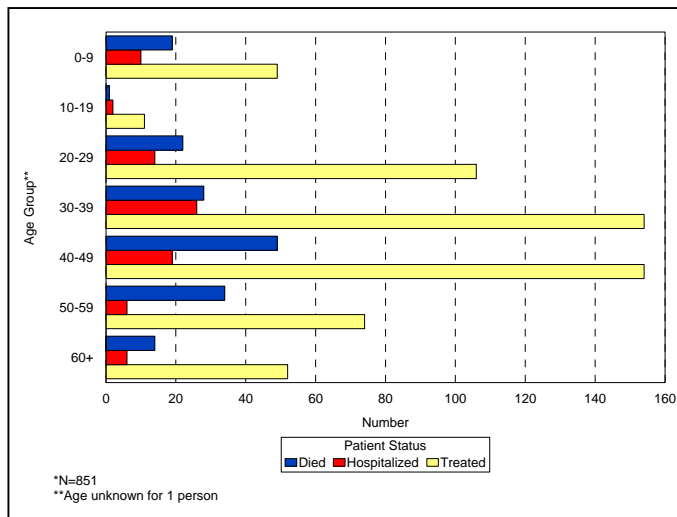


Table 1. Types of Injuries among Persons Treated in Hospitals, Oklahoma City Bombing

Types of Injuries among Hospitalized Persons (83 persons)	
81 (98%)	soft tissue injuries (lacerations, abrasions, and contusions)
48 (57%)	fractures or dislocations
44 (53%)	head injuries
31 (37%)	eye injuries
20 (24%)	severe lacerations (involving nerves, tendons, blood vessels, or vital organs)
9 (11%)	burns
Types of Injuries among Persons Treated and Released from Emergency Rooms (364 persons)	
322 (88%)	soft tissue injuries (lacerations, abrasions, and contusions)
56 (15%)	head injuries
39 (11%)	eye injuries
30 (8%)	fractures or dislocations

Locations of Deaths and Injuries

Deaths. Of 167 persons who died, 163 were occupants of the Alfred P. Murrah Building (Figure 2). Of these, 118 worked in the Murrah Building, 15 were children in the day-care center, and 30 were visitors (including 4 children) in the building, Two additional deaths occurred in the Water Resources Building, one death in the Athenian Building, and one death occurred outdoors near the blast.

Occupants of the Alfred P. Murrah Building experienced the highest number of injuries and deaths (Figure 3). Forty-five percent (163/361) of the building's occupants died, and 47% (168/361) were injured, yielding a combined fatal and nonfatal injury rate of 92% (331/361). Within the second floor day care center of the Murrah Building, 76% (19/25; 15 children and 4 adults) of the occupants died. Additionally, 1 death (which was not a direct result of the blast) occurred when a volunteer rescuer was injured entering the Murrah Building after the blast.

Injured Survivors. Sixty-one percent (419) of injured survivors were located inside the most heavily damaged buildings at the time of the blast: Murrah (168 injured persons), Journal Record (128), YMCA (78), Water Resources (41), and Athenian (4).

Another 25% (172) of injured survivors were located in other buildings and 9% (60) were outdoors or in vehicles at the time of the blast. Location was not ascertained for 33 (5%) of injured survivors.

Uninjured Survivors. Thirty-four percent (305/886) of survivors in the most heavily damaged buildings [Murrah (30), Journal Record (168), YMCA (85), and Water Resources (22)] were uninjured or received very minor injuries that did not require medical treatment. Another 85 persons in other buildings, outdoors, or in vehicles, survived uninjured or with very minor injuries that did not require medical treatment.

Acute Care Hospital Costs. Hospital charges for acute care exceeded \$2.5 million (charges exclude emergency transport, physician, surgeon and rehabilitation charges). The mean charge for persons treated and released in emergency departments was over \$350 and the mean hospitalization charge was over \$28,000.

Figure 2. Location of Damaged Buildings Oklahoma City Bombing

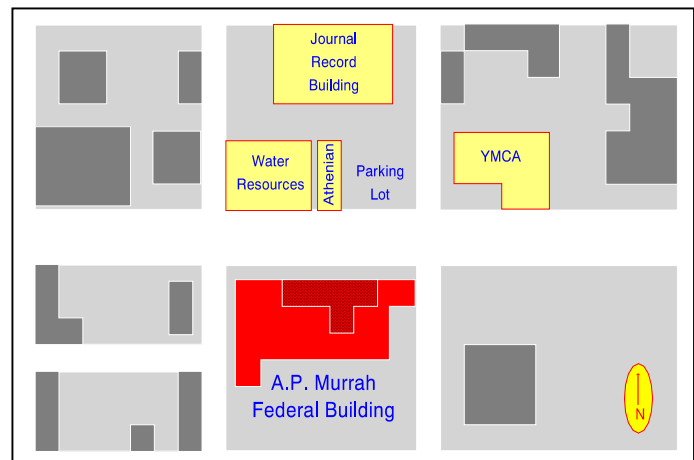
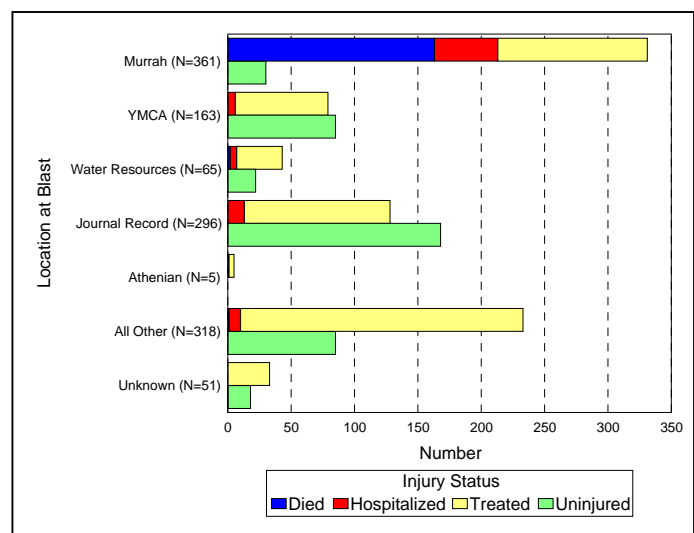


Figure 3. Injury Status by Location at Blast* Oklahoma City Bombing



FOLLOW-UP STUDY

In October 1996, IPS began contacting persons 18 years of age and older who were identified as survivors of the bombing to complete a follow-up survey. These survivors had signed consent forms allowing IPS to contact them. Of 914 persons eligible for the study, 494 (54%) persons were interviewed; 35 (4%) refused to participate; 11 (1%) had died since the bombing; and we were unable to contact 374 (41%). Forty percent of persons interviewed were male and 92% had been injured in the bombing.

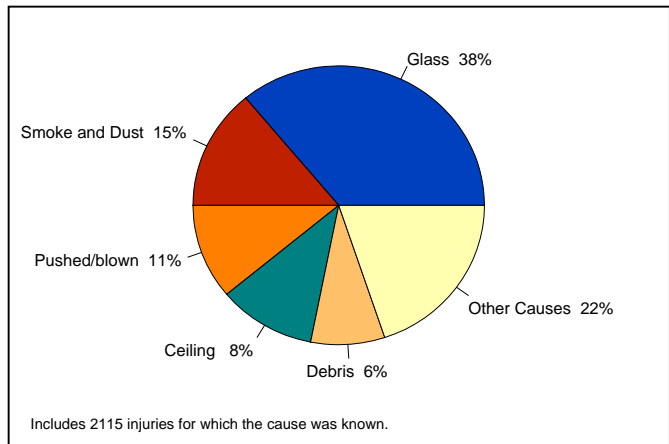
**Table 2. Body Regions of Injury
Oklahoma City Bombing**

	Number of Injuries (%)
Head/Neck And Face	1082 (39%)
Upper Extremities	561 (20%)
Lower Extremities	444 (16%)
Chest	396 (14%)
Back	166 (6%)
Pelvis	56 (2%)
Abdomen	35 (1%)
Other	52 (2%)
Total	2792

Types and Anatomical Site of Injuries. The most common types of injuries reported by those interviewed were soft tissue injuries; they accounted for 61% of all injuries. Organ systems injuries including auditory damage and smoke/dust inhalation accounted for 19% of injuries followed by orthopedic injuries (fractures, dislocations, and sprains) (12%). The head/neck/face were the most frequently injured body region (39%) followed by the upper extremities (20%); lower extremities (16%); chest (14%); and back (6%) (Table 2). Injuries to the head/neck/face and chest were more common among males while injuries to the lower extremities and back were more common among females.

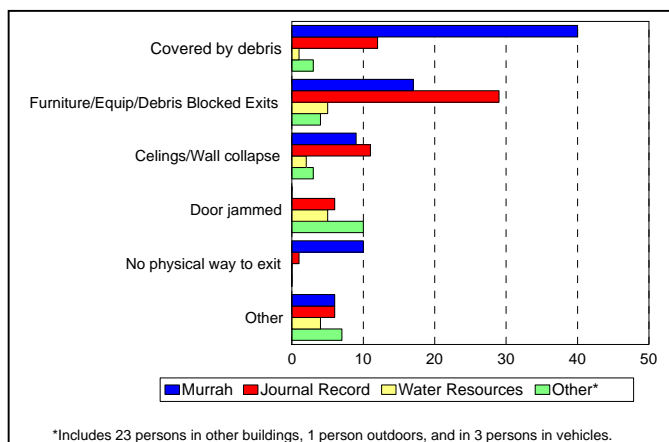
Causes of Injuries. Glass was the most frequently reported cause of injury, contributing to 38% of injuries. The next most frequent cause of injury, smoke and dust, accounted for 15% of injuries. Being pushed or blown was responsible for 11% of injuries. Ceiling materials including tiles, metal grids, ductwork, and light fixtures were responsible for 8% of injuries (Figure 4).

**Figure 4. Causes of Injuries
Oklahoma City Bombing**



**Figure 5. Causes of Entrapment
Oklahoma City Bombing**

Entrapment. Thirty-nine percent of persons were trapped or delayed in reaching the outside after the bomb exploded. The causes of entrapment varied by location. In the majority of cases, "being covered by debris" and "blocked exits" were the causes of entrapment (58% combined). Other causes of entrapment included collapsed ceilings/walls (14%), doors jammed (11%), and no physical way to exit (6%) (Figure 5).



Noise Perception and Hearing Damage.

Sixty-five percent of persons said they heard the blast noise; 27% did not hear the noise; and for 8% of respondents noise perception was unknown. The proportion of people who did not hear the noise was highest in the Murrah Building (45%), followed by the Water Resources Building (24%) and the Journal Record Building (24%) (Figure 6).

Forty-nine percent of the study population suffered hearing injuries including ruptured eardrums, short-term or long-term hearing loss, tinnitus, and equilibrium/balance problems. Of persons who sustained hearing injuries, 62% heard the noise of the blast while 29% did not. The highest proportion of people who suffered hearing injuries were located outdoors (72%) and in vehicles (67%) (Figure 7).

Services Utilization. Eighty-one percent of persons interviewed utilized one or more follow-up health care services for conditions related to the bombing. Sixty-three percent of persons had utilized psychological counseling services, 48% audiology services, 21% physical therapy, 16% vision services, 13% family counseling, and 12% had utilized dental services.

Self-reported Symptoms. Respondents were asked about new onset of symptoms of anxiety, depression, post-traumatic stress disorder (PTSD), hearing loss, and other problems experienced since the bombing. A large percentage of people reported being jumpy or easily startled (70%), having recurring or distressful thoughts of the bombing (59%), difficulty concentrating (60%), trouble sleeping (56%), poor memory (49%), and disturbing dreams (47%). Twenty-one percent of the symptoms reported had resolved by the time of the interview.

Long-term Costs. The overall long-term medical costs related to the bombing were estimated at \$5.7 million (average cost per person was \$16,000). Ninety-three percent (456/491) of respondents had health care insurance. Medical expenses were paid by Workers' Compensation (44%), private insurance (31%), special funds (2%), Medicare/Medicaid (2%), self pay (2%), and other sources (14%). Eighty-four persons had incurred no medical expenses.

Figure 6. Noise Perception by Location Oklahoma City Bombing

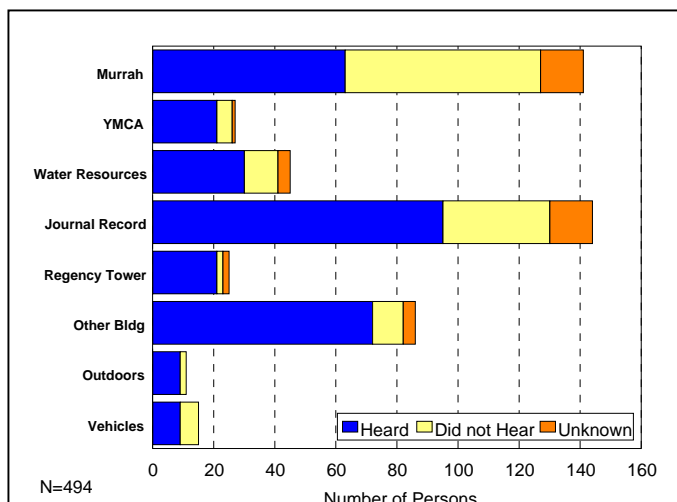
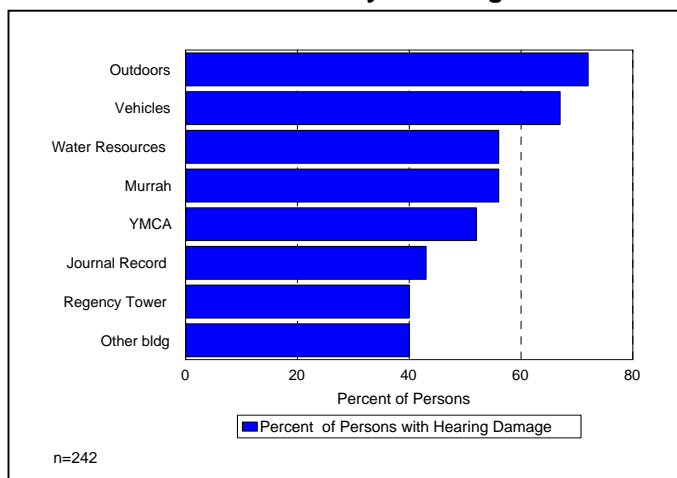


Figure 7. Hearing Damage by Location Oklahoma City Bombing



Employment. At the time of interview, 80% of respondents were employed. At the time of the bombing, 94% were employed. Sixty-six (14%) persons had experienced changes in employment status since the bombing; of these, 55% were unemployed, 24% received medical disability or workers' compensation, and 21% had taken early or regularly scheduled retirement.

PREVENTION AND POTENTIAL USES OF THE DATA

The data collected in this study (excluding personal identifiers) will be used by researchers to develop models of how injuries occur in bombings. Engineers will use the injury models to develop and test building modifications that may prevent or minimize the occurrence of deaths and injuries in such events. Some modifications include the use of laminated glass, tempered glass, and mylar films in windows to prevent shattered glass shards from becoming flying projectiles. Other modifications such as increased and continuous steel reinforcement of building structural components may prevent building collapse. Terrorist bombings are an increasing international problem. However, little is known about the long-term health impact of such events. It is important to follow Oklahoma City bombing survivors over time to determine and report the long-term health effects associated with this type of disaster. Additionally, information about the long-term health problems associated with this bombing should be distributed to medical practitioners so that needed services will be available to survivors if future events occur.