

# The 1980 earthquake in southern Italy: rescue of trapped victims and mortality\*

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*A retrospective survey was undertaken on the health effects of the 1980 earthquake in southern Italy. The study population included 3619 people living in 7 villages situated near the epicentre of the disaster. The overall casualty rate (dead and injured) was 19.7%. Nearly all the deaths (192/202) occurred among trapped people who died before they could be rescued. Eighty per cent of all the trapped people were extricated within 2 days, mostly without the use of sophisticated means. The probability of survival decreased sharply, the longer the time before extrication. The crude mortality during the 18 months following the earthquake was 19.0 per thousand among the injured people who received treatment, and 14.1 per thousand among non-injured people. After age standardization, there was no significant difference between these two figures and the expected mortality figures for the Italian population in normal times (14.4 per thousand). These results stress the importance of providing rescue activities in the first 48 hours after the impact. Strengthening the self-reliance of the community in disaster preparedness is suggested as the best way to improve the effectiveness of relief operations. In disaster-prone areas, training and education in methods of rescue should be an integral part of any primary health care programme.*

On 23 November 1980, at 19 h 34, an earthquake struck southern Italy, the epicentre of which was in the region of Campania. A study of the health effects of this disaster was undertaken with special attention to the casualties. The object of the study was to identify the risk factors, the most appropriate type of rescue operation and medical aid in terms of personnel and material, and the optimum time for their introduction.

## SUBJECTS AND METHODS

The people who were exposed to the earthquake of 23 November 1980 and who were living in the most affected area constituted the reference population. Seven villages covering a surface area of 261 km<sup>2</sup> were

selected according to three criteria: (1) a crude injury rate of over 50 per thousand, (2) a mortality rate of over 20 per thousand, and (3) a seismic activity of grade 8 or more on the Mercalli scale.

The population registers were used for sampling, at random, one out of every three households totalling 3619 persons who were present on the day of the disaster. A house-to-house retrospective survey was performed by local interviewers using a standard questionnaire.

Two matters were important for operational purposes: (1) the mortality immediately after the impact or, in the case of trapped people, at the time of extrication (these were defined as deaths from impact); (2) the subsequent mortality rate, up to 18 months following the earthquake. The efficacy of any intervention could then be assessed in terms of mortality, thus quantitatively relating the types of rescue action at different times to the outcome.

People were said to be "trapped" when they had been buried underneath debris or been locked into an enclosed space and needed help from outside to be freed. They were classified as "injured" when individuals reported with injuries and could indicate the part of the body that was affected. People who died before they could be rescued were not considered in the calculation of the injury rates. A "casualty" was defined as a person either dead or injured.

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A follow-up of those individuals who had reported with injuries and had been accepted for medical care was made through a study of their hospital records. However, details on the management of these injured people are not included in this paper.

Software designed specifically for this study was developed for the use of a microcomputer in the field. This reduced the time for collection, validation and processing of the data.

RESULTS

The total number of deaths from the moment of impact until 18 months later was 256 (7%) in the sampled population of 3619 persons who had been exposed to the earthquake.

*Immediate effects*

The death rate, including those found dead on extrication from the debris, was 5.6% (202/3619). Of the exposed population, 15.1% (548) had been trapped. Nearly all the deaths (95%) were among trapped people who died before they could be rescued. The mortality in this group of trapped people was 35.0% (192), compared with 0.3% (10) among the non-trapped persons.

The overall injury rate was 14.2% and the ratio of injured persons to dead persons was 2.5:1. Among the trapped people this ratio was 1.3:1.

The overall casualty rate (dead and injured) was 19.8%. The casualty rate among the trapped persons was 80.0% compared with 9.0% among those who were not trapped.

*Follow-up*

All the people who had escaped death at impact or been extricated alive were followed up for 18 months (Table 1). The subsequent mortality among the non-trapped people was 13.4 per thousand (41/3061), compared with 36.4 per thousand (13/356) among those who had been trapped. The mortality rate, over the same period, differed widely between people who escaped injury and those who were injured. Among those who escaped injury, it was 12.9 per thousand for the non-trapped victims and 46.3 per thousand for the trapped. For the injured people, the mortality rate was calculated separately according to whether treatment had or had not been provided; 92 persons (17.8%) did not receive treatment, and 422 (82.2%) were given medical care on the spot or were evacuated to a medical centre either directly or after first aid on the field. Among the treated people, the mortality rate was 19.0 per thousand (8/422) during the 18 months after the earthquake, the rates for those who had and had not been trapped being 22.2 and 15.3 per thousand, respectively. Of the 92 injured people who were not treated, 5 died (3 of these had been trapped victims who died in the immediate post-impact period, i.e., the 24 hours after the earthquake, and before any treatment could be applied).

Several individual and environmental factors (places, circumstances) have been correlated with the casualties. The fact of being trapped is in itself the most significant risk factor for injury and death. Table 2 shows that for those who were trapped, the probability of being alive at extrication from the debris declined sharply over time. From the fourth day onwards, no one was found alive. Fig. 1 shows the time distribution of people extricated after the

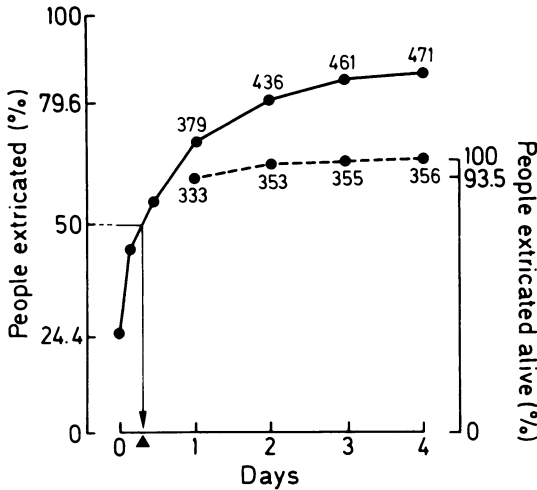
Table 1. Number of deaths and mortality rates among the people who escaped death at impact, or who were extricated alive, during the 18 months following the earthquake

No. of exposed people who escaped death at impact or who were extricated alive		Mortality		
		No.	rates (per 1000)	
Not trapped (3061)	not injured (2795)	36	12.9	
	injured (266)	not treated (70)	2	28.6
		treated (196)	3	15.3
Trapped (356)	injured (248)	treated (226)	5	22.2
		not treated (22)	3	136.4
	not injured (108)	5	46.3	

19.0 } 25.3

Table 2. Probability of being alive, in relation to the number of days trapped, based on 548 casualties rescued after the earthquake

No. of days after the earthquake	No. of persons extricated	No. of persons alive	Probability of being alive at extrication (%)
0	379	333	87.9
1	57	20	35.3
2-3	35	3	8.5
≥ 4	77	0	0.0



▲ Time (Lib<sub>50</sub>) = 8 h  
 — Cumulative number of trapped people extricated  
 ---- Cumulative number of people extricated alive

Fig. 1. Numbers and percentages of trapped people extricated, and the numbers alive during the first 4 days.

impact. During the first day after the earthquake, 134 people (24.4%) were extricated within half an hour, 241 (44.0%) within 3 hours, and 305 (55.7%) within 12 hours. The time within which 50% of the trapped victims had been extricated (Time Lib<sub>50</sub>) was 8 hours. Within two days, 79.6% (436) of all the trapped people were extricated. Of all the people extricated alive, 93.6% (333) were rescued within the first 24 hours.

An analysis was made of the place of origin of the persons who helped in extricating the victims. As regards injured victims who were also evacuated, it was shown (Table 3) that 90.0% of them had been extricated by the inhabitants of the same village, mainly by persons residing in the same building (76.2%).

Table 3. Place of residence of the people who helped in extricating the casualties and the number of victims rescued and evacuated to a medical centre

Place of residence	Injured victims evacuated	
	No.	%
(1) Same house as victim	121	76.2
(2) Another house in the village	22	13.8
Subtotal: (1) + (2)	143	90.0
(3) Outside the village	13	8.2
(4) Unknown	3	1.8
Total	159	100.0

The means used for the extrication of injured victims who were later evacuated to a medical centre are shown in Table 4. These means were divided into two groups: unsophisticated (hands, shovel, ladder) and sophisticated (tractor, crane). Most of the severely injured victims (96.8%) were extricated without any sophisticated equipment. On the first day, only simple measures were available, but by the second day more sophisticated means came into use. For each of the seven villages, the proportion of people extricated alive and the proportion of use of sophisticated means were calculated. There was a negative correlation between these two indices ( $r = -0.76$ ). When only the first day after the impact was considered, no correlation was found, indicating that an earlier use of sophisticated means would not have improved survival rates.

DISCUSSION

Few studies have attempted to determine the factors specifically responsible for deaths at impact;

Table 4. Means used for extricating trapped persons, by time<sup>a</sup>

Means of extrication	No. of injured people evacuated to a medical centre	No. of trapped persons (dead included) extricated on:		
		Day 1	Day 2	Day 3 and later
Hands	119 (74.8)	297 (76.5)	10 (17.2)	13 (12.7)
Shovel	33 (20.7)	58 (14.9)	28 (48.3)	33 (32.4)
Ladder	2 (1.3)	14 (3.6)	1 (1.7)	1 (1.0)
Subtotal	154 (96.8)	369 (95.0)	39 (67.2)	47 (46.1)
Tractor, crane	5 (3.2)	10 (2.6)	12 (20.7)	36 (35.3)
Unknown		9 (2.4)	7 (12.1)	19 (18.6)
Total	159 (100)	388 (100)	58 (100)	102 (100)

<sup>a</sup> Figures in parentheses give percentages.

they have mainly concentrated on the use of different building materials and techniques in relation to the risk of death (1).<sup>a</sup> In the present study, the fact of being trapped was the single most significant risk factor.

Indices have been proposed for assessing the health effects of natural disasters and related needs (2). One of these indices is the time-related death rate following the impact, taking into consideration the rescue measures used and the self-reliance of the community. The mortality figures over a period of 18 months after the 1980 earthquake in southern Italy show that, once people were liberated alive from the debris, very few died. Indeed, of the 514 injured victims, only 13 died over this period; 3 of them died within 24 hours of the earthquake before any treatment could be applied. In this 18-month period, 8 people, irrespective of being trapped, died among the 422 victims who were treated. The expected number of deaths for the same age-standardized Italian population is 9.87. There is thus no evidence of any increased mortality among the earthquake survivors who received medical guidance. Medical intervention, after the earthquake, on those still requiring attention (e.g., the injured victims extricated alive) was very effective, with only a narrow margin for improvement, if any. Increasing the medical resources available for helping the trapped victims after their extrication would therefore not be expected to be very cost-effective.

It was not possible to ascertain the cause of death in the 5 trapped victims who escaped injury at impact but died subsequently (Table 1). The high death rate

(46.3%) observed in this group calls for further study. Trapped people with no recognizable injury after the impact could constitute a potentially vulnerable population.

The great majority (95%) of deaths were among trapped people who died before they could be rescued. Although the proportion of persons who died instantly on impact is not known, the probability of survival in relation to time after the impact leads to the conclusion that if any significant reduction in earthquake mortality is to be achieved, attention should be given to rescue action within the first 2 days after the impact. The aim should be to decrease the number of victims found dead at rescue (35% of the trapped).

The death rate of people liberated from the debris was about the same for all age groups exposed; only the oldest age group experienced a slightly higher mortality (1.5 times the mean). Similar mortality profiles were observed by de Ville et al. (3) after the earthquake in Guatemala in 1976, and by Sommer & Mosley (4) after the cyclonic storm of 1970 in Bangladesh.

From Fig. 1 and Table 2, it is clear that the bulk of the rescue work was done by the local people within 2 days of the impact. After this period, the probability of rescuing people alive is very low. A similar relationship between time of extrication and survival has been reported in Tang Chan, China, in 1976 (Wen-Kui Mai, personal communication). Considering this short time period within which any effective rescue work can be done, the local people in the village itself are in fact the only available human resources. Moreover, the available means and skills for rescue (equipment, know-how) must also be considered. There is no evidence that the use of sophisti-

<sup>a</sup> MITCHELL, W. A. ET AL. *Predicting casualties and damages caused by the earthquake in Turkey: a preliminary report*. Colorado, US Air Force Academy, Department of Economics, Geography and Management, 1978 (USFA-TN-78-2).

cated equipment, even very soon after the impact, can improve the survival rate among the rescued people. This could be because these methods were not appropriate or because people were not sufficiently skilled in their use specifically for rescue operations.

#### CONCLUSIONS

A state of preparedness, with reliance on the community's own resources and reinforcement of self-

help, is the most important approach for the reduction of mortality due to an earthquake. The dispatch of special rescue teams must be considered only if they are highly qualified and if they can be operational within 24 hours. These considerations have clear implications for disaster preparedness. In disaster-prone areas, the training of community health workers and medical personnel, as well as lay persons, in methods of rescue, should be an integral part of any primary health care system. Locally appropriate rescue techniques should be introduced into the curriculum of such programmes.

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#### RÉSUMÉ

##### LA TREMBLEMENT DE TERRE DE 1980 EN ITALIE DU SUD: SAUVETAGE DES VICTIMES ENSEVELIES ET MORTALITÉ

Une étude rétrospective des effets sur la santé du tremblement de terre de 1980, dans le sud de l'Italie, a été réalisée. La population étudiée consiste en un échantillon de 3619 personnes habitant 7 villages situés près de l'épicentre du séisme.

Le pourcentage total des blessés (morts et vivants) représente 19,7%. Presque tous les morts (192 sur 202) sont des personnes emprisonnées mortes avant d'avoir été secourues.

Quatre-vingts pour cent des personnes ensevelies ont été dégagées au cours des deux premiers jours, la plupart sans utilisation de moyens sophistiqués. Au-delà de ce temps, la probabilité de survie au moment du dégagement décroît rapidement. A partir du 4ème jour après le séisme, on ne trouve plus aucune personne en vie. Parmi les personnes dégagées vivantes, 93,6% l'ont été le premier jour. Parmi les blessés évacués ultérieurement, 90% ont été extraits par les

habitants du village même et, principalement, par les habitants du même immeuble (76,2%).

Le taux brut de mortalité en 18 mois est de 19,0 pour mille parmi les blessés qui reçoivent un traitement et de 14,1% pour mille parmi la population non blessée. Après standardisation des âges, on constate qu'il n'y a pas de différence significative entre ces deux taux et le taux de mortalité de la population italienne en temps normal (14,4 pour mille).

Les résultats montrent l'importance primordiale des activités de secours dans les 48 premières heures après le séisme. La meilleure voie pour améliorer l'efficacité des secours se trouve dans le renforcement de l'autosuffisance de la communauté sinistrée. Dans les régions prédisposées aux désastres, formation et éducation au sauvetage doivent être partie intégrante de tout programme de soins de santé primaires.

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