Journal of Medical Sciences

ISSN 1682-4474

science alert

ANSInet
an open access publisher
http://ansinet.com

Research Paper

JMS (ISSN 1682-4474) is an International, peer-reviewed scientific journal that publishes original article in experimental & clinical medicine and related disciplines such as molecular biology, biochemistry, genetics, biophysics, bio-and medical technology. JMS is issued eight times per year on paper and in electronic format.

For further information about this article or if you need reprints, please contact:

Nematollah Jonaidi Jafari
Military Health Research Centre,
Baqyiatallah (a.s) University of Medical Sciences,
Molla Sadra ave., Vanak Sq,
Tehran Iran

Tel: +98-21-22962315

J. Med. Sci., 7 (4): 597-602
15th May, 2007

Incidence of Infectious Diseases One Month after the Bam Earthquake (2004)

[1]N. Jonaidi Jafari, [2]M.H. Radfar and [3]H. Ghofrani

There are eight destructive earthquakes and 74 natural disasters happen annually all over the world. Iran is one of the 10 calamitous countries in the world. Natural disaster change the echo system and inanimate environment which we are living in. these changes can cause new pathogen or increase the pathogenicity of the available pathogens. This is a descriptive study. We collect data of infectious diseases such as acute severe watery diarrhea, dysentery, acute respiratory infection, suspected to malaria, suspected to measles, suspected to meningitis, hemorrhagic fever, acute icter, acute flaccid paralysis, suspected to brucellosis, tuberculosis and bitten by animals which refer to the health care center after one week of the disaster. The most common cases infections were acute respiratory tract infections. During the study period, 6241 cases refer to clinic because of acute respiratory tract infection. Gastrointestinal infections were the second common cause of referring to clinic. During one month, 738 cases refer to clinic because of gastrointestinal infection. Staging by incidence of other infectious diseases were in the next grade. Cold weather, lack of appropriate housing, lack of heating system, over crowded population in camps were reasons which increase the incidence of respiratory tract infection. So we should provide hygienic water and food and also provide heating system as soon as possible. If any infectious diseases happened, we should mobilize the health care center not to postpone treatment of patients. In this research, we report the incidence of infectious diseases within one month after the Bam earthquake.

Key words: Bam earthquake, hygiene, infectious diseases, incidence

[1]Military Health Research Centre,
Baqyiatallah (a.s) Medical Sciences University,
[2]Labbafi Nejad Medical Centre,
[3]Educational Development Centre,
Shaheed Beheshti University of Medical Sciences, Iran

ANSInet
Asian Network for Scientific Information

INTRODUCTION

Earthquakes are probably the most costly of all natural disasters, both in terms of the lives lost and the property destroyed. So that in the earthquake in Roodbar in 1990 almost 40000 people dead (Table 1) (Noji, 1991).

On the average, there is a destructive earthquake every five years in Iran. From the natural disaster occurrence, Iran is in the 6th grade in the world. So, in the 10 past years over 2157 billion rails damage is imposed on our country (Un published data).

Natural disasters that have a rapid onset and broad impact can produce many factors that work synergistically to increase the risk of morbidity and mortality resulting from communicable diseases (Toole, 1997). Large numbers of people are forced to seek temporary shelter in crowded conditions with inadequate sanitation and waste management, compromised sources of water, potential food shortages, malnutrition and a low level of immunity, all factors that play a key role in compounding the devastation (Connolly *et al*., 2004; WHO, 2005).

In the days and weeks following such a devastating disaster, the threat of infectious disease outbreaks is high. The goal of emergency health is to prevent epidemics and improve deteriorating health conditions among the population affected. The highest priority is directed toward diseases that could potentially cause excess mortality and morbidity as a result of the disaster (USAID, 2002).

Communicable diseases are a major cause of mortality and morbidity in emergencies and particularly in complex emergencies, where collapsing health services and disease control programmes, poor access to health care, malnutrition, interrupted supplies and logistics and poor co-ordination among the various agencies providing health care often coexist. The main causes of morbidity and mortality in emergencies are diarrhoeal diseases, acute respiratory infections, measles and in areas where it is endemic, malaria. Other communicable diseases, such as epidemic meningococcal disease, tuberculosis, have also caused large epidemics among emergency-affected populations (Connolly, 2003).

Many factors promoting communicable disease transmission interact synergistically in complex emergencies. These factors include mass population movement and resettlement in temporary locations, overcrowding, economic and environmental degradation, impoverishment, scarcity of safe water, poor sanitation and waste management, absence of shelter, poor nutritional status as a result of food shortages and poor access to health care. Additionally, the collapse or overwhelming of public health infrastructure and absence of health services hamper prevention and control programmes, with a consequent rise in vector-borne diseases such as malaria, trypanosomiasis and yellow fever and vaccine-preventable diseases such as measles and pertussis. These factors are further compounded by absent or unstable governments, ongoing conflict and insecurity limiting access to the affected populations, dearth of drugs and supplies and multiple agencies providing health care with poor coordination (Connolly *et al*., 2004).

Table 1: Number of death cases in huge earthquake

Location	Year	Death toll
Italy	1908	75,000
China	1920	200,000
Japan	1923	143,000
USSR	1948	100,000
Peru	1970	70,000
China	1976	250,000
Iran	1990	40,000

Other communicable diseases, such as epidemic meningococcal disease, tuberculosis, relapsing fever and typhus, have also caused large epidemics among emergency-affected populations (WHO, 2005). Acute respiratory infections account for a large proportion of the morbidity and mortality burden in complex emergencies. Conditions such as overcrowding, indoor fires and inadequate shelter and blankets, especially in cold climates, provide favorable conditions for respiratory droplet transmission. Acute respiratory infections likewise amplify the transmission risk for meningococcal disease through aerosol transmission of respiratory secretions during coughing and sneezing (Connolly *et al*., 2004). In addition, Diarrheal diseases are a major cause of morbidity and mortality in complex emergencies. These diseases mainly result from inadequate quality and quantity of water, substandard and insufficient sanitation facilities, overcrowding, poor hygiene and scarcity of soap. In camp situations, diarrheal diseases have accounted for more than 40% of these deaths in the acute phase of an emergency, with over 80% of these deaths occurring in children aged under 2 years. Outbreak investigations have shown that common sources of infections include polluted water sources (by faecal contamination of surface water entering incompletely sealed wells), contamination of water during transport and storage (through contact with hands soiled by faeces), shared water containers and cooking pots, scarcity of soap and contaminated foods (Connolly *et al*., 2004).

No any data about of incidence of infectious diseases after natural disaster in Iran was published yet. Thus, this study is first published research from Iran. In this research in addition to the study of the incidence of infectious diseases, especially respiratory infections and

diarrheal diseases within one month after the Bam earthquake, the results will compare with findings of studies in other countries.

MATERIALS AND METHODS

This is a descriptive follow up study. Considering that this study was done during a fixed period (in a one month duration a week after the earthquake from 2nd Jan. 2004 to 1st Feb. 2004.) all of the patients which refer to the health care centers of Bam (either Iranian or other countries) considered and included in our project. According to formal data after the earthquake, the settlers of Bam were 90928.

After settelering in Bam area, which was stricken by earthquake, we go to all of the health care centers such as governmental centers and the hospitals that were built by the contributed countries. and according to the standardized forms which were prepared by Iranian ministry of health, we gathered the data of the infectious diseases such as acute respiratory infection, acute severe watery diarrhea, dysentery, suspected malaria, suspected measles, suspected meningitis, suspected hemorrhagic fever, acute icter, acute flaccid paralysis, suspected brucellosis, suspected typhoid, anthrax, cutaneous leishmaniasis, tuberculosis and bitten by animals which refer to health care centers in the period of in week after the event up to one month. For uniformity of definition of each infectious disease and easiness of clinical diagnosis, we used definition of diseases, which are used by World Health Organization (WHO). Considering that, Bam city was divided into 13 regions for easier and better helping, the number of each infectious disease was studied in each region. After completing the forms, we calculate the incidence of each infectious disease manually.

RESULTS

In this study, the most common cause of referring to the health care centers was acute respiratory infection. During the period of study 6241 individual, refer to clinic because of acute upper respiratory infections. According to the total population of Bam after earthquake, which was 90928, the incidence of respiratory infection within 1 month was 686 in 10000 populations (6.86% of total population). Gastrointestinal infection was the second common reason to referring to clinic after acute respiratory infection. During one month 738 individual, refer to clinic because of gastrointestinal infection. The incidence of it was 82 in 10000 populations (0.81% of total population) in one month. 676 individual (94.6% of them) suffering from watery diarrhea and the incidence was 75 in 10000 and 62 individual (8.4% of them) suffer from dysentery diarrhea with the incidence of 7 in 10000 population.

Table 2: Frequency and Incidence of infectious diseases one month after the Bam earthquake

Infection	Freq.	Incidence
Diarrhea		
Watery	676	75.0
Dysentery	62	7.0
Respiratory infection		
Upper tract	6241	686.0
Lower tract	241	26.0
Suspected malaria	53	6.0
Suspected measles	10	1.0
Suspected meningitis	0	0.0
Suspected hemorrhagic-fever	0	0.0
Acute icter	3	0.3
Acute flaccid paralysis	0	0.0
Animal bite	21	2.0
Suspected brucellosis	2	0.2
Suspected typhoid	4	0.4
Anthrax	0	0.0
Tuberculosis	11	1.2
Cutaneous leishmaniasis	68	7.5
Total	7856	853.5

Of 676 cases of watery diarrhea, 208 patients studied for cholera and none of the samples were positive. We diagnose type of diarrhea according to clinical manifestations and samples of patients and we have no any more laboratory data.

Other infectious diseases such as suspected malaria, suspected measles, suspected meningitis, suspected hemorrhagic fever, acute icter, acute flaccid paralysis, suspected brucellosis, suspected typhoid, anthrax, cutaneous leishmaniasis, tuberculosis and cases that were bitten by animals were on the next grade of incidence and they were rare (Table 2).

DISCUSSION

Experiments which were obtained by the previous natural disaster such as tsunami disaster in 2004 in Asian continent showed that cutaneous, respiratory and diarrheal infections are the most common infectious diseases among the survivors of the disaster. Although The epidemic of infectious diseases especially in advanced countries which followed by the natural disaster are rare (Lim *et al*., 2005; Shultz *et al*., 2005; Blake, 1989). Acute respiratory infections caused 63% of the morbidity in Nicaraguan refugees in Costa Rica in 1989 (Diaz and Achi, 1989). In 1993, 30% of the under-5 deaths in residents of Kabul, Afghanistan and 23% of those in displaced people were a result of acute respiratory infections (Gessner, 1994). Also after the Earthquakes in El Salvador in 2001, 30% of infections were upper respiratory infections (Woersching and Snyder, 2004).

However, some interventions in complex emergencies such as vaccination for measles, diphtheria and pertussis have the added value of reducing the risk of acute respiratory infections, as these vaccine-preventable diseases not only cause acute respiratory infections but also diminish host defenses and increase vulnerability to secondary bacterial infections (Fawzi *et al*., 2000). In this study the most common infectious diseases was respiratory infection especially upper respiratory tract infection that this result support findings of previous studies. Unfortunately, there was no data for the prevalence or incidence of respiratory infection in the past year in Bam, which can be compared by our results.

While measles epidemics are an expected threat in some complex emergency settings, few outbreaks have been associated with acute natural disasters (Connolly *et al*., 2004). Global awareness and rapid implementation of postemergency Immunization campaigns have contributed to a trend of decreasing frequency of reports of measles epidemics during the past couple of decades (Spiegel *et al*., 2002). However, following the eruption of Mount Pinatubo in the Philippines in 1991, measles accounted for 25% of the cases of morbidity and 22% of the cases of mortality among the more than 100,000 people displaced. The high morbidity and mortality rates were attributed to the indigenous tribe who were the majority of the displaced population and who had very low immunization coverage and cultural barriers to care (MMWR, 1992). Therefore, the possibility of a measles epidemic following a natural disaster remains high and can only be prevented through an effective early warning system and rapid response to suspicious reports (Waring and Brown, 2005).

However, fortunately because of the widespread project of measles vaccination-mass vaccination against measles and rubella (MR vaccination) has been done in Iran before earthquake-cases of suspected measles were rare and there was no any confirmed case of measles. This result is contradiction of previous studies as discussed above because of measles mass vaccination. In comparison with measles data of Kerman province, (Bam city is located in Kerman province) in 2002 that 320 cases were reported (Shirzadi and Pedram, 2004) after the earthquake of Bam there was no any confirmed case and only 10 cases were suspected.

Tuberculosis is becoming an important problem in complex emergencies. Population mobility and scarcity of access to health services and drugs interrupt tuberculosis control programmes and transmission is increased as a result of overcrowding and malnutrition. Additionally, complex emergencies might encourage the development of chronic cases and multidrug resistance because of low case detection, high defaulter and low cure rates, further heightening transmission. Over 85% of refugees originate from and stay within, countries with high tuberculosis burdens (Connolly *et al*., 2004).

In disasters directly observed therapy programs or the medication supply may be disturbed for lengthy periods. Such disruption may have caused the fourfold increase in tuberculosis cases during the Bosnian conflict in 1992 (Toole *et al*., 1993). Fortunately, during our research reported patients who were suspected to tuberculosis were rare and did not support of previous studies as discussed above. There were two major reasons for that: 1-sufficient supervision of previous tuberculosis patients by the health care centers settled in Bam. 2-It is probable that there was no sufficient time to show the clinical manifestation of tuberculosis in the contacted people because of the short study period. In comparison with data of Kerman province in 2002, there were 178 smears positive pulmonary tuberculosis and 104 smear negative pulmonary tuberculosis (Shirzadi and Pedram, 2004). In this study only 11 cases were suspected to tuberculosis.

Large outbreaks of meningococcal meningitis have been reported in complex emergencies. Serogroup A and C of *Neisseria meningitidis* are the main causes of epidemic meningococcal meningitis in most countries. Dry season, dust storms, overcrowding and high rates of acute respiratory infections also amplify the risk of epidemic meningococcal disease. There were six epidemics of meningococcal meningitis in Democratic Republic of the Congo in the first half of 2002 alone, affecting six health zones in four provinces (WHO Alert and Response, unpublished data). An outbreak in February 1994, in a Sudanese refugee camp in northern Uganda lasted for over 1 year and was reported to have begun in the camp's reception centre (Santaniello-Newton and Hunter, 2000). In addition, a meningococcal outbreak in 2003 affected eight of 12 provinces in Rwanda, seven of 17 provinces in northeastern Burundi and refugee camps in neighbouring Kibondo province, Tanzania (Connolly *et al*., 2004). In this study in spite of the fact that we had overcrowded camps, the rate of suspected meningitis was zero that did not supported of findings in previous studies as discussed above. In comparison with data of Kerman province in 2002, reported meningococcal meningitis were seven cases (Shirzadi and Pedram, 2004).

General warming of the climate may change the endemicity of certain vector-borne diseases such as malaria, dengue fever, yellow fever and a number of viral encephalitides, making the likelihood of these diseases emerging from a disaster a realistic threat (Patz *et al*., 1996). Overcrowded conditions and temporary shelters,

which increase bite frequency, also promote the transmission cycle. Inadequate access to health care services, which prevents early and appropriate treatment, protracts the time parasites remain in the blood (WHO, 2002). The largest known malaria epidemic following a disaster occurred in Haiti in the aftermath of Hurricane Flora in October 1963. Over 75,000 cases of malaria emerged 2 to 3 months after the storm's devastation. The epidemic was attributed to the fact that over 200,000 people were homeless and thus, the exposure potential was greater (Mason and Cavalie, 1965). In this study, in spite of that Bam city is endemic for malaria only 53 cases of suspected malaria were reported thus did not completely supported findings in previous studies. In comparison with data of Kerman province in 2002, 1473 cases of malaria were reported.

Vibrio cholerae, *Shigella dysenteria* and rarely, hepatitis A and E, leptospirosis and *Salmonella typhi* constitute the waterborne infectious diseases that appear following disasters and complex emergencies. Diarrheal illness remains the most lethal infectious disease involving refugees and population displacements (Toole, 1997). Cholera and dysentery warrant particular concern because of their ease of transmission, rapid spread in crowded conditions and immediate life threatening conditions (Waring and Brown, 2005). Cholera, although rare in the developed world following natural disasters, has appeared in refugee camps in Bangladesh, Iraq, Malawi, Nepal, Turkey, Swaziland and Zimbabwe (Toole and Waldman, 1993; Swerdlow *et al*., 1997). Cases of cholera rarely occur in the United States and cholera epidemics, such as those reported in certain developing countries, are unlikely, even with the extreme flooding, caused by the two hurricanes. After Hurricane Katrina on August 29, 2005; Louisiana Office of Public Health and CDC reported two cases of toxigenic *V. cholerae* O1 infection in a Louisiana couple; the cases were attributed to consumption of undercooked or contaminated seafood (MMWR, 2006). In this study, fortunately, there was no any case of cholera in the patients who refer with watery diarrhea and the incidence was zero that did not completely supported findings in some previous studies as discussed above. For all diarrheal illness, watery diarrhea is more common than dysentery or mucoid diarrhea. Following the Bangladeshi floods of 1988, watery diarrhea comprised 47% of all diarrheas; mucoid, 42%; and the more lethal bloody diarrheas, 11 % (Siddique *et al*., 1991). In this study after respiratory and gastrointestinal infections, diarrhea was the most common infectious disease and the most of them were watery diarrhea that supported findings in some previous studies as discussed above.

Damage to public water supplies and sewage systems can lead to the cross-contamination of water lines from sewage pipes if the two systems run in parallel, a scenario that could easily occur in an earthquake. Such breaks lead to a loss of water pressure that creates a vacuum into which pathogens from the broken sewer line can be drawn. Over 2,800 cases of typhoid in Dushanbe, Tajikistan, were attributed to such a situation in early 1997 (Roberts, 1998; Personal correspondence). Contradiction to this report, in our study suspected cases of typhoid were only four cases. In addition, the confirmed and suspected cases of typhoid in Kerman province in 2002 were 165 cases (Shirzadi and Pedram, 2004).

Outbreaks of viral haemorrhagic fevers are becoming increasingly frequent in complex emergencies. This is partly attributable to better surveillance but also shows changes in human behaviour that potentiate the risk of viral introduction and amplification in human populations. The major viral haemorrhagic fever threats to human populations in complex emergency settings are Ebola haemorrhagic fever, yellow fever, Lassa fever and Crimean-Congo haemorrhagic fever (LeDuc, 1989). There was no any case seen in this study that did not supported of findings in previous study as discussed above. However, in the Kerman province in 2002, only one case was seen (Shirzadi and Pedram, 2004).

From this study it can be concluded that and cold weather, lack of appropriate shelter and heating system and overcrowded camps cause respiratory infection more than gastrointestinal infection. At the time of disaster especially earthquake make a lot of difficulty in providing healthy and hygienic food and water and it is impossible to hygienic repel the rubbish and some times because of the demolition, injection system the water in the pipe is contaminated with sewage and it can spread gastrointestinal infection.

So it is recommended to provide healthy water and food and prevent from using the water in the injection system and establish suitable shelters and provide heating system. If such infections happen, we should mobilize health care center not to postpone treatment of patients.

ACKNOWLEDGMENTS

This study is part of research program that funded and financially supported by Military Health Research Centre in Baqyiatallah (a.s) Medical Sciences University. The authors are grateful for the kind cooperation of Iranian Disease Management Centre (DMC) in the Ministry of Health (MOH). Special thanks to Mr. Saffari and Dr. Namdari who assisted us in data collection. We also thank Dr. Morteza Izadi for scientific cooperation.

REFERENCES

Blake, P.A., 1989. Communicable Disease Control [Chapter 3]. In: The Public Health Consequences of Disasters, 1989. MB Gregg, Ed. Atlanta, GA: US Department of Health and Human Services, CDC; 1989.

Connolly, M.A., 2003. Communicable Disease Control in Emergencies-A Field Manual (WHO-OMS; 2003) pp: 223.

Connolly, M.A., M. Gayer, M.J. Ryan, P. Salama, P. Spiegel and D.L. Heymann, 2004. Communicable diseases in complex emergencies: Impact and challenges. Lancet, 364: 1974-1983.

Diaz, T. and R. Achi, 1989. Infectious diseases in a Nicaraguan refugee camp in Costa Rica. Trop. Doct., 19: 14-17.

Fawzi, W.W., R. Mbise, D. Spiegelman, M. Fataki, E. Hertzmark and G. Ndossi, 2000. Vitamin A supplements and diarrheal and respiratory tract infections among children in Dar es Salaam, Tanzania. J. Pediatr., 137: 660-667.

Gessner, B.D., 1994. Mortality rates, causes of death and health status among displaced and resident populations of Kabul, Afghanistan. JAMA, 272: 382-385.

LeDuc, J.W., 1989. Epidemiology of hemorrhagic fever viruses. Rev. Infect. Dis., 11 (suppl 4): S730-35.

Lim, J.H., D. Yoon, G. Jung, K.W. Joo and H.C. Lee, 2005. Medical needs of tsunami disaster refugee camps. Fam. Med., 37: 422-428.

Mason, J. and P. Cavalie, 1965. Malaria epidemic in Haiti following a hurricane. Am. J. Trop. Med. Hyg., 14: 533.

MMWR., 1992. Centers for Disease Control and Prevention. Surveillance in evacuation camps after the eruption of Mt. Pinatubo, Philippines, 41: 9-12.

MMWR Morb Mortal Wkly Rep., 2006. 55: 31-32.

Noji, E.K., 1991. Natural Disasters. In: Kvetan, V., R. Carlson and M. Geheb (Eds.), Disaster Management. Crit. Care Clin., 7: 271-292.

Patz, J.A., P.R. Epstein and T.A. Burke *et al.*, 1996. Global climate change and emerging infectious diseases. JAMA, 275: 217-223.

Roberts, L., Personal correspondence. January, 1998.

Santaniello-Newton, A. and P.R. Hunter, 2000. Management of an outbreak of meningococcal meningitis in a Sudanese refugee camp in Northern Uganda. Epidemiol. Infect., 124: 75-81.

Shirzadi, M. and N. Pedram, 2004. Information and Data of communicable diseases of Iran. Ministry of Health. Iranian CDC.

Shultz, J.M., J. Russell and Z. Espinel, 2005. Epidemiology of tropical cyclones: The dynamics of disaster, disease and development. Epidemiol. Rev., 27: 21-35.

Siddique, A.K., A.H. Baqui and A. Eusof *et al.*, 1988. Floods in Bangladesh: Patterns of illness and causes of death. J. Diarrhoeal. Dis. Res., 9: 310-314.

Spiegel, P., M. Sheik, C. Gotway-Crawford and P. Salama, 2002. Health programmes and policies associated with decreased mortality in displaced people in post emergency phase camps: A retrospective study. Lancet, 360: 1927-1934.

Swerdlow, O.L., G. Malenga and G. Begkoyian *et al.*, 1997. Epidemic cholera among refugees in Malawi, Africa: Treatment and transmission. Epidemiol. Infect., 118: 207-214.

Toole, M.J., S. Galson, W. Brady, 1993. Are war and public health compatible? Lancet, 341: 1193-1196.

Toole, M.J. and R.J. Waldman, 1993. Refugees and displaced persons: War, hunger and public health. JAMA, 270: 600-605.

Toole, M.J., 1997. Communicable Diseases and Disease Control. In: The Public Health Consequences of Disasters. Noji, E.K. (Ed.), New York: Oxford University Press, pp: 79-100.

US Agency for International Development, USAID., 2002. Disaster reduction: A practitioner's guide. Office of US Foreign Disaster Assistance; Washington, DC.

Waring, S.C. and B.J. Brown, 2005. The threat of communicable diseases following natural disasters: A public health response. Disaster Manag Response, 3: 41-47.

WHO., 2002. Prevention and control of malaria epidemics. 3rd meeting of the Technical Support Network. Geneva: WHO, 2002. WHO/CDS/RBM/2002.40.

WHO-OMS, 2005. Communicable Disease Control in Emergencies. A Field Manual, pp: 295.

Woersching, J.C. and A.E. Snyder, 2004. Disaster Manag Response, 2: 40-45.

World Health Organization, 2005. Tsunamis: Technical hazard sheet and natural disaster profile. WHO., Geneva.