and United States Army archives (Hansen and Condon, 1989). Building information is also available. While incomplete, this information may possibly be used to generate some structural performance-morbidity/mortality correlations. Other potential sources of historical data can be found in Jones et al., (1990a).

SOME IMPORTANT ISSUES IN EARTHQUAKE INJURY EPIDEMIOLOGY

It is clear from the above discussion that despite recent efforts to collect more detailed data on earthquake injuries, a better database of statistical information relating injuries to mechanism of injury is still required. It is appropriate, therefore, to dedicate some of this chapter to a discussion of research issues associated with casualty data collection, and to an identification of some of the unresolved issues that remain to be investigated, both in general and relative to a central or eastern United States event.

Data Collection Methodology

One of the most important tasks researchers face is how to develop sound methods to collect reliable and accurate data in the aftermath of a disaster. Specifically, the definition and organization of the research questions to be asked, when to ask them, of whom, and by whom all need to be addressed before the fact. The following recommendations and observations can be made.

It is clear from past events that the existence of a defined set of focused yet comprehensive questions is critical. The questions must serve to test particular hypotheses. Each relevant discipline should contribute its knowledge to the development of a comprehensive, integrated survey instrument. If standarized questions, or sets of questions, can be developed, then comparative studies of the effects of different earthquakes will be facilitated. A standardized instrument does not now exist; developing such an instrument should be an important goal of earthquake injury researchers.

The time periods studied (i.e., the pre-event, event, and post-event phases of an earthquake) as well as the time period(s) when the data are actually collected are important to consider in research design. Most previous investigations have employed a retrospective design, collecting information on hazards and injuries after the earthquake has occurred. A potential problem with this approach includes recall bias of the injured with respect to the risk factors of interest. Another problem is that data on the event phase are highly perishable and may not be available by the time the investigators begin their studies. In some instances, information on risk factors (e.g., structural factors) is available before the event occurs, making it possible to employ a prospective research design (usually an historical cohort.) Prospective studies eliminate recall bias and ameliorate the problems caused by perishability of the data (at least for those factors measured before the event.)

The source of the information in many cases will determine the level of detail and ultimate application of the data. For example, in the event or post-event phases, with regard to emergency medical response, questions addressing "needs" will certainly yield different responses depending on whether health departments, hospital administrators, individual physicians and rescue or EMT's are asked. Each group has its own view and assessment of the situation.

The priorities for data collection must be established *a priori*. In the event and post-event phases, for example, data collection personnel must not be burdened with requirements to collect what may be termed archival information: records, reports or data which are not immediately available, at the expense of perishable data which may be available only in the context of the impact phase, or data which are critical in terms of mobilization of response.

Tracking victims through the response system is an important potential source of information. Outcomes can be related to the circumstances and timing of injury, on-site treatment, extrication, transportation, and hospital treatment.

Carefully designed, comprehensive follow-up, surveys of building occupants should be conducted. Data should be collected on occupants of damaged structures, whether injured or not. Data on the uninjured are potentially of great use in understanding which features of structure performance cause injuries and which do not.

Data collection is not always simply a matter of having the questions defined, and being there to the collect the data. Political problems, internationally, nationally, and even between organizational or responding departments can often hinder collection processes, and restrict information flow. In many cases, sources are simply not prepared to release, or allow access to, critical data. Researchers or journalists are often particularly suspect. Damage to facilities, e.g., hospitals, can result in loss of information. As noted above, another challenge is how to collect perishable data in the critical hours before it disappears as a results of the rescue efforts. The psychological responses of an affected population (e.g., those who are in mourning or shock) should be assessed, particularly when using interviews.

Identification of Critical Risk Factors for Physical Injury

It is important that the appropriate measures of risk factors for physical injury and their interactions are identified in the generation of a multivariate model of outcome. The risk factors to be studied depend, of course, on the focus of the study. The risk factors explored must reflect what is known already, to avoid collection of unnecessarily repetitive data and improve the level of detail and quality. At the very least, researchers should include the variables found in past studies to be associated with earthquake casualties (see earlier).

Injury Issues

The classifications of earthquake-related non-fatal and fatal injury must be defined precisely and standardized (Pollander and Rund, 1989; Wagner et al., 1992). Physical injuries should be clearly distinguished from medical conditions, such as heart attacks and mental health ailments thought to be associated with earthquakes. The definition of whether or not injuries are earthquake related should also be clearly stated. Here, knowing when the injury occurred (i.e., during or after the earthquake) and whether it was directly or indirectly associated with the earthquake is critical.

While it has been suggested that injury could be defined by utilization of medical services, such as "requiring medical care" or "requiring hospital care," rather than by using diagnoses, these definitions will vary across cultures, perhaps making them unreliable. To correlate building types and damage with the total number and distribution of the types of injury, and injury severity is important. Both types and numbers of injuries are important for the estimation of supplies and personnel needs. Such a classification system must be field applicable. More work needs to be done to develop simple severity measures (Noji et al., 1989). However, distinctions should be made between those requiring hospital (or emergency 24-hour care) and those treated as outpatients or not seen at all by trained medical personnel. At present, this represents the best simple indicator of severity available.

Assessment of the number of out-of-hospital deaths is extremely difficult. Also, backtracking injuries from hospitals to specific buildings potentially poses major problems. The concept of tracking victims, the determination of time trends for morbidity and mortality, and determination of the precise cause of death is critical for evaluation of intervention strategies.

The use of injury severity scoring as a means of providing detailed quantitative injury data is strongly advocated. Two different types of injury may generate identical injury severity scores, but the interventions they demand may be quite different. In addition, there needs to be a larger database of detailed descriptive data on earthquake injuries. How do victims of collapsed structures differ from standard trauma victims? Can the findings generated from motor vehicle injury studies be extrapolated to trapped earthquake victims?

FUTURE RESEARCH NEEDS

While individual scientific and technical disciplines are making major advances in their research, there is clearly an important role for a multidisciplinary approach to the study of injuries and casualty estimation. Epidemiology can play a useful role in identifying risk factors relating to building design and construction but collaboration with engineering and other disciplines is essential. An important new research agenda is to study the detailed relationships between building design and building performance in earthquakes and how these then result in - or are independent of - injuries. Just as the interface between engineering, vehicle design and epidemiology have led to large improvements in automobile design, so can similar studies linking together engineering and epidemiology potentially lead to improvements in building structural and nonstructural design. However, before such actions can be taken, a number of important research issues must be addressed. These are outlined below using a basic epidemiologic framework of studying injury patterns in time and place: How, where, when and why do people get injured in earthquakes. These basic questions provide a useful framework for defining future research needs.

1) How are people killed or injured in a building subjected to an earthquake?

Understanding of the mechanism by which people are killed or injured is essential to developing prevention strategies. Injuries are caused by the transfer of energy to the body in amounts or at rates that exceed the bodies threshold or ability to withstand the energy transfer (Haddon, 1973).

The majority of injuries are caused by the building or its components. Seaman, et al. (1984) found a direct linear relationship between mortality and the number of houses destroyed for 19 earthquakes in Turkey during the period 1912-1976 (approximately 8.5 people killed per 100 houses destroyed or badly damaged). Few studies, however, have looked at exactly what components of a building cause the injuries, particularly in those situations where some people are killed and others only injured or escape without injury. To date, most aseismic building designs have been engineered to preserve the integrity of the building with variable attention to the effects of non-structural components on injury risk. Falling light fixtures, other equipment such as wall-mounted x-ray machines or even overhanging verandas, may become lethal weapons even when the building remains intact. Analysis of previous building failures in the context of injury studies can lead to the development of simple but effective retrofit prevention strategies design to mitigate injury or death.

As noted above, in most earthquakes, people are injured by mechanical energy as a direct result of falling building materials or contents. However, surprisingly little is known about the exact mechanisms. For example, anecdotal evidence from Armenia suggests that suffocation from dust inhalation may be a significant factor in many people who die without other apparent injury. Autopsy information has provided invaluable data for analyzing automobile crashes and making appropriate modifications to automobile interiors: There is a need for detailed autopsy data on a sample of earthquake cases to determine the exact cause of death, especially for those with little evidence of external trauma.

In some earthquakes, few people may be killed by the building collapse but die due to complexities produced by aftershocks and significant secondary effects such as post-earthquake fires. In the 1923 earthquake in Kanto, Japan, more than 143,000 people were killed; most did not die due to the earthquake directly, but from the post-earthquake fire that swept rapidly through the damaged area immediately after the earthquake (Seaman, et al., 1984). Similarly the large fire that occurred after the 1906

San Francisco earthquake was responsible for much of the death toll resulting from that event. Some earthquakes produce large flood waves from tsunamis and have caused a proportion of the deaths in the five largest United States fatal earthquakes. Another factor that may affect the number of people killed is exposure to cold. In Armenia, for example, it is believed that some of the people who could otherwise have been rescued may have perished due to the intense cold.

2) Where are victims located?

Is there a difference in the locations in a building between the survivors and those who are fatally or nonfatally injured? Determining where people are located when they are injured or killed can provide valuable information to both assist in locating potential survivors, and in making recommendations to building occupants as to what to do during an earthquake. Anecdotal evidence from search and rescue personnel describe situations where survivors are located many days after the earthquake trapped in small protected spaces where water was available. Individual rescues such as these raise a number of epidemiologic questions that require future quantitative study.

The study of injury patterns from previous earthquakes also may help predict those characteristics that are related to survivability of building collapse or damage. It may not be cost-effective (or possible) to strengthen all older buildings to prevent collapse, but relatively simple modifications may increase the probability that severe damage will cause fewer injuries; for example, strengthening stair wells or creating "safe" corridors. Research efforts such as these will require the cooperation of engineers, architects, search and rescue personnel, medical staff, and epidemiologists.

3) How is behavior related to death and injury in earthquakes?

The behavior of building occupants during an earthquake is another area for research. No comprehensive guidelines exist for what is the best plan of action for an occupant. Foreshocks may provide valuable warnings that can affect behavior, although they cannot be counted on. For example, the Montenegro earthquake of 1979 came in two shocks with enough time between them for people to get outside their houses (Tiedemann, 1989). Studies from the 1980 Italian earthquake suggest that those who immediately ran outside were less likely to be injured or killed (de Bruycker, et al., 1985). However, while running outside may be good advice in rural areas, it may not necessarily be the best thing in densely populated urban areas. Narrow streets provide no protection and can rapidly fill with debris falling from damaged walls or roofs of buildings, whereas inside the building major parts of the building may be left standing and provide protection. Reports from the 1985 Chilean earthquake suggest that a number of people were killed from falling building overhangs as they tried to escape (Aroni, personal communication, 1989). Stories of people surviving under desks or beds suggest that such behavior may prevent injuries. However, only by developing reliable data on the location of injured and non-injured persons can sound advice be developed as to the best behavior to reduce the likelihood of injury. The advice is likely to be specific for certain types of buildings and will be different for densely populated urban areas and rural areas.

4) How long after building collapse do people die?

Understanding when people die following building collapse can provide important information for planning rescue efforts. However, little is known concerning the effectiveness and appropriateness of the different levels of search and rescue, because no formal evaluations of these efforts have been carried out. Evidence from the few studies that exist suggest that most people who are successfully rescued are excavated by local survivors immediately after the quake occurs.

Studies of acute blunt trauma, as represented by motor vehicle trauma, have shown that rapid extraction, resuscitation, and transportation to hospital can dramatically affect survivability following injury (Sacco, et al., 1984). In fact, much is made of the importance of the "Hour of Survival." This concept suggests that the probability of survival is greatly increased if persons can be transported to definitive care within one hour of injury. Such rescue times are unachievable in most earthquake situations. Even if they could be achieved for limited numbers of people, the patients would rapidly overcome available medical resources, which themselves are probably heavily affected by the earthquake. However, the limited earthquake rescue literature to date suggests that rapid rescue is essential to increase survivability.

Olson (1987) defined the "**Golden 24 Hours**" as the period of time during which the victim in a collapsed building has the greatest chances of surviving if rescued. However, few data are available to support this concept. A study of the 1976 Tangshan earthquake in China (Sheng, 1987) however, found that 99.3% of those extracted by rescue squads within one-half hour survived, whereas only 81% of those extracted between one-half hour and one day survived. Only 7.4% of those who were extracted on the fifth day survived. Similar findings of rapidly declining probability of being alive at extraction were found in the 1980 Southern Italian earthquake (de Bruycker, et al., 1985). However, these rather crude calculations do not taken into account that the less severely injured may be rescued earlier or that those people showing signs of life are easier to locate, and thus will be extracted earlier. Future studies need to consider factors such as the severity of injury (Noji et al., 1989).

Information also needs to be collected on those who are extricated dead so that the time of death can be estimated. This may help predict the potential for rescue. The predictive models for survival time are based largely on blunt trauma such as that due to motor vehicles. Some people may be trapped in voids in the building, but may be relatively uninjured. Thus, the severity score and other models used for classical blunt trauma injuries may not be appropriate for use in disaster situations. More research is needed to develop tools for assessing severity of injuries related to earthquakes.

In planning research on the efficacy of search and rescue, the distinction must be made between light search and rescue conducted immediately following an earthquake, and heavy urban search and rescue. Most people are rescued with light rescue methods using untrained, uninjured survivors who use simple tools such as shovels and axes. In the 1980 Italian earthquake it was estimated that about 97% of the trapped survivors taken to one medical center were extracted using primitive tools such as shovels or bare hands, and only 3% were rescued using tractors or cranes (de Bruycker, et al., 1983). More research is needed to determine the needs for expert outside assistance with search and rescue. Often such help can only be of assistance for heavy urban rescue where there is a likelihood of survivors trapped in voids within buildings.

5) Can casualty prediction models be improved?

As noted earlier, there is a need to develop better methods to predict the number of people killed and injured following an earthquake. This information is essential for both rapidly assessing the magnitude of the problem and for planning rescue and other relief efforts. In the absence of such data, the relief effort may not always be appropriate for the needs (de Ville de Goyet, et al., 1976; Zeballos, 1985).

In one earlier model, Lechat (1979) proposed using a ratio of injuries to deaths as a useful guide to predict the number of injuries. This information could then be used to assess medical needs after earthquakes, and predict the amount of supplies and personnel needed in a disaster relief effort. However, the ratio of 3:1 injuries to deaths only applies to the sample of 3 earthquakes used in the initial analysis, and a limited number of other earthquakes (de Bruycker, et al., 1985). A more comprehensive analysis by Alexander (1985) found it was not a useful predictor when studying other earthquakes. Such estimates are coarse at best, and even if they could be refined to take into account various other factors such as building type, intensity of earthquake, etc., accurate estimates of fatalities are often not available. It may take days or weeks before reasonable estimates of the number of fatalities become available. There are often large discrepancies in the number of fatalities reported by different sources for the same earthquake. For example, three different estimates are available for the number of people killed in the Nicaraguan earthquake in 1972 (Coultrip, 1974; OFDA, 1988; Whittaker, et al., 1974).

Another possible approach is to develop a predictive model based on earthquake risk. While geologic maps that outline the earthquake prone areas are available, they do not relate to risk of death or injury. A predictive model could possibly be developed based on a combination of factors such as risk of earthquake of defined magnitude, the particular building construction of the area at risk, and the population likely to be affected. To be able to develop such a model, there is a need to develop simple measures of the lethality of the injury producing potential of different types of buildings, particularly as they relate to different severities of earthquake. A simple classification system for building types should be based on their potential to both cause injury, and also with regard to their potential for creating void spaces upon collapse. This task, however, while sounding simple, is indeed extremely complex and requires significant effort to accomplish.

6) Can data quality be improved with other considerations?

It is impossible to compare injury patterns for different disasters without establishing common definitions. Even if broad definitions are available it is essential to have more exact measures of severity in order to enable more detailed comparisons to be made (Noji et al., 1989). It is essential to develop simple scoring systems to quantify the extent of trauma. These are usually based on prediction of survivability. However, detailed medical information is often not available in the acute disaster situation.

There is a need to develop standardized definitions since there is a huge difference between minor contusions and life-

threatening injuries requiring hospitalization. As discussed earlier there may be problems counting the number of people killed. However, the problems of measurement are even more acute when trying to measure the number of injured. There is no standardized definition of injury in use. Most studies to date have only classified injuries as fatalities and non-fatalities (persons injured). Others have used uninformative terms such as minor, serious, or critical. Future developments of earthquake injury severity scores will greatly assist in this but may be difficult to use in all situations (Noji et al., 1989). The practicality of a simple definition which separates injuries into those that require inpatient hospitalization (if available), and those that can be managed safely as outpatients or do not need professional medical attention needs to be determined. This definition would at least allow separation of minor from serious injuries. The low ratio of people injured to killed in Tangshan is probably due to their only recording cases of "severe injury" (Tiedemann, 1989).

The data needed for comparative studies are often lacking even for such basic information as the magnitude of the earthquake, the number of deaths, number injured (using standard definitions) or the size of the affected population. In most areas of the world where major earthquakes have occurred official census records are poor. Other problems include uncounted urban migrants, or other groups such as refugees.

Even when good census data are available, as in California, other factors such as the proportion of people commuting to and from the affected area may greatly affect the population present at the actual time of the earthquake. Thus, even to estimate the population at risk may be difficult. The initial very high estimates of those on the collapsed Cypress structure of the Nimitz Freeway in Oakland in 1989 is such an example. The risk of injury may vary greatly by the type of building a person is occupying, which changes depending on the time of day that an earthquake occurs. For example, the 1933 earthquake in Long Beach, California caused significant damage to school buildings, but no deaths because it occurred at a time when school was not in session (Jones, 1989). Wooden, single family homes, such as suburban houses in California, are reasonably earthquake resistant. Even if they did collapse their potential to cause injury is much less than that of a non-earthquake-resistant old stone building, like those often used for businesses, offices, or schools.

Time of day can also affect the ability to escape. In Guatemala, the 1976 quake occurred at 3:05 in the morning while everyone was asleep. If the same quake had occurred later in the day many more people would have been outside and thus uninjured. The 1988 Spitak, Armenia earthquake occurred at 11:41 in the morning, and thus many people were trapped in schools, hospitals, office buildings, or factories. If it had occurred at another time of day, very different patterns of injury and places of injury would have occurred.

IMPLICATIONS FOR THE CENTRAL AND EASTERN UNITED STATES

The preceding section has given a rather broad overview of the problem of casualty assessment and estimation in earthquakes. Conspicuously absent is a section entitled "Revised Casualty Estimates for the Central and Eastern United States." This omission, however, is deliberate. It is clear from the discussion that earthquake casualty researchers are still struggling with the development of robust estimates for the regions of the country (and the world) where the earthquake process, the construction types, and their interactions are reasonably well understood. For much of the Central and Eastern United States, none of the above is true. Existing studies are based on data of marginal quality and relevance to this region.

Nevertheless, significant effort is being made to more fully understand the phenomenon of intraplate earthquakes, and engineers are learning more about the performance of marginally resistant or unresistant (in the seismic context) structures. As more morbidity and mortality data are collected and analyzed, using the techniques outlined and exemplified above, and general casualty and loss estimation procedures are developed, realistic estimates for the central and eastern regions will be forthcoming. Indeed, in some respects the lack of realistic estimates for the Central and Eastern United States does not place them too far behind the Western States, where casualty estimation procedures are also not highly developed.

More research is clearly necessary, however, to enable a more complete understanding of the problem. The issues raised in this chapter are relevant to not only the Central and Eastern United States, but also the remainder of the country and beyond. In addition, specific research needs include the development of an appropriate structure inventory for these regions which will both enable the possible usage of risk-factor data from other events and form the basis for comprehensive modeling capability. This inventory problem alone is not a trivial task and needs to be addressed as early as feasible.

Solutions to the problems faced by the Central and Eastern States as they attempt to plan for future earthquakes may well serve as a model for other parts of the country and the world if done effectively. Casualty assessment and estimation not only forms an integral part of the process, but also can be used to influence and guide the allocation of the resources needed to face these challenges.

CONCLUSIONS

Despite the inherent difficulties in conducting studies of injuries following earthquakes, a number of studies have already shown that it is possible to collect valuable information that can be used for prevention of health care probelms. However, more refined methodologies will need to be developed (Armenian, 1989). These will include the development of appropriate sampling frames, the use of case-control and cohort studies, and the use of multivariate techniques for analysis. Case-control studies are the usual method of studying health and injury risks and have had widespread use. The use of epidemiology techniques to study injury risks from earthquakes is rapidly gaining the acceptance of earthquake researchers. Only through the application of such techniques can we develop better casualty estimation data and methods and provide advice as to which engineering solutions or other methodologies are the most effective for reducing casualties in earthquakes.

The integration of epidemiologic studies with those of other disciplines such as engineering, architecture, the social sciences and medicine is essential to the provision of suitable variables for analysis. Just as epidemiology and other public health principles have provided important new insights into the study of disease processes, so the integration of epidemiologic techniques to other disciplines involved in earthquake research is likely to lead to better methods to reduce casualties in future earthquakes. Interdisciplinary studies are necessary if we are to develop improved understanding of injuries following earthquakes and the development of effective strategies for reducing injuries from earthquakes.

Reliable casualty estimates for the Central and Eastern United States are not yet available. This is not a problem peculiar to these regions, however, as few (if any) meaningful estimates have been developed for the more seismically active regions of the country. This deficiency is still cause for some concern. It is well known that the central and eastern regions are both susceptible and vulnerable to earthquakes. Because of the relative lack of preparedness, reasonable efforts should be directed towards

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: preparation of these models as planning tools to develop both short-
m and long-term strategies for reducing earthquake risk.

REFERENCES AND BIBLIOGRAPHY

Alaska Division of Emergency Services (ADES), 1989, arthquake Response Study: Medical Facilities", Cole, D.A., K.B. alch., et al. Response Study (Task III) prepared by DOWL IGINEERS under Contract Agreement W.O. #D12393 for the ADES, ate of Alaska, Anchorage, Alaska.

Alexander, D.E., 1982, "Disease epidemiology and earthquake saster: The example of Southern Italy after the November 23rd, 1980 rthquake", *Social Sciences and Medicine*, v.*16*, pp. 1959-1969.

Alexander, D.E., 1985, "Death and Injury in Earthquakes." *'sasters, v. 9, no. 1*, pp. 57 - 60.

Alexander, D.E., 1989, "Spatial aspects of earthquake idemiology." In *Proc. Int. Workshop on Earthquake Injury idemiology for Mitigation and Response*, (eds. Jones, N.P., Noji, E.K., nith, G.S., Krimgold, F.) The Johns Hopkins University, Baltimore, D, July 10- 12, 1989.

Anon, 1990, "Disaster-Related Deaths from Hurricane Hugo and the orthern California Earthquake," *J. Emergency Nursing, v. 16, no. 4*, igust, pp. 295-297.

Applied Technology Council (ATC), 1985, "Earthquake damage aluation data for California." *ATC 13*, Applied Technology Council, edwood City, Ca.

Armenian H.K., 1989, "Methodologic issues in the epidemiologic udies of disasters." In *Proc. Int. Workshop on Earthquake Injury oidemiology for Mitigation and Response*, (eds. Jones, N.P., Noji, E.K., nith, G.S., Krimgold, F.) The Johns Hopkins University, Baltimore, D, July 10- 12, 1989.

Armenian, H.K., Noji, E.K., Oganessian, A.P., 1992, "Case control udy of injuries due to the earthquake in Soviet Armenia." *Bull. World ealth Organ., v. 70, no. 2.*

Arnold, C., 1986, "Occupant Behavior Related to Seismic Performance in a High-Rise Office Building," *Proc. Third United States Nat Conf on Earthquake Engrg*, Aug. 24-28 Charleston, EERI, pp. 1755 - 1766.

Association for the Advancement of Automotive Medicine (AAAM), 1990, The Abbreviated Injury Scale, 1990 Revision, AAAM, Des Plaines, IL.

Autier, P., Férir, M., Hairapetien, A., et al., 1990, "Drug supply in the aftermath of the 1988 Armenian earthquake." *Lancet*, *v. 335*, pp. 1388-1390.

Baker, S.P., O'Neill, B., Haddon, W., Long, W.B., 1974, "The Injury Severity Score: A Method for Describing Patients with Multiple Injuries and Evaluating Emergency Care," *J. Trauma*, *v. 14*, pp. 187-196.

Barbera, J.A. and Cadoux, C.G., 1991, "Search, rescue and evacuation." *Crit. Care Clin.*, *v. 7*, *pp.* 321-337.

Binder, S. and Sanderson, L.M., 1987, "The role of the epidemiologist in natural disasters," *Annals Emergency Medicine*, *v. 16*, 1987, pp. 1081-1084.

Blake, P., 1970, "Peru earthquake, May 31, 1970." Report of the DC epidemiologic team, 1987, Centers for Disease Control, Atlanta, Georgia.

Centers for Disease Control, 1989, "Earthquake-associated deaths - California" *Morbidity and Mortality Weekly Report*, *v. 38*, pp. 767-770.

Centers for Disease Control, 1990, "Earthquake disaster - Luzon, Philippines." *Morbidity and Mortality Weekly Report*, *v. 39*, pp. 573-577.

Coburn, A.W., Murakami, H.O., Ohta, Y., 1987, "Factors affecting fatalities and injury in earthquakes," Internal Report, Hokkaido University, Sapporo, Japan, pp. 1-80.

Coburn, A.W., Pomonis, A. and Sakai, S., 1989, "Assessing strategies to reduce fatalities in earthquakes." In *Proc. Int. Workshop on Earthquake Injury Epidemiology for Mitigation and Response*, (eds. Jones, N.P., Noji, E.K., Smith, G.S., Krimgold, F.) The Johns Hopkins University, Baltimore, MD, July 10-12, pp. 107-132.

Coburn, A.W., Spence, R.J.S. and Pomonis, A., 1992, "Factors determining human casualty levels in earthquakes: Mortality predicion in building collapse." *Proc. 10th World Conf. Earthquake Engrg.*, Madrid, Spain, July, pp. 5989-5994.

Copes, W.S., Champion, H.R., Sacco, W.J., Lawnick, M.M., Keast, S.L., Bain, L.W., 1988, "The Injury Severity Score Revisited," J. Trauma, pp. 69-77.

Coultrip, R., 1974, "Medical aspects of United States Disaster Relief Operations in Nicaragua." *Military Medicine*, Nov., pp. 879-883.

Coulson, A.H., 1989, "Epidemiologic Concepts and Earthquake Injury Research," International Workshop on Earthquake Injury Epidemiology for Mitigation and Response, Johns Hopkins University, Baltimore, MD, July 10-12, 1989, pp. 133-142.

de Bruycker, M., Greco, D., Annino, I., et al., 1983, "The 1980 earthquake in Southern Italy: Rescue of trapped victims and mortality." *WHO Bulletin, v. 61, no. 6*, pp. 1021 - 1025.

de Bruycker, M., Greco, D., Lechat, M., 1985, "The 1980 earthquake in Southern Italy: Morbidity and mortality." *Int. Jnl. Epidemiology, v. 14, no. 1*, pp. 113 - 117.

de Ville de Goyet, C. , 1976, "Earthquake in Guatemala: Epidemiologic evaluation of the relief effort." *Bull. Pan American Health Organization, v. 10, no. 2*, pp. 95 - 109.

de Ville de Goyet, C., del Cid, E., Romero, A., Jeannee, E., and Lechat, M., 1976, "Earthquake in Guatemala: Epidemiologic Evaluation of the Relief Effort," PAHO Bulletin, *v. 10, no. 2*, pp. 95-109.

de Ville de Goyet, C., and Jeannee, E., 1976, "Epidemiological data on morbidity and mortality following the Guatemala earthquake". *IRCS Medical Sciences, v. 4*, pp. 212.

"Disaster-Related Deaths from Hurricane Hugo and the Northern California Earthquake," 1990, J. Emergency Nursing, *v. 16, no. 4*, August, pp. 295-297.

Division of Mines and Geology (DMG), 1982, "Earthquake Planning Scenario For a Magnitude 8.3 Earthquake on the San Andreas

Fault in Southern California", Davis, J.F., et al. Report prepared for the Governor's Emergency Task Force by DMG, Department of Conservation, Sacramento, California.

Division of Mines and Geology (DMG), 1982, "Earthquake Planning Scenario for the Magnitude 8.3 Earthquake on the San Andreas Fault in the San Francisco Bay Area", Davis, J.F., et al. Report prepared for the Governor's Emergency Task Force by DMG. Department of Conservation, Sacramento, California.

Division of Mines and Geology (DMG), 1987, "Earthquake Planning Scenario for a Magnitude 7.5 Earthquake on the Hayward Fault in the San Francisco Bay Area", Steinbrugge, K.V., J.H. Bennett, et al. Report prepared for DMG and the State of California. Department of Conservation, Sacramento, California.

Division of Mines and Geology (DMG), 1988, "Planning Scenario For a Major Earthquake on the Newport-Inglewood Fault Zone", Toppozada, T.R., C. Johnson, et al. Report prepared by DMG for the State of California. Department of Conservation, Sacramento, California.

Durkin, M., 1985, "Behavior of Building Occupants in Earthquakes," *Earthquake Spectra, v. 1, no. 2*, pp. 271-283.

Durkin, M., 1987, "The San Salvador earthquake of October 10, 1986: Casualties, search and rescue, and response of the health care system." *Earthquake Spectra*, EERI, *v. 3*, pp. 621-634.

Durkin, M.E., 1989, "The physical setting's role in earthquake injuries." In *Proc. Int. Workshop on Earthquake Injury Epidemiology for Mitigation and Response*, (eds. Jones, N.P., Noji, E.K., Smith, G.S., Krimgold, F.) The Johns Hopkins University, Baltimore, MD, July 10-12, pp. 143-151.

Durkin, M.E., 1992, "Improving earthquake casualty and loss estimation." *Proc. 10th World Conf. Earthquake Engrg.*, Madrid, Spain, vol.1, pp. 557-562.

Durkin, M., Aroni, S., Coulson, A., 1983, ``Injuries in the Coalinga earthquake." In *The Coalinga Earthquake of May 2, 1983.*, Earthquake Engineering Research Institute, Berkeley CA, pp. 271-283

Durkin, M., and Murakami, H.O., 1988, "Casualties, Survival. and Entrapment in Heavily Damaged Buildings", Proc. Ninth World Conference on Earthquake Engineering, Tokyo-Kyoto, Japan, v. VIII pp. 977-982.

Durkin, M.E. and Thiel, C.C., 1991,"Integrating earthquake casualty and los estimation." *Proc. Workshop on Modeling Earthquake Casulaties for Planning and Response.*, Pacific Grove, CA, pp. 81-100.

Durkin, M.E., Thiel, C.C., Schneider, J.E., De Vriend, T., 1991, "Injuries and emergency medical response in the Lomà Prieta earthquake." *Bull Seis Soc Am., v. 81, no. 5,* October.

Durkin M.E., Thiel C.C., 1992, "Improving measures to reduce earthquake casualties." *Earthquake Spectra, v. 8,* pp. 95-113.

Faich, G.A., 1973, "Epidemiologic surveillance and immunization following the 1972 Managua earthquake." Paper presented at the Annual Meeting of the American Public Health Association, November 7, 1973. Centers for Disease Control, Atlanta, Georgia.

Federal Emergency Management Agency, 1980, "A Study of Earthquake Losses in the Honolulu Area", Furumoto, A., W. Lum, et al. Report prepared for the State Civil Defense Division and the State of Hawaii, Washington, D.C., 1980.

Federal Emergency Management Agency, 1980, "Greater Anchorage Area Earthquake Response Study", Bessette, D., D. Cole, et al. Report prepared by the Alaska Division of Emergency Services (ADES) for FEMA under DHUD Contract #DU-210-2. FEMA, Washington, D.C.

Federal Emergency Management Agency, 1981, "An Assessment of the Consequences and Preparations for a Catastrophic California Earthquake: Findings and Actions Taken", Press, F., President's Science Advisor, Chairperson, Ad Hoc Committee on the Assessment of Consequences and Preparation for a Major California Earthquake. Prepared by the FEMA from analyses carried out by the National Security Council Ad Hoc Committee, Washington, D.C.

Federal Emergency Management Agency, 1982, "Earthquake Vulnerability of Honolulu and Vicinity: Secondary Threats and Credible Surprises", Steinbrugge, K., and H.J. Lagorio. Report prepared for the

State Civil Defense Division and the State of Hawaii by the FEMA, Washington, D.C.

Federal Emergency Management Agency, 1985, "An Assessment of Damage and Casualties for Six Cities in the Central United States Resulting From Earthquakes in the New Madrid Seismic Zone". Prepared under Contract #EMK-C-0057 by the Central United States Earthquake Preparedness Project (CUSEPP). FEMA, Washington, D.C.

Federal Emergency Management Agency, 1988, "An Earthquake Vulunerability Analysis of the Charleston, South Carolina, Area", Harlan, M.R., and C. Lindbergh. Final Report prepared under FEMA Contract #EMA-84-K-0042 in cooperation with the South Carolina Emergency Preparedness Division. FEMA, Washington, D.C.

Filson, J.R., Agbabian, M.S., Noji, E.K., 1989, "Post-earthquake investigations of the December 7, 1988, Spitak Earthquake by the United States." In *Proc. Int. Seminar on the Spitak Earthquake*, Yerevan, S.S.R. of Armenia, 23-26 May, 1989. Cidlinsky K (Ed). Brno, Czechoslovakia.

Foege W.H., 1986, "Public health aspects of disaster management." In *Public Health and Preventive Medicine*, Last J.M. (ed.), Appleton-Century-Croft, Norwalk CT, pp. 1879-1886.

Glass, R.I., Urrutia, J.J., Sibony, S., Smith, H., Garcia, B., and Rizzo, L., 1977, "Earthquake Injury Related to Housing in a Guatemalan Village." *Science*, v. *197*, pp. 638 - 643.

Glass, R.I., et al., 1980, "Injuries from the Wichita Falls tornado: Implications for prevention." *Science*, v. *207*, pp. 734-738.

Glass, R.I., Noji, E.K., 1992, "Epidemiologic surveillance following disasters: Some practical approaches to disease control and casualty prevention." In *Textbook of Epidemiologic Surveillance*, Halperin W.E., Baker, E. (eds.),

Greenspan, L., McLellan, B.A., Greig, H., 1985, "Abbreviated Injury Scale and Injury Severity Score: A Scoring Chart," J. Trauma, *v. 25, no. 1*, pp. 60-64.

Gregg, M.B., 1989, "The public health consequences of disasters." Centers for Disease Control, Atlanta, Georgia.

Guha-Sapir, D., and Lechat, M.F., 1986,."Information systems and needs assessment in natural disasters: An approach for better disaster relief management." *Disasters, v. 10*, pp. 232-237.

Guha-Sapir. D. and Lechat. M.F., 1986, "Reducing the impact of natural disasters: Why aren't we better prepared?" *Health Policy and Planning, v. 1*, pp. 118-126.

Haddon, W., 1973, "Energy damage and the ten countermeasure strategies." *J. Trauma, v. 13*, p. 321.

Haddon, W., 1980, "Options for the prevention of motor vehicle crash injury." *Isr J. Med Sci, v. 16, no. 1*, pp. 45-68.

Hansen, G. and Condon, E. , 1989, *Denial of Disaster*, Cameron, San Francisco.

Hays, W.W., 1990, (ed). *Proc. Meeting of the U.S. Working Group on Earthquake Related Casualties.*, US Geological Survey Open-file Report 90-244, Reston, Virginia.

Hingston, R.A., and Hingston, L., 1983, "Respiratory injuries in earthquakes in Latin America in the 1970's: A personal experience Peru. 1970, Nicaragua, 1972, and Guatemala, 1976," *Disaster Medicine, v. 1*, pp. 425-426.

Jones N.P., 1989, "Reducing earthquake casualties: New considerations for engineers." In *Proc. Int. Workshop on Earthquake Injury Epidemiology for Mitigation and Response.*, (eds. Jones, N.P., Noji, E.K., Smith, G.S., Krimgold, F.) The Johns Hopkins University, Baltimore, MD, July 10- 12, 1989.

Jones, N.P., Krimgold, F., Noji, E.K., Smith, G.S., 1989, *Proc. Int. Workshop on Earthquake Injury Epidemiology for Mitigation and Response.*, (eds. Jones, N.P., Noji, E.K.. Smith, G.S., Krimgold, F.) The Johns Hopkins University, Baltimore, MD, July 10- 12, 1989.

Jones, N.P., Krimgold, F., Noji, E.K., Smith, G.S., 1990, "Considerations in the epidemiology of earthquake injuries". *Earthquake Spectra, v. 6*, pp. 507-528.

Jones, N.P., Noji, E.K., Smith, G.S., and Krimgold, F., 1990, "Preliminary Earthquake Injury Epidemiology Report," in The Loma

Prieta Earthquake, Studies of Short-Term Impacts, Bolin, R., ed., Prgm on Env & Behavior, Monograph #50, Inst Behav Sci, Univ Colorado, Boulder, pp. 33-43.

Jones, N.P., Wagner, R., and Smith, G.S., 1992, "A case control study of the casualties associated with the Loma Prieta Earthquake: County of Santa Cruz." *Proc. 10th World Conf. Earthquake Engrg.*, Madrid, Spain, v. 10, pp. 6,253-6,258.

Jones, N.P., Wagner, R.M. and Smith, G.S., 1993, "Injuries and building data pertinent to the Loma Prieta earthquake: County of Santa Cruz." *Proc. U.S. National Earthquake Engineering Conference*, Memphis, TN.

Kates, R.W., Haas, J.E., Amaral, D.J., et al., 1973, "Human impact of the Managua earthquake". *Science, v. 182*, pp. 981-990.

Katsouyanni, K., Kogevinas, M., Trichopoulos, D., 1986, "Earthquake-related stress and cardiac mortality". *Int. J. Epidemiology, v. 15*, pp. 326-330

Krimgold, F., 1989, "Earthquake casualty estimation and response modeling." In *Proc. Int. Workshop on Earthquake Injury Epidemiology for Mitigation and Response.*, (eds. Jones, N.P., Noji, E.K., Smith, G.S., Krimgold, F.) The Johns Hopkins University, Baltimore, MD, July 10- 12, pp. 17-25.

Kunkle, R.F., 1989, "Medical care of entrapped patients in confined spaces". In *Proc. Int. Workshop on Earthquake Injury Epidemiology for Mitigation and Response.*, (eds. Jones, N.P., Noji, E.K., Smith, G.S., Krimgold, F.) The Johns Hopkins University, Baltimore, MD, July 10- 12, pp. 338-344.

Lagorio, H.J., 1990, "Status of medical inputs in vulnerability studies conducted by U.S. Federal and State agencies", in *A Meeting of the U.S. Ad Hoc Working Group on `Earthquake Related Casualties', Proc. Conf XLIX*, W.W. Hays, ed., U.S. Geological Survey (USGS), Washington, D.C.

Last, J.M. , 1983, *A dictionary of epidemiology*, Oxford University Press, New York.

Lechat, M.F., 1974, "An epidemiologist's view of earthquakes". In *Engineering Seismology and Earthquake Engineering*, J. Solnes (ed), Noordhoff, Leiden, pp. 285-306.

Lechat, M.F., 1975, Editorial: "Disaster epidemiology." *Int J Epidemiol*, *v. 4*, pp. 5-6.

Lechat, M.F., 1976, "The epidemiology of disasters." *Proc R Soc Med*, *v. 69*, pp. 421-426.

Lechat, M.F., 1979, "Disasters and public health." *WHO Bulletin*, *v. 57*, pp. 11 - 17.

Lechat, M.F., 1989, "Corporal damage as related to building structure and design: The need for an international survey." In *Proc. Int. Workshop on Earthquake Injury Epidemiology for Mitigation and Response.*, (eds. Jones, N.P., Noji, E.K., Smith, G.S., Krimgold, F.) The Johns Hopkins University, Baltimore, MD, July 10- 12, 1989.

Lechat, M.F., 1990, "Updates: The epidemiology of health effects of disasters." *Epid. Rev.*, *v. 12*, pp. 192-197.

Lilienfeld, A.M. and Lilienfeld, D.E., 1980, *Foundations of epidemiology*, 2nd ed. Oxford University Press, New York.

Liu, B.-C., et al., 1979, "Earthquake Risk and Damage Functions: An Integrated Preparedness and Planning Model Applied to New Madrid", Final Report prepared by the Midwest Research Institute (MRI) in Kansas City, Missouri, under a National Science Foundation (NSF) Grant no. ENV 77-15669, NSF, Washington, D.C..

Logue, J.N., Melick, M.E., Hansen, H. , 1981, "Research issues and directions in the epidemiology of health effects of disasters." *Epidemiology Review.*, *v. 3*, pp. 140 - 162.

MacKenzie, E.J., Shapiro, S., and Eastham, J.N., 1985, "The Abbreviated Injury Scale and Injury Severity Score: Levels of Inter- and Intrarater Reliability," Medical Care, *v. 23*, *no. 6*, June.

MacKenzie, E.J., Shapiro, S., Moody, M., Siegel, J.H. and Smith, 1986, "Predicting Posttrauma Functional Disability for Individuals Without Severe Brain Injury," Medical Care, *v. 24*, *no. 5*, May.

Mahoney, L.E., 1989, "Public policy needs in earthquake injury measurement." In *Proc. Int. Workshop on Earthquake Injury Epidemiology for Mitigation and Response.*, (eds. Jones, N.P., Noji, E.K., Smith, G.S., Krimgold, F.) The Johns Hopkins University, Baltimore, MD, July 10-12, pp. 345-349.

Mann, O.C., F.H. Kellogg, W. Howe, et al., 1974, "Regional Earthquake Risk Study", Technical Report prepared by M&H Engineering and Memphis State University under DHUD Contract no. CPA-TN-04-37=1013 for Mississippi-Arkansas-Tennessee-Council of Governments/ Memphis Delta Development District (MATCOG-MDDD), Memphis, Tennessee.

McNutt, S., 1990. "Loma Prieta Earthquake, October 17, 1989, Santa Cruz County, California," *California Geology*, January, pp. 3-7.

Meli, R. , 1989, "Modes of failure of buildings under seismic actions" In *Proc. Int. Workshop on Earthquake Injury Epidemiology for Mitigation and Response.*, (eds. Jones, N.P., Noji, E.K., Smith, G.S., Krimgold, F.) The Johns Hopkins University, Baltimore, MD, July 10-12, pp. 366-377.

Miyano, M. and Mochizuki, T., 1988, "On the Characteristics of Human Casualties Due to Earthquake," *Proc. Second Japan-U.S. Workshop on Urban Earthquake Hazards Reduction*, Tokai Univ., Shimizu, Japan, July 27-29, EERI/ISSS, pp. 210-212.

Mochizuki, T., 1988, "Dangerous Factors in Living Environments to Human Caseloads," *Proc. Second Japan-U.S. Workshop on Urban Earthquake Hazards Reduction*, Tokai Univ., Shimizu, Japan, July 27-29, EERI/ISSS, pp. 202-203.

Mochizuki, T., Hayasaka, S. and Kosaka, S., 1988, "Human Behavior and Casualties in Wooden Houses with Little Ductility," *Proc. Ninth World Conf on Earthquake Engrg*, Aug. 2-9, Tokyo-Kyoto, Japan, pp. 983-988.

Mochizuki, T. and Miyano, M., 1983, "A simplified failure model analysis of rural houses typical in East Turkey aiming at countermeasures against human casualty due to an earthquake." In *A Comprehensive Study on Earthquake Disasters in Turkey in View of Seismic Risk Reduction*, Hokkaido University, Sapparo, Japan, pp. 87-129.

Mitchell, W.A., Wolniewicz, R., Kolars, J.F., 1978, "Predicting casualties and damages caused by earthquakes in Turkey: A Preliminary Report." Department of Economics, Geography and Management, U.S. Air Force Academy, Colorado, pp. 1-29.

Moorhead, G.V., Freeman, C., Van Ness, C., 1984, "Injury patterns in a major earthquake." Emergency Medical Services Authority, State of California, Sacramento, pp. 1-5

National Oceanic and Atmospheric Administration (NOAA), 1972, "A Study of Earthquake Losses in the San Francisco Bay Area", Algermissen, S.T., K.V. Steinbrugge, et al. Report prepared for the Office of Emergency Preparedness (OEP), Executive Office of the President, and the State of California. Department of Commerce, Washington, D.C.

National Oceanic and Atmospheric Administration (NOAA), 1973, "A Study of Earthquake Losses in the Los Angeles, California Area", Algermissen, S.T., K.V. Steinbrugge, et al. Report prepared for the Federal Disaster Assistance Administration (FDAA) and the State of California. U.S. Department of Commerce, Washington, D.C.

National Research Council, 1984, "Injury in America: A continuing public health problem." Committee on Trauma Research, National Academy Press, Washington, D.C.

Noji, E.K., 1989, "Medical and healthcare aspects of the 1988 earthquake in Soviet Armenia" *Earthquake Spectra Special Supplement*, pp. 101-107.

Noji, E.K., 1990, "Epidemiologic Studies from the 1988 Armenia Earthquake: Implications for Casualty Modelling," *Proc. Workshop on Modelling Earthquake Casualties for Planning and Response*. VSP Associates, Inc. and CA Emergency Medical Services Authority, Pacific Grove, CA, Dec. 4-6.

Noji, E.K., 1991, "Medical consequences of earthquakes: Coordinating medical and rescue response." *Disaster Management., v. 4*, pp. 32-40.

Noji, E.K., 1992, "Acute renal failure in natural disasters." *Renal Failure., v. 14*, pp. 245-249.

Noji, E.K., Baldwin, R., Toole, M., Glass, R., Blake, P., 1991, "The role of WHO in disaster epidemiology: Operations, research and training." WHO Expert Panel on Emergency Relief Operations, 11-15 March 1991, Geneva, World Health Organization.

Noji, E.K. and Jones, N.P., 1990, "Hospital preparedness for earthquakes." Joint Commission on the Accreditation of Health Care Organizations: Plant, Technology & Safety Series. *v. 2*, pp. 13-20.

Noji, E.K., Jones, N.P., Smith, G.S., Krimgold, F. , 1989, "Use of quantitative measures of injury severity on earthquake research." In *Proc. Int. Workshop on Earthquake Injury Epidemiology for Mitigation and Response.*, (eds. Jones, N.P., Noji, E.K., Smith, G.S., Krimgold, F.) The Johns Hopkins University, Baltimore, MD, July 10- 12, 1989.

Noji, E.K., Kelen, G.D., Armenian, H.K. et al., 1990, "The 1988 earthquake in Soviet Armenia: A case study." *Annals of Emergency Medicine, v. 19*, pp. 891-897.

Noji, E.K. and Sivertson, K.T., 1987, "Injury prevention in natural disasters: A Theoretical Framework" *Disasters, v. 11*, pp. 290-296.

Office of U.S. Foreign Disaster Assistance, (OFDA), 1988, "U.S. Agency for International Development: Disaster History." Significant data on major disasters worldwide, 1900-present." May.

Ohashi, H., and Ohta, Y., 1983, "Distribution characteristic of structural damage and casualty at several recent earthquakes in Turkey and its factor analysis." In *A Comprehensive Study on Earthquake Disasters in Turkey in View of Seismic Risk Reduction*, Hokkaido University, Sapparo, Japan, pp. 131-166.

Ohta, Y., and Ohashi, M., 1980, "A Field Survey on Human Response During and After an Earthquake," *Proc. Seventh World Conf on Earthquake Engrg*, Sept. 8-13. Istanbul, Turkey, pp. 345-352.

Ohta, Y., Ohashi, H., Kagami, H., 1986, "A semi-empirical equation for estimating occupant casualty in an earthquake", *Proc. 8th European Conference on Earthquake Engineering*, Prentice Hall, Englewood Cliffs, pp. 81-88.

Ohta, Y., and Omote, S., 1977, "An Investigation into Human Psychology and Behavior During an Earthquake," *Proc. Sixth World Conf on Earthquake Engrg*, Meerut, India, pp. 702-708.

Olson, R., Freeman, C. (eds), 1990, *Proc . Workshop on Modelling Earthquake Casualties for Planning and Response.*, California Emergency Medical Services Authority, Sacramento.

Olson, R.S., Olson, R.A., 1987, "Urban heavy rescue." *Earthquake Spectra, v. 3, no. 4*, pp. 645-658.

Ortiz, M.R., Roman, M.R., Latorre, A.V. et al., 1990, "Brief description of the effects on health of the earthquake of 3rd March 1985-Chile". *Disasters, v. 10*, pp. 125-140.

Osawa, Y., 1987, "Countermeasures against earthquake disasters in relation to medical treatment in Japan". *Prehospital and Disaster Medicine, v. 3*, pp. 99-101.

Pollander, G.S. and Rund, D.A., 1989, "Analysis of medical needs in disasters caused by earthquakes: The need for a uniform injury reporting scheme". *Disasters, v. 13*, pp. 365-369.

Rahimi, M., 1992, "Classification and analysis of occupant behavior during earthquake shaking." *Proc. 10th World Conf. Earthquake Engrg.*, Madrid, Spain, July, pp. 6085-6090.

Sacco, W.J., Champion, H.R., Stega, M., 1984, *Trauma care evaluation*, University Park Press, Baltimore.

Sanchez-Carrillo, C.I., 1989, "Morbidity following Mexico City's 1985 earthquakes: Clinical and epidemiologic findings from hospitals and emergency units", *Public Health Reports, v. 104*, pp. 483-488.

Safar, P., 1986, "Resuscitation potentials in mass disasters" *Prehospital and Disaster Medicine, v. 2*, pp. 34-47.

Saidi, F., 1963, "The 1962 earthquake in Iran: Some medical and social aspects" *New England Journal of Medicine, v. 268*, pp. 929-932.

Schlesselman, J.J., 1982, *Case-Control Studies: Design, Conduct, Analysis*, Oxford, University Press, Oxford.

Seaman, J., Leivesley, S., Hogg, C., 1984, *Epidemiology of Natural Disasters*, Basel, New York. Karger.

Seismic Safety Advisory Council (SSAC), 1979, "Seismic Risk Assessment of Utah Health-Care Facilities and Recommendations for Risk Reduction", Taylor, C.E. and D.B. Ward. Final Report prepared and issued by the SSAC under the Utah State Contract no. 79-5037. State of Utah, Salt Lake City, Utah.

Sheng, Z-Y, 1987, "Medical Support in the Tangshan Earthquake: A review of the management of mass casualties and certain major injuries." *J. Trauma., v. 27, no. 10*, pp. 1130 - 1135.

Shilts, R., and Sward, S., 1989, "Devastating Reports from Big Quake Area, Disaster Declared in 7 Counties," *San Francisco Chronicle*, October 19, p. A1.

Shilts, R., and Sward, S., 1989, "Hundreds Dead in Huge Quake, Oakland Freeway Collapses - Bay Bridge Section Fails," *San Francisco Chronicle*, October 18, p. A1.

Shiono, K. and Krimgold F., 1989, "A computer model for the recovery of trapped people in a collapsed building: Development of a theoretical framework and direction for future data collection." In *Proc. Int. Workshop on Earthquake Injury Epidemiology for Mitigation and Response.*, (eds. Jones, N.P., Noji, E.K., Smith, G.S., Krimgold, F.) The Johns Hopkins University, Baltimore, MD, July 10-12, 1989.

Shiono, K., Krimgold, F. and Ohta, Y., 1992, "Modeling of search-and-rescue activity in an earthquake." *Proc. 10th World Conf. Earthquake Engrg.*, Madrid, Spain, July, pp. 6043-6048.

Smith G.S., 1989, "Research issues in the epidemiology of injuries following earthquakes." In *Proc. Int. Workshop on Earthquake Injury Epidemiology for Mitigation and Response.*, (eds. Jones, N.P., Noji, E.K., Smith, G.S., Krimgold, F.) The Johns Hopkins University, Baltimore, MD, July 10-12, 1989.

Spence, R.J., Coburn, A.W., Sakai, S. et al., 1990, "Reducing human casualties in building collapse: Methods of optimising disaster plans to reduce injury levels." Martin Centre for Architectural and Urban Studies, Cambridge University, Cambridge, pp. 1-55.

Spencer, H.C., Campbell, C.C., Romero, A., Zeissig, O., Feldman, R.A., Boostrom, E.R., Croft Long, E., 1977, "Disease surveillance and decision-making after the 1976 Guatemala earthquake." *Lancet, no.* 2, pp. 181-184.

Stratton, J.W., 1989, "Earthquakes," Chap. 4 , in "The Public Health Consequences of Disasters," M.B. Gregg, ed., U.S. Department of Health and Human Services, Public Health Service, CDC Monograph, Atlanta, September, pp. 13-24.

Tiedemann, H., 1989, "Casualties as a function of building quality and earthquake intensity." In *Proc. Int. Workshop on Earthquake Injury Epidemiology for Mitigation and Response.*, (eds. Jones, N.P., Noji, E.K., Smith, G.S., Krimgold, F.) The Johns Hopkins University, Baltimore, MD, July 10-12, 1989.

Tierney, K.J., 1990, "Developing Multivariate Models for Earthquake Casualty Estimation," *Proc. Workshop on Modelling Earthquake Casualties for Planning and Response*, VSP Associates, Inc. and CA Emergency Medical Services Authority, Pacific Grove, CA, Dec. 4-6, pp. D-1 - D-24.

Trichopoulos, D., Katsouyanni, K., Zavitsanos, X., 1983, "Psychological stress and fatal heart attack: The Athens 1981 earthquake natural experiment". *Lancet, v. 1*. pp. 441-443.

U.S. Geological Survey, 1975, "A Study of Losses in the Puget Sound, Washington, Area", Algermissen, S.T., B. Olsen, et al. Open-File Report 75-375 prepared for the Federal Disaster Assistance Administration (FDAA) and the State of Washington by the U.S. Geological Survey. Department of the Interior, Washington, D.C.

U.S. Geological Survey, 1976, "A Study of Losses in the Salt Lake City, Utah Area", Algermissen, S.T., and H. Hughes, et al. Open-File Report 76-89 prepared for the Federal Disaster Assistance Administration (FDAA) and the State of Utah by the U.S. Geological Survey. Department of the Interior, Washington, D.C.

U.S. Geological Survey, 1981, "Metropolitan San Francisco and Los Angeles Earthquake Loss Studies: 1980 Assessment", Steinbrugge, K.V., S.T. Algermissen, et al. Open-File Report 81-113 prepared by the U.S. Geological Survey. Department of the Interior, Washington, D.C.

U.S. Geological Survey (USGS), 1985, "Evaluating Earthquake Hazards in the Los Angeles Region - An Earth-Science Perspective", Ziony, J.I., Editor. Professional Paper no. 1360 prepared by U.S. Geological Survey. Department of the Interior, Washington, D.C.

U.S. Geological Survey (USGS), 1989, "Lessons Learned for the Loma Prieta, California, Earthquake of October 17, 1989," Plafker, G. and Galloway, J.P., eds., USGS Circular 1045, Denver.

U.S. Geological Survey (USGS), 1990a. "The Loma Prieta Earthquake of October 17, 1989," Ward, P.L., and Page, R.A., Washington, D.C., 2nd printing,

U.S. Geological Survey (USGS), 1990b, "A Meeting of the U.S. Ad Hoc Working Group on 'Earthquake Related Casualties'," *Proc. Conf XLIX*, W.W. Hays, ed., Washington, D.C.

Wagner, R.M., Jones, N.P., Smith, G.S. and Krimgold, F., 1992, "Study methods and progress report: A case-control study of the casualties associated with the Loma Prieta Earthquake: County of Santa Cruz." USGS Professional Paper (Loma Prieta), in press.

Western, K.A., 1972, "The epidemiology of natural and man-made disasters: Present state of the art". DTPH Dissertation for the London School of Hygiene and Tropical Medicine, University of London, London.

Whittaker, R., Fareed, D., Green, P., et al., 1974, "Earthquake disaster in Nicaragua: Reflections on the initial management of massive casualties" *J. Trauma, v. 14*, pp. 37-43.

Zeballos, J.L., 1986, "Health effects of the Mexico earthquake - 19th Sept. 1985" *Disasters, v. 10*, pp. 141-149.