# EPIDEMIOLOGY OF POST-EARTHQUAKE DISEASES IN GANGGA SUBDISTRICT, NORTH LOMBOK, INDONESIA

**Almira F[1], Hidajah AC[2]**
[1]*Field Epidemiology Training Program, Department of Health Policy and Administration, Universitas Airlangga, Indonesia*
[2]*Department of Epidemiology Faculty of Public Health, Universitas Airlangga, Indonesia*

*Correspondence:*
*Faridha Almira*
*Department of Health Policy and Administration,*
*Faculty of Public Health, Universitas Airlangga, Indonesia*
*Email: faridha.almira-2017@fkm.unair.ac.id*

## Abstract

**Background**: An earthquake with a magnitude 7.0 has shaken northern Lombok. Eight Centres for Public Health or called *Puskesmas* (*Pusat Kesehatan Masyarakat*) in North Lombok district were damaged. The threat of post-disaster diseases continues to lurk, such as infectious diseases related to epidemics, mental health, non-infectious diseases caused by trauma and poor environmental conditions among the refugees.

**Objective:** The objective of this study is to analyze the post-disaster diseases that occur in the North Lombok District, especially in the Gangga Subdistrict.

**Methods**: This study was a descriptive study carried out for 14 days. The data was obtained from the daily post-disaster surveillance system using WhatsApp and Epi Info Software made by the Control Disease Centre, Indonesia Ministry of Health and carried out by the surveillance officers and FETP (Field Epidemiology Training Programme) students who were placed in each *Puskesmas* in the North Lombok District.

**Results:** Based on gender, 52% of the total patient visits in *Puskesmas* Gangga were women. The most age group were 18-45 years. The most cases reported were the Acute Respiratory Infection (ARI) as much as 23% of total cases, diarrhoea as much as 15% cases and 43% were other cases which were not included in the system. There was one measles suspect and four varicella suspects. The total deaths that were reported in the *Puskesmas* Gangga were 89 cases until August 31, 2018.

**Conclusion:** The most reported cases in the *Puskesmas* Gangga were ARI and Gastrointestinal diseases. The monitoring of the most reported cases and potential outbreaks such as diarrhoea, measles and varicella needs to be optimized. The epidemiological investigations need to be conducted to look for disease causes and resolve additional cases. Collaboration among the provincial government, district government, health office, and other stakeholders is needed to accelerate the recovery.

**Keyword**s: *Earthquake, Disaster, Surveillance, Disease*

### Introduction

An earthquake is an event when the earth shakes caused by collisions between the earth's plates, fault activities, volcanic activity, or rock debris. This type of disaster can be destructive. It occurs at any time and in a short time. An earthquake can shatter the buildings, roads, bridges, etc. in an instant (1). Geographically, Indonesia is located in a ring of fire which runs along the pacific plate, the most active tectonic plate in the world. This zone contributes almost 90% of earthquakes and most of them are the largest earthquakes in the world (2).

A series of moderate and strong earthquakes shook the cities and districts in Lombok Island, West Nusa Tenggara, starting with a force of M 6.4 on July 29, 2019. It was followed by M 7.0 on August 5, 2018, M 6.2 on August 9 2018, and M 6.3 on August 19, 2018. The Lombok region, West Nusa Tenggara Province, is located in an active tectonic region. Lombok Island is surrounded by various earthquake sources, called the Back Arc Thrust Zone in the north, megathrust in the south and shear fault systems on the west and east sides. The worst area affected by earthquakes was the North Lombok Regency (3,4).

The earthquake resulted in landslides at some points, fatalities and injuries. Losses due to the earthquake were felt in almost all aspects such as economic, social, political, and health. As of August 13, 2018 (13.30 UTC + 7 hours), the National Disaster Management Agency (NDMA) verified 436 deaths, 1,353 people were injured (all levels of injury), and 352,793 people were evacuated. The updated assessment has been carried out and identified around IDR 5.4 billion (+ USD 368 million) in the economic field. The damage of health facilities and health workers involved in the earthquake caused health service and programme activities to be disrupted and not run normally. On the other hand, the threat of post-disaster diseases continues to lurk, such as infectious diseases potentially outbreaking, mental health, non-infectious diseases caused by both trauma and poor environmental conditions in the refugee camps. Monitoring efforts are needed on the possibility of diseases that will arise by carrying out surveillance activities for post-disaster diseases as well as giving an immediate response to these problems. The condition of health workers at the disaster area requires additional support, so that the placement of FETP (Field Epidemiology Training Programme) students at the disaster area is expected to be able to assist *Puskesmas* surveillance officers to restart the surveillance system at their working area which is stopped at the time of the disaster (4,5).

The objective of this activity is to carry out post-disaster surveillance activities, to conduct epidemiological investigations and to analyze data on the results of the recording and reporting in West Nusa Tenggara Province, especially in *Puskesmas* Gangga subdistrict, North Lombok Regency. The utilization of Lombok's post-disaster surveillance data for article writing has gone through the licensing process to the Director of Health Surveillance and Quarantine, Ministry of Health of the Republic of Indonesia through the Indonesian FETP Association.

### Methods

Post-disaster surveillance activities in Lombok Island involve the Indonesian Ministry of Health Team, West Nusa Tenggara Provincial Department of Health, North Lombok Department of Health, *Puskesmas* Officers in North Lombok, FETP students from various universities in Indonesia and other medical volunteers. The post-disaster surveillance team's activities were carried out for 14 days, starting on August 17 2018 and ending on August 31 2018. Activities were carried out at the West Nusa Tenggara Provincial Department of Health which is located in Mataram and *Puskesmas* Gangga, North Lombok as the location for FETP student placement. Each FETP student was placed alternately according to a predetermined time. One student was assigned to one *Puskesmas* and then placed in the provincial department of health.

The post-disaster recording and reporting system was implemented in two methods. The

first, reports of the number of health services (inpatients, outpatients, referrals) and death cases were reported by *Puskesmas* and hospital officers using the prescribed format delivered at 12.00 (local time) every day via WhatsApp messenger. The second, the recording and reporting system were carried out by using the early warning system tools using the Epi Info software designed by the Indonesian Ministry of Health Surveillance Team. Data sources were registers of services in the main post or *Puskesmas*, health team reports, and mobile medical volunteer teams. The data were entered every day into the epi info system individually and sent to the email address of gempa.ntb@gmail.com. Data analysis was carried out descriptively to describe disease events based on people, place and time.

## Results
### Health Facilities
The earthquake that occurred in Lombok had resulted in the collapse of health services at the beginning of the earthquake due to damage of health facilities such as *Puskesmas* and hospitals. North Lombok is a district which had a serious disaster impact with 100% damage to its health facilities as illustrated in Table 1.

**Table 1:** Condition of Health Facilities in North Lombok, West Nusa Tenggara Province

| No | Health Facilities | Total | Condition | |
|----|-------------------|-------|-----------|-----------|
| | | | Good | Damaged |
| 1 | Hospitals | 1 | 0 | 1 |
| 2 | Pharmaceutical Buildings | 1 | 0 | 1 |
| 3 | *Puskesmas* | 8 | 0 | 8 |
| 4 | Secondary Branch Center for Public Health or called *Pustu* (*Puskesmas Pembantu*) | 30 | 0 | 30 |
| 5 | Center for Village Health or called *Poskesdes* (*Pos Kesehatan Desa*) | 50 | 0 | 50 |
| | Total | 90 | 0 | 90 |

### Health services
Eight *Puskesmas* buildings in North Lombok suffered serious damage so they could not be used. Temporary health services were carried out in emergency tents provided by the Indonesian National Army or Police and NDMA. Based on the results of daily records and reports through WhatsApp messenger, the number of patients who visited health care facilities in North Lombok from August 5 to August 31, 2018 were 22,970 patients and *Puskesmas* with the highest number of visits was *Puskesmas* Tanjung and *Puskesmas* Gangga ( Graph 1).
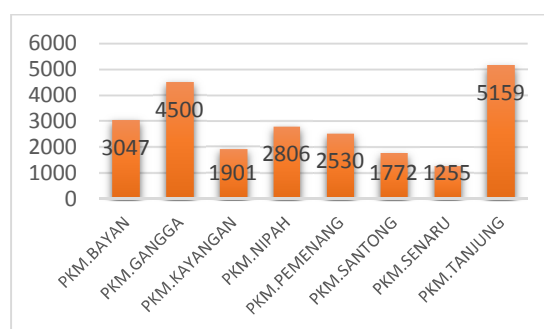


**Graph 1:** Distribution of Patient Visits Based on the Location of *Puskesmas* in North Lombok From 05-31 August 2018

Based on gender, the number of patients who visited *Puskesmas* Gangga, between men and women is not much different. Based on age groups, the highest number of visits is in the group of patients aged between 18-45 years (Graph 2).
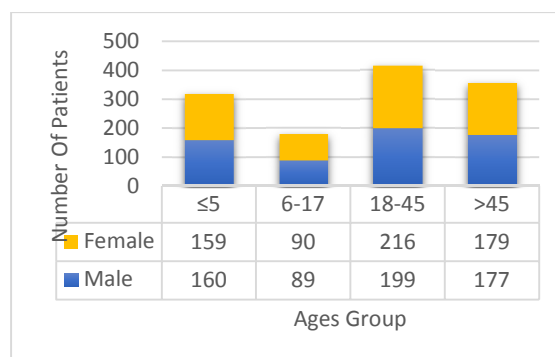


**Graph 2:** Distribution of Patient Visits by Gender and Age Groups in *Puskesmas* Gangga, North Lombok From 05-31 August 2018

### *Mortality*

As of August 31, 2018, there were 487 deaths recorded in the North Lombok Regency. The highest mortality cases were in the work area of *Puskesmas* Kayangan with 173 cases and *Puskesmas* Gangga with 89 cases (Graph 3).
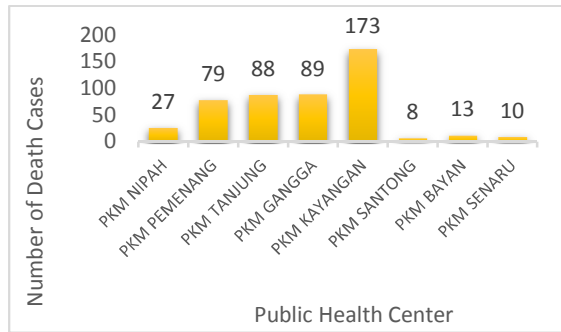


**Graph 3:** Distribution of the Number of Deaths based on work area of *Puskesmas* in North Lombok From 05-31 August 2018

### *Morbidity at Puskesmas Gangga (as of 31 August 2018)*

The data reported from 29 July 2018 - 31 August 2018 shows (Graph 4) that the most reported diseases in *Puskesmas* Gangga work area are Acute Respiratory Infection (ARI) with a proportion of 23%, followed by Acute Diarrhoea (15%) and Skin Diseases (6%). Meanwhile, other diseases were accumulations of several types of diseases or other symptoms that were not included to the list of diseases which existed in the reporting system.
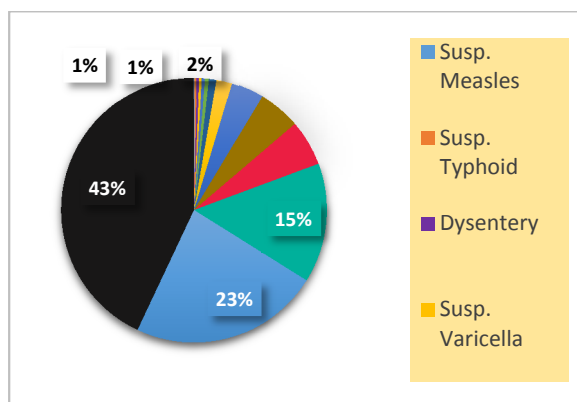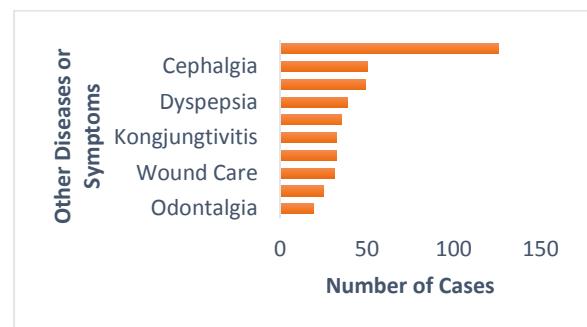


**Graph 4:** Distribution of reported diseases in the work area of *Puskesmas* Gangga, North Lombok from 05-31 August 2018

Based on age groups, ARI was widely reported in the age group of less than five years. Based on gender, there was no significant difference in ARI incidences between men and women (Graph 5).
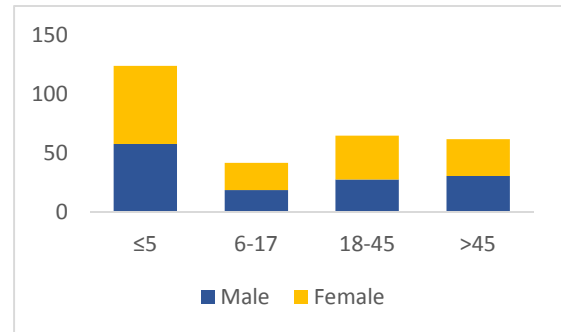


**Graph 5:** Distribution of ARI Based on Gender and Age Groups in the work area of *Puskesmas* Gangga, North Lombok From August 05 August 31 2018

The most reported others diseases or symptoms in *Puskesmas* Gangga were gastrointestinal diseases, followed by cephalgia, pharyngitis and other diseases as shown in Graph 6.



**Graph 6:** Distribution of Diseases or Other Symptoms Reported in the work area of *Puskesmas* Gangga, North Lombok From 05-31 August 2018

Based on sex, the gastrointestinal diseases reported in the Gangga Health Centre was higher in women. Based on the age groups, the gastrointestinal diseases were widely reported to occur in the age groups of 18-45 (see Graph 7).
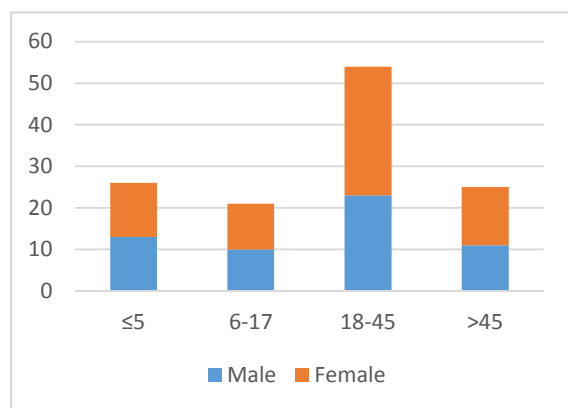
**Graph 7:** Distribution of Gastrointestinal Diseases by Gender and Age Groups in the work area of *Puskesmas* Gangga, North Lombok from August 05-31 2018

### Discussion

Indonesia is located in an active seismic region. Large-scale earthquakes have often resulted in severe casualties and material losses. The earthquakes have caused more than one million deaths and more than one billion dollars in property losses in the last 20 years worldwide. Earthquakes are sometimes followed by chaos in the community with issues about the disaster. For example, there will be a larger aftershock or a large tsunami wave like the one in Aceh, and so on. People who panic cannot think clearly and act appropriately when the disaster occurs. Large-scale natural disasters, such as earthquakes or tsunamis, destroy buildings, vital infrastructure, communication technology, and transportation facilities, had often resulted in many deaths and traumatic injuries. Medical resources and public health services in disaster areas also often experience serious disruptions due to damage of buildings, medical devices and materials. The magnitude of the earthquake, population density, level of earthquake preparedness, and mitigation measures are the main factors affecting earthquake damage and death (6,7,8).

Increasing the spread of infectious diseases after a disaster is an impact commonly found after a primary disaster. Other post-disaster impacts include population displacement (refugees), poor mental health including

increased levels of depression, changes in the environment and an increase of vascular breeding places (e.g. increased risk of malaria). Overcrowded shelters, reduced water and sanitation quality, lack of food or personal hygiene can reduce immunity to vaccine-preventable diseases, increase the risk of infectious diseases. The damage mentioned earlier in health service infrastructure can cause insufficient vaccination coverage and, of course, limit access to remaining health care services (9).

During emergencies, the countermeasures activities are focused on medical care for survivors and implementing public health measures, such as sanitation and hygiene, to reduce the incidence of infectious diseases. During this emergency period, communication and coordination are very limited, it makes systematic collection of information or disease surveillance activities difficult. In these conditions, it is necessary to monitor the possibility of a disease that will arise by carrying out surveillance activities for post-disaster diseases and systems which can support the surveillance process as a mitigation effort (5,10).

Large disasters can be followed by an increase of incidents and outbreaks of infectious diseases, and there is a strong relationship between the level of damage caused by earthquakes and increase of morbidity for acute diseases (8). From the results of post-disaster surveillance at *Puskesmas* Gangga in North Lombok, ARI was the most reported disease with a proportion of 23% of the total reported diseases and mostly occurred in children who were less than five years old. The results of observations at the main evacuation camp in Gangga were obtained, the condition of the camps which were located in open and dusty places, were overcrowded, the behaviour of refugees who burned garbage in front of the tents was suspected to be a risk factor for ARI in Gangga. ARI was a major cause of illness and deaths among the refugee population and often occurred within the first 3-5 days after an emergency. The risk of ARI can increase among refugees due to

overcrowded shelters, poor ventilation and nutrition especially in cold weather. ARI is an infectious disease which was the most often reported to occur at the disaster area. ARI caused 20% of all deaths in children under 5 years. In Iran, respiratory infections were also found among 14% of the 75,586 displaced populations by the 2003 earthquake related to inadequate protection during winter nights. An increase of incidences of ARI was also documented in the province of Aceh (Indonesia), morbidity and mortality due to ARI being the highest among the victims of the 2004 tsunami earthquake (11,12,13).

Besides ARI, the most reported disease or symptom in *Puskesmas* Gangga was gastrointestinal problems with a proportion of 21% from the total of other diseases. ARI and Gastrointestinal diseases have been reported as the most frequent diseases which emerged after natural disasters in developed and developing countries. The risk of ARI and Gastrointestinal diseases among refugees after natural disasters depend on the extent of preventive measures and control of these diseases. After natural disasters, the refugees tend to live in shelters which were crowded with bad water and food supplies. The density in the shelters forced a close contact between the refugees and those who were infected with ARI or Gastrointestinal diseases. Moreover, the lack of personal hygiene, personal protection and clean water increased the transmission of these diseases among the refugees. The loss of housing forced people to stay at emergency shelters, tents, community development with a limited daily life support (11,13).

In this study, besides the two diseases above, other outbreak of potential diseases was found including diarrhoea, skin diseases, measles, chicken pox, and influenza. Besides infectious diseases, non-infectious diseases such as hypertension and injuries were also widely reported. The weakness in this study is first, the absence of disease data in the work area of *Puskesmas* Gangga before the disaster due to the destruction of the buildings and officers' laptops, so that it was difficult to measure the

severity of the cases. Second, the operational definition of disease used in the Early Awareness and Response System is unclear and not standardized so that there is a lack of uniformity in the recording and reporting of disease diagnoses, especially in the category of injuries. The division of operational definitions for minor, moderate and severe injuries is unclear. Third, the limited assignment time causes the investigation of the potential disease outbreaks to be not optimal.

### Conclusion
*Puskesmas* Gangga had the second highest number of visits reported in North Lombok. The most widely reported disease in *Puskesmas* Gangga is 53.5% for the Upper Respiratory Tract Infection (URI) and this was the most reported in the age group of children who were less than 5 years old. The disease can be caused by dust and smoke in the evacuation site. The most widely reported disease or symptom was gastrointestinal diseases. 55.8% occur in the female group and 42.9% occur in the 18-45-year age group. There were some cases that have potential outbreaks such as diarrhoea measles, varicella that need to be monitored.

### Suggestion
Quick and adequate preventive and control measures, as well as case management and appropriate monitoring systems are important to minimize the burden of infectious diseases. Operational definitions need to be established for each diagnosis of the reported diseases, so that there is uniformity in the recording and reporting for all medical teams and supervision teams to obtain valid data. Optimizing monitoring activities by surveillance officers through daily data entries and analyzing data as an early warning for an outbreak. Epidemiological investigations need to be done to find out the causes of the diseases and find additional cases. Collaboration among the provincial government, district government, health offices and other stakeholders is needed to accelerate recovery.

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