The incidence and characteristics of acute respiratory infection (ARI) after the earthquake in West Pasaman and Pasaman Districts, West Sumatra Province in 2022

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Abstract: In February 2022, an earthquake struck Pasaman City in West Sumatra and caused outbreaks of infectious diseases such as acute respiratory infections (ARI). Method: This study used an ecological design by collecting data on the population in West Pasaman and Pasaman Regency in 2022. 13 subjects in West Pasaman and 16 subjects in Pasaman were obtained. ARI cases were mostly found in the female (51.7%) and in the >5 years old group (55.2%). The nutritional status was mostly found in the undernourished category (79.3%). There was no significant relationship between the location of natural disasters and fever or cough in ARI patients (>0.05). Most subjects had a cold (75.9%). Most ARI patients from West Pasaman do not have families with smoking habits (84.6%), while most ARI patients from Pasaman have families with smoking habits (87.5%). There is a significant relationship between the location of natural disasters and families with smoking habits in ARI patients (<0.05). The prevalence of post-earthquake ARI in West Pasaman District and Pasaman Regency was higher among females, particularly in over 5 years old. The affected individuals had low nutritional status, with most of them had cold.

1 Introduction

Indonesia is very vulnerable to natural disasters due to its geographic, geological, climatic, and population characteristics. Between 2004 and 2018, Indonesia had eleven earthquakes with a magnitude above 7 on the Richter Scale (SR) [1, 2]. West Sumatra a province in Indonesia is located in close proximity to the subduction zone, which is responsible for the formation of the Mentawai and Sumatra faults. This geographical positioning makes it one of the Indonesian provinces that is highly susceptible to earthquake activity [3]. In February 2022, an earthquake tragedy struck Pasaman City in West Sumatra, resulting in seven fatalities, several injuries, and damage to 1,765 structures [4]. Figs. 1 and 2 shows the conditions of the earthquake victims.

Natural disasters not only result in a high death toll and destruction of infrastructure, but they also present a variety of health risks, such as the spread of infectious illnesses, which are particularly dangerous for children, the elderly, and refugees [5–7]. After natural disasters, outbreaks of infectious diseases such as acute respiratory infections (ARI) are often found in refugee camps [8]. Following the 2009 earthquake in Sumatra and the 2010 earthquake in Haiti, the most cases that were documented were acute respiratory infections (16.3%). In the 10 days following the 2013 Lushan earthquake in Sichuan Province, China, ARI was also a prevalent infectious condition among children [9].

Acute respiratory infections (ARIs) are illnesses that invest symptoms such as fever, coughing, difficulty swallowing, and difficulty breathing. They are a leading cause of illness and mortality in children under the age of five worldwide. Acute respiratory infections (ARI) encompass both upper and lower respiratory tract infections, with the common cold and influenza being the most widespread types. The leading cause of mortality among the 5.4 million children under the age of five who died in 2017 was Acute Respiratory Infection (ARI). Furthermore, the mortality rate for ARI in impoverished countries is two to six times higher compared to industrialized nations [10–12]. Age, gender, nutritional status, exclusive breastfeeding, socioeconomic level, population density, indoor pollution, passive smoking, and other variables can all have an impact on this [11].

Overcrowding in refugee camps, poor air ventilation, dirty drinking water, inadequate personal hygiene, and the temporary shutdown of emergency response and local health services are some of the variables that may make people more susceptible to contracting ARI after a catastrophe [6, 7]. Apart from environmental variables, public health awareness and knowledge are also thought to be important determinants of the prevalence of infectious illnesses during crisis occurrences [5]. In light of this context, the author will investigate the incidence and characteristics of ARI after the earthquake disaster in West Pasaman and Pasaman Districts, West Sumatra Province in 2022.

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Fig. 1. Tents for earthquake victims

Fig. 2. Medical examination of children affected by the earthquake

2 Method

This study used an ecological design by collecting data on the population. Case data describes the cumulative number of ARI and describes specific individual characteristic that affected by the earthquake in West Pasaman Regency and Pasaman Regency in 2022. The data were collected by The Disaster Team of Department of Child Health, Faculty of Medicine, Universitas Andalas and The Indonesian Pediatric Society Disaster Team West Sumatra Branch, data collected from February 2022 to April 2022.

3 Results

During the research period, 13 subjects in West Pasaman and 16 subjects in Pasaman were obtained. ARI cases were mostly found in the female gender (51.7%) and the age of children in the >5 years group (55.2%). There was no significant relationship between gender and disaster location in ARI cases. The relationship between age and disaster location in ARI cases could not be analyzed. In 2022, according to the Central Bureau of Statistics (BPS) of West Pasaman Regency, the population aged 0-19 years was 163,317 people while Pasaman Regency had a population aged 0-19 years of 109,070 people. Thus, the prevalence of ARI in children in West Pasaman District is 0.008% and in Pasaman District is 0.014%. The characteristics of the study subjects can be seen in Table 1.

Table 1. Research subject characteristics

Variable	Location		Total	p value
	West Pasaman n=13	Pasaman n=16		
Gender Male Female	 5 (38.5%) 8 (61.5%)	 9 (56.3%) 7 (43.8%)	 14 (48.3%) 15 (51.7%)	0,462
Age (year) 1-2 2-3 3-4 4-5 >5	 2 (15.4%) 2 (15.4%) 1 (7.7%) 1 (7.7%) 7 (53.8%)	 3 (18.8%) 2 (12.5%) 1 (6.3%) 0 (0%) 9 (56.3%)	 5 (17.2%) 4 (13.8%) 2 (6.9%) 1 (3.4%) 16 (55.2%)	-

The nutritional status of the subjects was mostly found in the undernourished category (79.3%). Both earthquake disaster locations had more subjects with poor nutritional status than good nutrition (92.3% vs 7.7%, and 68.6% vs 31.3%). The results of bivariate analysis showed no significant relationship between the location of the earthquake and the nutritional status of patients with ARI (p value>0.05). The nutritional status of the study subjects can be seen in Table 2.

Table 2. Research subject nutritional status

Variable	Location		Total	p value
	West Pasaman n=13	Pasaman n=16		
Good Deficient Poor	1(7.7%) 12(9.3%) 0(0%)	5(31.3%) 11(68.6%) 0(0%)	6(20.7%) 23(79.3%) 0 (0%)	0,183

Clinical manifestation of the subject including fever are investigated in the study. This study shown that most subjects did not have fever (65.5%). There was no significant relationship between the location of natural disasters and fever in ARI patients (>0.05). Other manifestation such as cough are seen in 13 subjects (44.5%). There was no significant relationship between the location of natural disasters and cough in patients with ARI (>0.05). Most subjects had a cold (75.9%). There was no significant relationship between the location of the natural disaster and fever in patients with ARI (>0.05). The clinical manifestation can be seen in Table 3.

Table 3. Research subject clinical manifestation

Variable	Location		Total	p value
	West Pasaman n=13	Pasaman n=16		
Fever Yes None	6(46.2%) 7(53.8%)	4(25%) 12(75%)	10(34.5%) 19(65.5%)	1.000
Cough Yes None	7(53.8%) 6(46.2%)	6(37.5%) 10(62.5%)	13(44.5%) 16(55.2%)	0.614
Cold Yes None	11(84.6%) 2(15.4%)	11(68.8%) 5(31.3%)	22(75.9%) 7(24.1%)	0.292

Family smoking is a risk factor assessed in this study. Most ARI patients from West Pasaman do not have families with smoking habits (84.6%), while most ARI patients from Pasaman have families with smoking habits (87.5%). There is a significant relationship between the location of natural disasters and families with smoking habits in ARI patients (<0.05). The description of families with smoking habits in the subject can be seen in Table 4.

Table 4. Research description of families with smoking habits

Variable	Location	Total	p value	
	West Pasaman n=13	Pasaman n=16		
Yes	2(15.4%)	14(87.5%)	16(55.2%)	0.00
None	11(84.6%)	2(12.5%)	13(44.8%)	

4 Discussion

Earthquakes inflict significant harm on both the environment and civilization, particularly on the health system. Following a tragedy, there are three subsequent phases that take place. Phase 1 is known as the impact phase and lasts for 4 days. During this stage, individuals who have been affected by the catastrophe are moved to a different location, saved from danger, and promptly provided with medical care for any injuries sustained. Common issues experienced during this stage include hypothermia, hyperthermia, and dehydration. period 2, often known as the post-impact period, occurs from day 4 to week 4. During this stage, the occurrence of infectious illnesses starts. Pathogens can be conveyed by water, air, or soil. Airborne infections encompass a range of illnesses caused by viruses (such as influenza, RSV, adenovirus), bacteria (including Streptococcus pneumoniae, pertussis, TB, legionella, Mycoplasma pneumoniae), and other pathogens including measles, varicella, and Neisseria meningitidis. period 3 is the recuperation period, which occurs after week 4. During this stage, the prevalent infectious illnesses are those characterized by a prolonged incubation time [13].

This study finds that female patients with ARI was 51.7%, which was higher than the proportion of male patients (48.3%), but the difference between these percentages was not significant. There was no discernible correlation between gender and the occurrence of natural catastrophes in individuals with ARI. The findings of this investigation diverge from the study conducted by Shah [14], which shown a higher incidence of acute respiratory infections (ARI) in males compared to women, both for viral-induced ARI (52.6% vs. 41.4%) and bacterial-induced ARI (55.1% vs. 44.9%). However, the data from this study also revealed a very small disparity in prevalence. Ahmad and Al Subaie [15, 16] both observed similar findings, with a male-to-female incidence ratio of 60% to 40%.

The study revealed that the age group with the largest number of patients with acute respiratory infections (ARIs) was above 5 years old in both catastrophe areas, accounting for 53.8% and 56.3% respectively. The bivariate analysis does not allow for the assessment of the link between age and the occurrence of natural disasters in patients with ARI. This finding aligns with the study conducted by Fitry Yani [17] which revealed that the majority of cases of Acute Respiratory Infection (ARI) occurred in individuals older than 5 years (50%) after the seismic catastrophe in West Sumatra. This finding is consistent with the study on the earthquake catastrophe in Nepal in 2015, which indicated that 65% of children above the age of 6 had upper respiratory tract infections [18].

Post-earthquake catastrophes can lead to a high prevalence of upper respiratory tract infections among youngsters [14, 17, 19]. Children are more susceptible to respiratory tract infections due to their underdeveloped immune systems in comparison to adults. Furthermore, shelters provided for individuals affected by disasters typically have high levels of humidity, congestion, and inadequate ventilation, so promoting the transfer of viruses and bacteria and facilitating the spread of diseases. Hassen demonstrated that shelters with inadequate ventilation resulted in a 4.3-fold increase in the likelihood of children developing acute respiratory infections (ARI). The conditions outside the shelter are particularly unfavorable as the surrounding air is contaminated as a result of the accident. During the nighttime, children may be subjected to frigid air as a result of insufficient shelter conditions. These circumstances can elevate a child's susceptibility to upper respiratory tract infection [14, 18, 20]. There is no correlation between the gender and age of a kid and the location of a natural catastrophe in terms of the risk of acquiring upper respiratory tract infection. Essentially, all children have an equal likelihood of having this condition following a disaster.

According to the data collected from this study, the majority of the individuals had a nutritional status that fell into the undernourished group (79.3%). The earthquake catastrophe sites had a higher prevalence of individuals with inadequate nutrition compared to those with adequate nutrition (92.3% vs 7.7%, and 68.6% vs 31.3%). Nevertheless, the bivariate analysis conducted in this study revealed that there is no statistically significant correlation between the earthquake's location and the nutritional state of patients with ARI, as shown by a p-value greater than 0.05. In a research conducted by Tazinya [21] it was shown that undernourished children had a considerably greater proportion of acute respiratory infections (ARI) compared to well-nourished children, with an odds ratio of 3.01 (95% confidence interval: 1.66-5.43). The difference in proportions was statistically significant (P < 0.05). Nevertheless, in the multivariate analysis, nutritional status did not show a significant impact when compared to other risk variables (p = 0.06). The variation in statistical methodology employed across different research may account for the observed discrepancy, as several investigations have consistently demonstrated a substantial impact of malnutrition on acute respiratory infections (ARI). Ronaldi's research on children impacted by the 2018 North Lombok earthquake [13] revealed that there is no correlation between the nutritional health of children and the incidence of sickness following the earthquake (with a significance level of q>0.005).

Conversely, Maria’s research [27] demonstrated a clear and statistically significant correlation between inadequate nutritional status and the occurrence of acute respiratory infections (ARI). Malnutrition leads to airway anomalies that disrupt the normal functioning of the airway, namely its ability to guard against disease-causing substances. In children with inadequate nutritional status, impaired physiological processes can lead to the entry of disease-causing substances into the lungs through the airway.

The study found no statistically significant correlation between the occurrence of natural disasters and the presence of fever in individuals with acute respiratory infections (p>0.05). According to Chen's research [23], there was no statistically significant correlation (P=0.559) between the presence of viral, bacterial, or bacterial co-infection with fever symptoms in babies and children with acute respiratory infections (ARI). newborns diagnosed with viruses had a significantly greater incidence of fever (P < 0.001) compared to newborns who were not infected with viruses. Chen [22] found that 51% of patients were diagnosed with at least one respiratory infection. The most frequently detected viruses were Human rhinovirus (HRV) (23%) and Respiratory syncytial virus (RSV) (22.7%). In contrast, Khan conducted a research in Pakistan with 314 children, where 89% of the observed clinical signs of Acute Respiratory Infection (ARI) were fever, followed by cough and rhinorrhea.

This study discovered that coughing, which is one of the symptoms of Acute Respiratory Infection (ARI), was not influenced by the location of the natural catastrophe. A literature review documenting the clinical manifestations of patients affected by the 2004 Indian Ocean tsunami tragedy revealed that around 325 out of 1021 patients (32%) presented with minor cough symptoms [7]. In their respective studies, Khan and Desouza [23, 24] discovered that cough symptoms manifested in 79% of the patients. During the earthquake, the evacuation circumstances were characterized by extreme overcrowding, with individuals cramped together in a single tent [9]. The presence of overcrowded tents and inadequate sanitation in emergency situations might heighten the likelihood of fast transmission of airborne illnesses, as patients may cough or sneeze [7, 13]. Following the earthquake, a multitude of pulmonary contaminants were prevalent in the atmosphere.

This study concluded that there was no substantial correlation between colds and the geographical location of the accident. In their study, Khan [23] discovered that 61.8% of patients experienced symptoms of a cold. In their study, Desouza [24] discovered that 80.72% of patients experienced symptoms of a cold. There is compelling data indicating the occurrence of a flu pandemic following an earthquake, which peaks one week after the seismic event and exhibits a twentyfold increase compared to pre-earthquake levels. The influenza virus primarily targets specific demographics, particularly youngsters [25].

A strong correlation was observed between the geographical occurrence of the natural calamity and the smoking behaviors of families in patients with Acute Respiratory Infection (ARI) (p-value <0.05). The prevalence of smoking parents is a contributing factor that is more frequently observed in one of the catastrophe regions. According to a study conducted by Maria, children whose parents smoke are more likely to have acute respiratory infections (ARI) compared to toddlers whose parents do not smoke. Parents who are exposed to acute respiratory infections (ARI) in newborns as a result of being exposed to cigarette smoke for a duration of 30 minutes might experience harm to endothelial cells and blood clotting cells, leading to the constriction and rigidity of blood vessels [24].

The study revealed that environmental variables, including being exposed to wood smoke, cigarette smoke, and living with someone who coughs, were found to have a substantial impact on the occurrence of acute respiratory infections (ARI) (P < 0.05). According to this study, passive smoking was identified as a significant risk factor for acute respiratory infections (ARI), increasing the chances by 4.67 (1.91-11.40) compared to children who were not exposed to secondhand smoke [21].

Tobacco use is a prevalent contributing factor to Acute Respiratory Infections (ARI) [26]. Exposure to cigarette smoke is associated with cough complaints, upper respiratory tract infections, and hospitalizations related to respiratory issues in children. Passive smoking has emerged as a significant health concern due to the prevalence of individuals spending a majority of their time in enclosed spaces. Secondhand smoke, equally detrimental as direct smoking, leads to significant health issues in youngsters. It exacerbates and simplifies the occurrence of respiratory disorders in both the upper and lower respiratory tracts, beginning in early childhood. Exposure to secondhand smoke has a substantial impact on the hospitalization rates and healthcare expenses of children, primarily owing to respiratory ailments. Furthermore, inadequate airflow and excessively congested environments during catastrophes can contribute to the spread of upper respiratory tract diseases [25].

Medical masks, including those for children, are distributed to individuals at the disaster scene. Chaabna [27] asserts that the utilization of medical masks is efficacious in preventing respiratory infections. It is strongly advised to wear medical masks in community settings when there is widespread transmission of the virus, and it is not feasible to maintain physical distance. Furthermore, at the location of the catastrophe, children get health screenings. Children exhibiting signs of Acute Respiratory Infection (ARI) get pharmacological treatment. Chiu (2022) states that it is crucial to supply children with medical equipment during catastrophes that is similar to the supplies provided to adults. Pediatricians are recommended to provide parents with information and knowledge on catastrophe emergency planning [28].

5 Conclusion

The occurrence of Acute Respiratory Infection (ARI) following the earthquake in West Pasaman District was 0.008%, whereas in Pasaman District it was 0.14%. The prevalence of post-earthquake Acute Respiratory Infection (ARI) in West Pasaman District and Pasaman Regency was higher among females, particularly in the age range of over 5 years. The affected individuals had low nutritional status, with most of them not experiencing fever but exhibiting signs of cough and cold. Additionally, the majority of the participants did not have a family member who smoked.

Raising early awareness of the occurrence of Acute Respiratory Infections (ARI) is crucial in order to avert epidemics. It is imperative to provide education on hygiene and healthy living practices, as well as improve infrastructure, in order to prevent Acute Respiratory Infections (ARI) following the earthquake, particularly in the West Pasaman and Pasaman Regency.

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