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Morbidity Following Mexico City's 1985 Earthquakes: Clinical and Epidemiologic Findings from Hospitals and Emergency Units

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Synopsis.....

Medical records of 822 inpatients and outpatients cared for by the Department of the Federal District medical services during the 1985 Mexico City earthquakes were reviewed. Record incompleteness varied between 92.8 percent and 14.0 percent for the various study variables. No gender differences were detected among the groups; more than 70.0 percent

of the patients were ages 15 to 64 years. Multiple traumatic injuries were frequent for inpatients across age groups, while simple contusions were more frequent among outpatients. Multiple head traumas, thorax-abdomen multiple traumas, and simple fractures of an arm or leg were more frequently recorded for inpatients than for outpatients. Head wounds with contusions; simple contusion of the thorax-abdomen, arms, and legs; and psychological trauma were more frequently recorded for outpatients.

Although a great many records were incomplete, the data may reflect what actually happened to these patients, given the similarity of the findings with other reports of disasters. Improved record keeping during emergencies is needed to standardize the quantity and the reliability of the data so that statistical and medical care requirements are soundly based. The use of standard questionnaires for data collection is stressed to facilitate the management of clinical and epidemiologic activities. Longitudinal studies are needed to determine patterns of physical injuries, psychological trauma, and survival.

THE COMBINED EFFECTS of the September 19 and 20, 1985, Mexico City earthquakes have been considered by some as the worst national disaster of the century, not only because of the number of recorded deaths (1,2) but also because of the economic impact and of the loss of infrastructure

of the health care system (3). The first quake registered as an 8.1 tremor on the Richter scale and the second, which followed nearly 36 hours later, as a 6.5 tremor.

Natural and manmade disasters are of importance in public health not only from the knowledge

that is derived from studying them but from the historical perspective. Information is obtained primarily from activities aimed at making an inventory of the impact (4-9), at the control and surveillance of communicable diseases (10-13), at the management of medical, food, and other emergency needs (14-16), and at describing the immediate and long-term health effects produced by these disasters (17-28).

After the 1976 Guatemalan earthquake (19), the type of inpatient injuries observed included fractures, severe contusions, and open wounds; age-specific rates for serious injuries increased with age. In the 1980 earthquake in southern Italy (25), 45.0 percent of trapped persons and 8.7 percent of the nontrapped persons suffered injuries. The types of lesions observed were lacerations, contusions, fractures, and cuts: these were most frequent on the legs, head, chest, arms, and pelvis.

The quality and quantity of the information about disasters is limited, however, by the effects of the very phenomena that are being studied. To obtain an overall view of the health effects, expensive population-based surveys are needed; when these are lacking, data from cross-sectional studies have to be analyzed.

The purpose of this study is to review medical records of inpatients and outpatients who sought emergency medical care as a consequence of the earthquakes to (a) evaluate record completeness and (b) describe the morbidity observed among seekers of medical care. This information should help medical service administrators to be prepared to deal with the expected injuries, according to the age structure of the population in the region, and to plan for contingency programs.

Methods

Medical care is delivered in Mexico by means of three schemes: (a) social security, (b) welfare, and (c) private. Social security is care supported by government, employees, and employer or by government and employees. Welfare care is subsidized by the government. Within Mexico City the Ministry of Health and the Department of the Federal District (DFD) provide welfare medical services to those not entitled to social security and to people who cannot afford private care. During the emergency period the three schemes provided medical care to all seekers, regardless of income and user service adscription.

The DFD has 24 hospitals and emergency units distributed throughout the Federal District; 10 of

these did not provide emergency medical care because they were too distant from the areas that suffered damage or because they were geared to provide gynecological and obstetric services. All medical records from the remaining 14 units were reviewed by hand to identify those which had medical notations dated from the hour of the first tremor (7:19 a.m.) to up to 72 hours thereafter. Trained physicians initiated the medical record review a week after the main tremor and transferred demographic and health related data; that is, patient's general health status, location at the time of the tremor, and injury type and site, into precoded forms. A total of 886 records were identified, of which 64 (7.2 percent) were excluded from further analysis because the notations could not be used for the study objectives or were illegible.

Access to this secondary source of data resulted from a collaborative effort of the Ministry of Health, DFD, and other agencies (6). Because the review was done retrospectively, it was not feasible to obtain missing data on some variables. The analysis is based, therefore, on the total number of records that included data on a given variable.

Results

Nearly half (48.4 percent) of all the patients were female, and 51.6 percent were male. Overall, 235 were inpatients and 587 were cared for as outpatients. Almost 73 percent of the patients, regardless of type of care received, were adults ages 15 to 64 years; the remainder were children less than 15 years old (21.9 percent) or persons older than 64 years (5.2 percent). These age groups were selected to allow the results to be compared with other reports on health effects. There were no gender differences among inpatients or outpatients up to 64 years of age; however, there was a slightly larger proportion of elderly females, as compared with the males.

A notation on general health status was found only on 34.4 percent of inpatient and 44.6 percent of outpatient records. Health status was recorded as serious for 39.5 percent of the inpatients and 15.7 percent of the outpatients; the conditions of the remainder were not considered as serious.

Patient location. Only 9.2 percent of the inpatient records and 15.7 percent of the outpatient records provided information on the person's whereabouts at the time of injury. Regardless of hospitalization status, 67.7 percent of the patients were at home,

Table 1. Percentage distribution by injury type of 154 inpatients injured in the September 1985 Mexico City earthquakes

Type of injury	0-14 years (N = 28)	15-64 years (N = 115)	65 years and older (N = 11)
Multiple traumas	42.9	53.9	45.5
Simple fractures	28.6	11.3	18.2
Compound fractures	7.0	2.6	9.1
Simple contusions	3.6	13.0	0.0
Crushing	0.0	3.5	9.0
Wounds with contusions	3.6	5.3	18.2
Other	14.3	10.4	0.0
Total	100.0	100.0	100.0

Table 2. Percentage distribution by injury type of 426 outpatients injured in the September 1985 Mexico City earthquakes

Type of injury	0-14 years (N = 100)	15-64 years (N = 312)	65 years and older (N = 14)
Multiple traumas	9.0	12.5	14.3
Simple fractures	11.0	10.0	14.3
Simple contusions	36.0	28.0	28.6
Wounds with contusions	17.0	17.4	14.2
Psychologic traumas	18.0	25.1	28.6
Other	9.0	7.0	0.0
Total	100.0	100.0	100.0

19.1 percent were at work, and 13.2 percent were outdoors.

Of the hospitalized persons who were at home or outdoors, 58.0 percent were adults, and 42.3 percent were children; all of those at work were 15 to 64 years of age. In the outpatient groups, 65.8 percent of those injured at home were children, 23.7 percent were adults, and 10.5 percent were elderly. All of those injured at work or outdoors were adults.

Cause of injury. Injuries were produced when people fell or were trapped. Information for this variable was obtained from only 58 inpatient records (24.7 percent) and 133 outpatient records (22.7 percent). Among hospitalized patients, 22.4 percent reported falling and 77.6 percent were trapped. Falls were recorded five times more frequently (76.9 percent) for adults than for children (15.4 percent), and being trapped almost one-half times more frequently for adults (60.0 percent) than for children (37.8 percent). Records for elderly persons indicated one had been trapped and one had fallen.

Of the outpatient records, 45.1 percent indicated that patients had fallen and 54.9 percent had been trapped. For this group, the frequency of registered falls was only twice as great for adults (63.3 percent) as for children (31.7 percent), and adults were trapped two times more frequently (67.1 percent) than children (28.8 percent). Three elderly outpatients fell, and three were trapped.

Type of injury. Type of injury was indicated in 65.5 percent of inpatient and 72.6 percent of outpatient records. Among the hospitalized, multiple traumas were identified in more than half of the records (51.3 percent), simple fractures in 14.9 percent, and simple contusions in 10.4 percent. Compound fractures (3.9 percent), wounds with contusions (5.8 percent), other types of minor lesions (10.5 percent), and psychological traumas (3.2 percent), among others, were recorded in the remaining 23.4 percent of the records. For the outpatients, simple contusions were noted in 29.9 percent of the records, psychological traumas in 23.5 percent, wounds with contusions in 17.1 percent, multiple traumas in 11.7 percent, simple fractures in 10.6 percent, and other lesions in 7.2 percent.

Injuries were further analyzed to provide information on age-specific distributions. Across the three age groups, between 42.9 percent and 53.9 percent of the inpatients needed care for multiple traumas, and between 11.3 percent and 28.6 percent had simple fractures (table 1). Compound fractures were more frequently recorded for children (7.0 percent) and the elderly (9.1 percent) than among adults. Simple contusions were experienced by 13.0 percent of adults and wounds with contusions by 18.2 percent of the elderly. Other types of injuries, such as penetrating wounds, psychological trauma, amputations, gas poisoning, and burns—combined under the "other" category—were mentioned in 14.3 percent of the children's records and 10.4 percent of the adults' records, but none of these were recorded for the elderly.

Table 2 shows the distribution of outpatients' injuries. Across the age groups, 28.0 percent to 36.0 percent received care for simple contusions, 18.0 percent to 28.6 percent for psychological traumas, and less than 18.0 percent for wounds with contusions. Simple fractures and multiple traumas were found in 9.0 percent to 14.3 percent of these records.

Type of injury and anatomical site. Data on both injury type and anatomical site were obtained from only 78 inpatient records (33.2 percent) and 223

outpatient records (38.0 percent). Of the inpatients (table 3), 24 had leg injuries (30.8 percent), 21 had injuries of the thorax or abdomen (26.9 percent), 18, the head (23.1 percent), and 15, the arms (19.2 percent). Multiple traumas, simple fractures, and simple contusions were the most frequent head injuries. Multiple traumas and simple fractures each accounted for 28.6 percent of body lesions, simple fractures for 40.0 percent of arm lesions, and simple fractures for 29.2 percent of leg lesions.

Arm and leg injuries each accounted for just over 30.0 percent of the 223 outpatients' injuries; 14.8 percent were recorded as body injuries and 23.8 percent as head injuries (table 4). The two most frequent head injuries were wounds with contusions (58.5 percent) and simple contusions (30.1 percent). Over half of the body injuries were also simple contusions, and contusions accounted for 32.3 percent of arm injuries and 46.4 percent of leg injuries.

Complications. Complications observed during care were mentioned in 23 inpatient records (9.8 percent) and in 125 outpatient records (21.3 percent). Seven inpatient records were those of children and 16, of adults. No complications were reported for patients older than 64 years. Among children, brain concussions (42.9 percent) and shock (28.6 percent) were the two most frequent complications; other complications, that is, pulmonary insufficiency or pneumothorax, were indicated in the remaining 28.5 percent of the records. Large vessel damage was the most commonly recorded complication among adults (25.0 percent); this was followed by other, less frequent problems such as shock, anemia, brain concussion, pulmonary insufficiency, and pneumothorax; each of these was recorded in 15.0 percent of the records.

Among outpatients anemia was, by far, the most frequent (99.8 percent) complication; 29.0 percent of the anemic patients were children. Shock was the only other complication detected, and it was found on one child's record.

Transference of outpatients to other units or services was mentioned in the records; almost 4 percent of inpatients had to be transferred to special care units or to surgery during the data collection period. By the end of the third day after the earthquake, 18.7 percent of all the patients had been released from care because their injury had improved or had been cured (6.8 percent), they needed no further care (77.3 percent), or the patient had died (15.9 percent).

Table 3. Percentage distribution of injury type by anatomical site for 78 hospitalized patients injured as a consequence of the September 1985 Mexico City earthquakes

Type of injury	Head (N = 18)	Body (N = 21)	Arms (N = 15)	Legs (N = 24)
Multiple traumas	33.3	28.6	13.3	20.8
Simple fractures.....	16.7	28.6	40.0	29.2
Compound fractures.....	11.1	4.8	0.0	12.5
Simple contusions.....	16.7	14.3	13.3	16.7
Wounds with contusions....	11.1	4.7	20.0	12.5
Penetrating wounds	11.1	4.7	6.7	0.0
Other	0.0	14.3	6.7	8.3
Total	100.0	100.0	100.0	100.0

Table 4. Percentage distribution of injury type by anatomical site for 223 outpatients injured as a consequence of the September 1985 Mexico City earthquakes

Type of injury	Head (N = 53)	Body (N = 33)	Arms (N = 68)	Legs (N = 69)
Multiple traumas	3.8	6.1	1.6	4.3
Simple fractures.....	0.0	12.1	27.9	27.5
Compound fractures.....	0.0	3.0	4.4	2.9
Simple contusions.....	30.1	51.5	32.3	46.4
Wounds with contusions....	58.5	15.2	30.9	17.4
Other	7.6	12.1	2.9	1.5
Total	100.0	100.0	100.0	100.0

Discussion

The proportion of victims who actively or passively seek medical care is directly related to population density, to the magnitude of the disaster and the time when it takes place, to the survival rate of the injured and the availability of medical services. An attempt to evaluate the quantity and the quality of such care, as measured by the number of patients who were cared for and by the completeness of medical notations, was done, using a secondary data base. Morbidity and mortality numerator-based statistics are the only available estimates in emergencies, and they must serve as substitutes for the more desirable population-based rates. This data base was also used to describe the morbidity patterns of patients.

The source of data was medical records of patients who were provided care at 14 medical units belonging to the Department of the Federal District within 3 days of the first earthquake, a period when 90.0 percent of those in need will have sought medical care (25). Records were reviewed by trained physicians who transferred the data into precoded forms. Because the medical records were created or annotated during an emergency, the

sources of bias may be more diverse than those which are known to affect medical records. Nevertheless, there is no reason to believe that the bias was not randomly distributed. Two of these biases merit further discussion; the first is related to the representativeness of the sample and the second to data quality.

In emergencies characterized by shortages of time, manpower, supplies, and equipment, the probability that records are not kept for outpatients is most likely to be high, while the probability that inpatients will lack a medical record during a hospital stay is most likely to be low. This would seem to be compatible, on the one hand, with the exigencies of delivering immediate medical care, but without keeping a record for patients seeking care due to simple contusions or psychological trauma, and with triage and, on the other hand, possibly with suboptimal quality of care, at least for the critically ill outpatients who were not admitted.

What proportion of the injured persons of the total who sought care from the DFD units is represented by the 587 outpatients is a question that cannot be answered. To do so, it would have been necessary to register all the patients to whom care was delivered, but such registries are not kept during emergencies.

With respect to the hospitalized patients, the perspective may be somewhat different. Most social security and private hospitals in the Federal Districts are located, independently of the population they serve, in areas with greater population density, which were also the ones that suffered the most damage. The DFD units are located, however, in accordance with administrative criteria, so that almost all political jurisdictions have at least one unit for emergency care. Because of these factors, units in the areas of greater damage had to provide most of the medical attention, while care was less often solicited from the least accessible units, which explains their 8.9 percent hospitalization rate compared with the overall rate reported by the Metropolitan Emergency Commission (27).

Injury definition and record incompleteness are frequently encountered in compiling disaster statistics (28). Medical record incompleteness was a frequent finding in this study; for example, demographic data were included in 92.8 percent of the records; general health status in 17.4 percent, the person's whereabouts in 13.9 percent, cause of injury in 23.2 percent, presence of injury in 70.6 percent, anatomical site of injury in 27.1 percent, and complications in 18.0 percent. If the random-

ness of the record provision and notation is accepted, then the information derived from this study reflects what actually happened to the patients who sought care, and it is representative of those who sought care and were hospitalized.

From the results, it also seems that care was provided to inpatients and outpatients according to their needs. Nevertheless, certain incongruities are apparent and cannot be explained from the available data, such as the reasons why the critically ill outpatients were not hospitalized when maximum bed occupancy was estimated to have been 85.0 percent at the time of the tremors (29), unless they were released in order to obtain care elsewhere.

There were no gender differences among and between the two study groups; however, age differences pointed towards larger proportions of injured persons being between 15 and 64 years, compared with children or the elderly. These findings may indicate that age-specific morbidity could be the complement, or counterpart, of the reported age-specific mortality, where the highest rates were found among children and the elderly (19). Further, adults may also represent the proportion of the population who could most readily flee from a hazardous situation. A final explanation could be that the age distribution of the injured is a reflection of the population's age structure, and that a different pattern would be observed in, for example, a population with a larger proportion of elderly persons.

The findings obtained from the study agree with other reports (19,25) in that more persons who were inside their homes were injured compared with those who were outdoors. The time of day when a tremor is felt probably influences morbidity and mortality rates. The earthquake was felt in Mexico City in early morning; morbidity and mortality might have been higher if the number of children and workers who were not at home had been larger, as an important number of schools and offices were damaged (1,27).

It seems that being trapped was a frequent cause of injury among adults. As expected, multiple traumas were more frequent (51.3 percent) among the inpatients than among the outpatients (11.7 percent), but simple contusions (29.9 percent) and psychological trauma (23.5 percent) were more frequent among the outpatients. Furthermore, leg and head injuries were equally frequent among both groups of patients (30.0 percent), and body injuries were recorded nearly twice as frequently for the inpatients (26.9 percent) as for outpatients (14.8 percent). The distribution of these findings

agrees with that of other reports on morbidity due to natural disasters (19,25,28), and it may also be a reflection of adequate patient triage.

The frequency of injury type and anatomical site is also in general agreement with those reported for the Guatemalan (19) and the Italian earthquakes (25). Medical administrators can, therefore, be prepared to care for large proportions of inpatients, across age groups, with multiple traumas and simple fractures of the head and extremities and for large proportions of outpatients, also across age groups, with simple contusions of head and leg and wounds with contusions on the head and body. The total number of persons with each injury and the hospitalization requirements can be projected if an area census is available.

The few reports of immediate psychological trauma and shock, especially among inpatients, could have resulted from the lack of physician or patient awareness or from the precedence of physical injury over those conditions. The proportion of psychological traumas detected among outpatients in this study (23.5 percent), is similar to that obtained during a retrospective study of post-traumatic stress (26), in which 19.0 percent of interviewed persons reported having had psychological disturbances. Medical and paramedical personnel in charge of emergency care should receive training in the detection, amelioration, and reporting of individual and collective psychologic stress. Rehabilitation programs for the affected populations should follow catastrophic events.

Awareness of danger, pre-existing morbidity and immediate health status, location indoors or outdoors, time of day, and the activity engaged in at the initiation of a disaster—among other factors—probably play important roles in survival, in the extent of the lesions, and in the feasibility of searching for care. Morbidity and mortality rates could be decreased, as stressed in the literature, by enhancing preparedness and by including emergency safeguards in buildings (19,25) in regions where natural disasters are common events.

These results can also serve to orient planners in at-risk areas and to orient international relief organizations to the provision of supplies in accordance with the types of injuries that can be expected following natural disasters (10,16). Improvements in record keeping, the training of physicians for emergencies, and the use of standard questionnaires or forms should enhance record completeness and comparability of collected data and, as a consequence, orient the activities of

administrators and epidemiologists working in disaster-prone areas.

Finally, because earthquake victims have indicated a worsening of their health status immediately after the event and during the following year (18), persons who are physically or psychologically injured should be followed clinically and epidemiologically to determine morbidity, rehabilitation needs, and mortality.

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Effects of Very Low Birth Weights on Fetal and Neonatal Mortality Rates in Alabama

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Synopsis

The relationship of births weighing less than 1,000 grams (g) to fetal and neonatal mortality

rates, including changes over time, was studied. In Alabama during the period 1974-84, the percentage of reported births that weighed less than 500 g doubled, and the percentage of reported births weighing 500 to 999 g increased by about 10 percent.

By the end of the study, while only 0.13 percent of reported births weighed less than 500 g, 24 percent of all stillbirths and 14 percent of all neonatal deaths were in this birth weight group. Similarly, in 1984, while only 0.62 percent of all births weighed 500 to 999 g, 23 percent of stillbirths and 42 percent of neonatal deaths were in this birth weight group.

The data suggest that Alabama neonatal and fetal mortality rates declined more than was apparent in vital statistics data because of changes in reporting practices for very low birth weight newborns during the study period. Changes in vital statistics reporting are suggested to improve data reliability.

EXTENSIVE STUDY of infant, neonatal, and perinatal mortality rates has shown a close relationship between low birth weight and fetal and neonatal mortality (1-3) and a need to evaluate mortality by birth weight grouping (4-7). However, the influence of pre-viable births, as well as births of borderline viability, on stillbirth and neonatal mortality rates, has not been well studied.

Factors which limit understanding of the influence of very low weight births on vital statistic measurements include (a) variations in legal definitions of live birth and stillbirth among geographic areas; (b) variations in reporting, even within areas using standard definitions; (c) a tendency to report separately data about neonatal mortality and stillbirth; and (d) a tendency evident in most vital