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# An approach to the background, methods and challenges of research in disasters

Pedro Arcos González<sup>1</sup>, José Antonio Cernuda Martínez<sup>1</sup>

<sup>1</sup> Universidad de Oviedo

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## Abstract

Disasters are phenomena of global distribution and increasing impact, with a social and interdisciplinary nature and that often require the use of quantitative and qualitative methods to be investigated. The purpose of this paper is to explore the historical background of disaster research, the current use of epidemiological methods in disasters, as well as the difficulties and future challenges of research in this field.

This study considers bibliographic elements and specific non-bibliographic events that have determined the historical evolution of disaster research, as well as its conceptual framework, particularly in relation to the approaches from which the research has been carried out and the range of methods epidemiological used. This is not a standard review.

Current disaster research is developed for a wide variety of purposes, including the identification and characterization of populations exposed or at risk of disaster; the study and establishment of the exposure model for each specific type of disaster; the estimation of the incidence and prevalence of the different types of disaster and the quantification of the impacts in the short, medium and long term. Research is also carried out in the field of disasters to assess needs, plan relevant and efficient types of aid; model and predict the occurrence and to design adequate and efficient prevention, preparedness, mitigation and rehabilitation strategies.

Even so, the predominant research on disasters is still very much focused on certain partial aspects of the phenomenon such as the response to the disaster and directed towards specific types of disasters, especially those of rapid onset. There is still little multidisciplinary and collaborative research among researchers from the different areas of interest that constitute the disaster phenomenon.

Important challenges persist in disaster research, including the design of a common conceptual framework that allows multidisciplinary research in disasters, the development of specific methods to investigate complex emergencies (complex humanitarian emergencies) or disasters related to climate change; the development of a specific approach to investigate slow-onset disasters and their social, political and cultural factors, as well as research to develop feasible and cost-efficient prevention and response strategies. Solving these challenges will depend to a large extent to which the investigative capacity of managers and heads of organizations and field personnel working in disasters is improved.

**Pedro Arcos González**, MD, PhD, and **José Antonio Cernuda Martínez**, RN, PhD

*Unit for Research in Emergency and Disaster. Department of Medicine. University of Oviedo, Spain*

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## Introduction

Disasters, defined as *serious interruptions to the functioning of a society that involve widespread human, material, economic or environmental losses and impacts that exceed the capacity of the affected community to cope with its own resources*<sup>[1]</sup>, are a phenomenon of global distribution and increasing impacts<sup>[2]</sup>.

Disasters are not an essentially natural phenomenon<sup>[3]</sup> <sup>[4]</sup>, but to a large extent the result of a set of elements of a social nature<sup>[5]</sup> and their impacts result from patterns of socioeconomic vulnerability, geographic exposure to unmitigated hazards and inadequate preparation<sup>[6]</sup>.

As a social phenomenon, disasters are multifaceted in nature. There are disasters of different origins (natural, technological, and caused by man), intensities, patterns and speeds of presentation, and these circumstances affect the methodological approach and the interpretation made by the researchers<sup>[7]</sup>. Phenomena of a multiform nature, such as disasters, are more difficult to investigate and often require quantitative, qualitative, and mixed study methodologies. In addition, the implementation by the United Nations of the International Strategy for Disaster Reduction (ISDR) from the year 2000<sup>[8]</sup> by proposing an approach focused on the study and control of disaster risk and vulnerability, has meant a paradigm shift and a new challenge for disaster research.

The purpose of this text is to explore several main historical antecedents of disaster research, the current use of epidemiological methods in disasters, as well as the difficulties and future challenges of research in this field.

## Materials

From a methodological point of view, this is a report based on a selective review of bibliographic elements and specific non-bibliographic events, which have determined the significant moments in the historical evolution of disaster research, as well as the current conceptual framework from which this research is carried out, particularly in terms of the approaches from which the disaster is studied and the range of epidemiological methods used. This is not a review of all the literature available.

## Results

For a long time, the disasters that have most concerned humanity have been epidemics and pandemics. However, it was not until the 19th century that scientific knowledge was applied in an empirical way to their study. In 1854, John Snow, a British physician, studied the London cholera epidemic using a cluster analysis of the geographical distribution of the cases and adopted control measures based on the results of his research<sup>[9]</sup>.

65 years later, and on the other side of the Atlantic Ocean, Samuel Henry Prince published what is probably the first doctoral dissertation done on a disaster as a topic<sup>[10]</sup>: the chain explosion occurred on December 6th, 1919 in the port of Halifax (Canada) due to the collision of the French cargo ship SS Mont-Blanc, full of war explosives, against the Norwegian ship SS Imo. This episode, only 20 minutes long, released a force equivalent to the 2.9 kiloton explosion of TNT and was the largest blast before nuclear explosions existed. The impact of the wave completely devastated the Richmond district, causing 2,000 deaths and 9,000 injuries.

In the century between 1850 and 1950, disaster research only used a reduced repertoire of basic epidemiological methods applied to an also limited type of specific disasters such as the surveillance and control of epidemic emergencies or the descriptive study of morbidity and mortality in earthquakes. In 1957 Saylor and Gordon<sup>[11]</sup> published the first review of the role and uses of epidemiological methods in disasters and a few years later, in 1964, the US government's Office of Foreign Disaster Assistance (OFDA) initiated the first global disaster data collection program. And since 1969, the Swiss Re Institute provide data and analysis of major natural and man-made disasters from its Nat Cat database.

At the end of the 1960s, the civil war in Nigeria Biafra (1967-1970), one of the bloodiest conflicts in history, provided an opportunity to apply epidemiological research methods in the field that would allow rapid nutritional assessment and management of the nutritional emergency and famine produced by the conflict. And in 1970, tropical cyclone Bhola that swept through East Bengal and Bangladesh on November 11 that year, leaving half a million dead and being the deadliest tropical cyclone on record, also led to the publication of the first study of a disaster made and published by researchers identified as epidemiologists working on disasters<sup>[12]</sup>.

In 1973, Professor Michel Lechat promoted the creation of the Center for Research in the Epidemiology of Disasters (CRED) at the School of Public Health of the Catholic University of Leuven (Belgium), and together with OFDA, started a program to implement databases of global disasters. Also, since 1974, the occurrence and loss data at a global level have been recorded by Munich Re's Geo Risks Research. This comprehensive database of natural catastrophes, going all the way back to the eruption of Mount Vesuvius in AD 79. And in two also natural disasters, the 1976 Guatemala earthquake and the 1980 Mount Santa Helena volcano eruption, important field research was conducted for the first time on how to better organize the disaster response. Also, some of the pioneering works on disaster research and its future lines of work were published, such as that of Logue, Melick and Hansen from 1981<sup>[13]</sup>.

In 1988, the CRED and OFDA launched the Emergency and Disaster Database (EM-DAT) and also the use of statistical packages for epidemiological analysis became widespread in the field, of which EpiInfo was one of the pioneers. Starting in the 90s, the first studies, now classics, on disasters such as those of Lechat (1990 and 1993) were carried out and published<sup>[14]</sup><sup>[15]</sup>, Noji (1997 y 2005)<sup>[16]</sup><sup>[17]</sup>, Alexander (1997)<sup>[18]</sup> and Ibrahim (2005)<sup>[19]</sup>.

Throughout this entire period, it could be said that the evolution of disaster research has undergone a transition *from description to analysis*, since traditional research has used approaches and methods essentially focused on describing and quantifying the effects of disasters, while current research makes more extensive use of different methods and under a comprehensive approach.

Epidemiological methods are today powerful tools widely used in general research and have also progressively been incorporated into the field of disaster research. These methods were applied progressively and mainly in four areas, first and foremost in (i) the assessment of the impacts of disasters, then in (ii) response planning, (iii) operational disaster management; and finally the methods were also incorporated into (iv) vulnerability assessment and risk analysis and reduction, especially after the appearance in 2000 of the International Strategy for Disaster Reduction and, in 2015, the Sendai Framework for Disaster Risk Reduction 2015-2030 [20] which emphasizes among its main objectives for 2030 the need to monitor, assess and understand disaster risk, as well as to strengthen disaster research.

Specific research methods are currently used [21][22][23] with a wide variety of purposes, including the identification and characterization of populations exposed or at risk of disaster (size, location, susceptibility, age distribution, etc.); the establishment of the exposure model (quantitative and qualitative characteristics) to specific types of disasters; in estimating the incidence and prevalence of types of disaster and in quantifying their impacts in the short, medium and long term. These methods are also used in rapid needs assessment to plan a type of aid relevant to the affected people or communities; in modeling and predicting the occurrence of disasters and in the design and development of adequate and efficient prevention, preparedness, mitigation and rehabilitation strategies.

A summarized way of understanding the use of the mentioned areas and methods is to see in which phases of the disaster cycle can they be used as a research tool, as shown in Table 1 in a diagram of the disaster phases. We used a simplified scheme of the disaster phases, more suitable for acute disasters, because it is probably more familiar to the general reader. But it should be noted that the disaster cycle is different for fast-onset and slow-onset disasters and that, although much of the disaster research of the last century is primarily concerned with sudden disasters [24], the differentiation into phases is not always easy, and particularly in slow-onset disasters [25].

**Table 1.** Simplified diagram of research areas in the phases of the disaster cycle

Fase del ciclo del desastre	Research areas
Pre-disaster	<ul style="list-style-type: none"> <li>• Hazards identification</li> <li>• Vulnerability and risk analysis</li> <li>• Epidemiological surveillance and monitoring</li> <li>• Identification of high-risk groups</li> <li>• Design of prevention, preparedness, mitigation and response strategies</li> <li>• Design of early warning system</li> </ul>
Disaster occurrence phase	<ul style="list-style-type: none"> <li>• Epidemiological surveillance and monitoring</li> <li>• Damage and loss analysis</li> <li>• Rapid needs assessment</li> <li>• Identification of impacts on vulnerable groups</li> <li>• Prioritization analysis of resource allocation</li> <li>• Decision support</li> </ul>
Post-disaster	<ul style="list-style-type: none"> <li>• Damage and loss assessment</li> <li>• Study of risks and indirect and secondary effects in the medium and long term</li> <li>• Evaluation of results of aid interventions</li> <li>• Design preventive strategies based on evidence of results</li> </ul>

From the point of view of the type of research design used, almost all the traditional available types of epidemiological designs are currently used in present disaster research, from descriptive observational designs, like cross-sectional studies, to analytical designs, including both prospective longitudinal cohort studies, analysis of temporal trends, survival analysis, and retrospective case-controls designs. In recent years, the use of operational or field-applied research designs and cost-effectiveness, cost-benefit, and cost-utility analyzes of interventions have also increased. It is worth noting the growing use of meta-analysis to examine and establish the evidence of results and its us to help in decision-making to help [\[26\]](#).

## Discussion

Although there is a growing trend in disaster research in the last 20 years, particularly in the USA, China, and Europe, and to also do a more interdisciplinary type of research [\[27\]](#), this research is still very focused on natural disasters, and in aspects such the occurrence predictive models or geospatial elements of risk<sup>[28]</sup> and still is relatively little comprehensive and collaborative [\[29\]](#). Furthermore, research on slow-onset disasters is still limited and, although there are many publications that mention these types of disasters in their content, they dedicate a limited part of it to these types of disasters.

Research on disasters shares difficulties that are common to research on all the topics that are multidisciplinary in nature and that, therefore, require an approach often multisectoral that includes the use of a variety of mixed research methods. But disaster research also presents specific difficulties derived from the nature of the disaster phenomenon and the context in which it occurs, such as the absence or limited time to organize the investigation adequately and in advance, the priority given to respond to the disaster; or the difficulties of the disaster occurrence context as is the case of the field

research in complex emergencies traditionally involving the element of lack of information sources, instability and violence [30].

## Conclusions

Currently predominant research on disasters is focused on partial aspects of disasters, for example on the response, and directed towards certain types of disasters, especially those of rapid onset. It is still reduced the multidisciplinary and collaborative research done by researchers from the different areas of interest of the disaster phenomenon.

Several challenges persist in disaster research, including the development of a common conceptual framework and definitions for multisectoral research on disasters, the development of specific methods to investigate complex emergencies and disasters related to climate change; the development of a specific approach to research slow-onset disasters and their social, political and cultural factors, as well as research into feasible and cost-efficient prevention and response strategies. Successfully resolving these challenges in the future will depend to a large extent on improving the investigative capacity of managers and heads of organizations and field staff.

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