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Prevalence, comorbidity and predictors of post-traumatic stress disorder, depression, and anxiety in adolescents following an earthquake

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ABSTRACT

Background: This study sought to assess prevalence rate, comorbidity and predictors of Post-Traumatic Stress Disorder (PTSD), depression and anxiety among adolescents affected by the 2016 Aceh Earthquake.
Methods: A cross-sectional study was conducted six months after the earthquake. The multi-stage random sampling method was applied to a selection of respondents from district schools. A total of 321 students participated in the study. In addition to generating demographic data, a brief PTSD inventory, the Patient Health Questionnaire (PHQ), the Generalized Anxiety Disorder (GAD-7) questionnaire and the Disaster Impact Questionnaire (DIQ) were administered.
Results: Approximately 58.3%, 16.8% and 32.1% of adolescents reported the clinical symptoms of PTSD, depression and anxiety, respectively. The associations and comorbidity between PTSD, depression, and anxiety were statistically significant ($p = 0.001$). Gender, depression, having directly seen someone injured or trapped, the injury or hospitalization of a member of the nuclear family and being afraid to stay inside a building since the earthquake were demonstrated to be the significant predictors for PTSD. The injury and hospitalization of a member of the nuclear family and feeling stressed after the earthquake were significant predictors for depression. Having been injured, having one's house destroyed; being afraid to stay inside a building and gender were significant predictors for generalized anxiety disorder.
Conclusions: The prevalence of PTSD in the current study population is relatively high and the fact that a significant number of adolescents were afraid to stay inside a building following the earthquake calls for further investigation and treatments.

1. Introduction

The 2016 Aceh earthquake, measuring 6.5 on the Richter scale, occurred on the 7th of December 2016, in the district of Pidie Jaya, Aceh province, Indonesia. The Indonesian National Board for Disaster Management (BNPB) reported that approximately 103 people were killed, around 700 injured, more than 16.238 buildings destroyed and around 85.161 people temporarily displaced (Tim PusGen, 2017). In modern history, it was considered as the second largest earthquake to occur in the province of Aceh after the 2004 Indian Ocean earthquake and tsunami. In addition to deaths, injuries, the destruction of buildings and livelihoods, and financial losses, the earthquake has had serious psychological consequences for the community living in the area.

Post-Traumatic Stress Disorder (PTSD) is a common psychiatric problem as a result of an event or events that are so painful or stressful that they pose an exceptional threat to someone's life. The individual may develop a variety of symptoms, including re-experiencing the aspects of the traumatic event, feelings of helplessness, intense fear, frightening dreams, or avoidance of the source of trauma (NICE, 2005). These symptoms seriously disturb the functions of the victim's daily life. In adolescents, declining school performance (Shannon et al., 1994) and increased days off from school have been associated with exposure to traumatic events (Strøm et al., 2016). The presence of post-traumatic stress symptoms, therefore, must be managed as soon as possible to avoid further suffering. The lack of appropriate treatment can lead to serious functional and emotional impairments for the individual, and create negative consequences for the community (Stein et al., 2003).

The comorbidity between PTSD, depression, and anxiety among children and adolescents following a disaster is evident (Kar and Bastia, 2006; Lai et al., 2015; Pan et al., 2015). Their prevalence rate, however,

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varies between studies and settings. A study conducted one year after the October 1999 super-cyclone in Orissa, India, found rates of 26.9%, 17.6% and 12.2% respectively for PTSD, major depression and generalized anxiety (Kar and Bastia, 2006). Higher rates of these mental disorders were found in a later report in China. A study conducted three years after the Wenchuan Earthquake revealed rates of 29.6%, 44.8% and 37.6%, respectively, for PTSD, depression, and anxiety (Pan et al., 2015). Lower rates of PTSD and anxiety but relatively higher depression rate was found among street children who survived the 2010 Haiti earthquake. PTSD and anxiety were found among 14.8% and 13.3% of the children, respectively, where approximately 29.7% of them had depression (Derivois et al., 2017). A significantly higher mean of PTSD-RI-5 score was also found among Japanese children who lived in a tsunami-affected compared to those who lived in a disaster-free area (Takada et al., 2018). In addition to the settings, the type of disaster and the consequences of disasters, different tools used to study these mental disorders could be responsible for the different prevalence rates found in these studies.

The determinants or predictors of PTSD, depression, and anxiety following a disaster exposure are numerous. Variables such as age, pre- and post-disaster traumatic event, enduring violence, peritraumatic distress, family violence, and street violence are major predictors of PTSD, depressive and anxiety symptoms in survivors of an earthquake (Derivois et al., 2017). Among burn survivors, the variable of negative appraisal of symptoms and maladaptive cognitive coping mechanisms are the most significant PTSD predictors (Su, 2018). Meanwhile, among a community exposed to a wildfire, pre-existing anxiety disorder, seeing homes destroyed by fire, receiving limited support either from the government or other family members and even after having consultation with regard to the disaster, were significant predictors of anxiety disorders (Agyapong et al., 2018). A study investigating the long-term effect of relocation following a natural disaster also found that the survivors who stayed in the earthquake affected area had a higher rate of PTSD compared to those who moved to other areas (Najarian et al., 2017). Studies examining the predictors of mental disorders among adolescent living in disaster-prone regions of Asia appear to be rare.

To add to the limited literature on the predictors of trauma-related mental disorders among adolescents living in the developing country of Indonesia, this study examines the impact of the 2016 Aceh earthquake on the prevalence and comorbidity of PTSD, depression and anxiety, and researches the question as to whether socio-demographic, exposure-related and clinical factors are associated with the presence of mental disorders. Consistent with previous literature concerning mental health following a traumatic event, it has been hypothesized that the prevalence of PTSD, depression, and anxiety will increase following the earthquake. It has been also hypothesized that socio-demographic, exposure-related, and clinical variables would predict the presence of PTSD, depression, and anxiety among adolescents affected by the Pidie Jaya earthquake in Indonesia.

2. Methods

2.1. Study settings and participants

This cross-sectional study was conducted in Pidie Jaya District, Aceh province, Indonesia. The study was carried out six months after the earthquake. A multi-stage random sampling method was applied to select respondents for the study. Participants were senior high school students, studying in seven schools across Pidie Jaya district. Before the collection of data, the teacher, parent or legal guardian of the students gave written informed consent. An ethics committee of Universitas Syiah Kuala approved the study.

2.2. Assessment tools

In this study, an assessment tool was used to generate data. The tool has five sections: demographic information, questions about earthquake impacts, and screening each for PTSD, depression and generalized anxiety disorder. Demographic information generated from the adolescents includes their age, gender, and number of the siblings. The inclusion criteria are that they were at school when the earthquake occurred. Respondents who were not in the Pidie Jaya district during the earthquake were excluded from the study.

2.3. Impact of disaster

A 14-item questionnaire was developed by the authors to assess the physical and psychological impacts of the earthquake. The Disaster Impact Questionnaire (DIQ) consists of queries on the common problems experienced by the disaster survivors such as having experienced the death of family members due to the disaster, being trapped in the ruins, witnessing others who were trapped, or feeling depressed and stressed from the disaster. It has dichotomous “yes” or “no” answer options. The validity of the questionnaire, the face validity, had been proven by experts in disaster management. The disaster management experts have background in mental health or clinical psychology. The Cronbach alpha of DIQ was also tested and gave the score of 0.62, which suggests an acceptable internal consistency. Details of DIQ questions are presented in Tables 2 and 4.

2.4. Post-traumatic stress disorder

The presence of post-traumatic stress disorder was screened using the PTSD-8 (Hansen et al., 2010), an 8-item screening questionnaire for PTSD that derived from the first sixteen questionnaires of the Harvard Trauma Questionnaire (Mollica et al., 2004). It consists of all three-symptom clusters of the DSM-IV PTSD diagnosis, which includes four intrusion items, two avoidance items, and two hyper-vigilance items. Each item of the PTSD-8 is scored from 1 (not at all) to 4 (all the time). The criteria of PTSD are met if there is at least one item in each cluster with a score of ≥ 3. The Cronbach’s alpha value for the present study was 0.809, which suggests good psychometric properties.

2.5. Depression

The presence of depression was screened using the nine-item Patient Health Questionnaire (PHQ-9) (Kroenke et al., 2001). The PHQ-9 is a well-validated tool for assessing depression and has been often used with adolescents experiencing traumatic events (Dorahy et al., 2015; Sakuma et al., 2015). The respondents were asked about how often they had experienced various depression-related symptoms in the last two weeks. Items are answered on four-points Likert scale, from “not at all (0)”, to “nearly every day (3)”. Scores of 5,10, 15 and 20 are considered as mild, moderate, moderately severe and severe depression, respectively. Depression criteria are met if the score ≥ 10, conforming to the previous suggestions (Kroenke et al., 2001; Moriarty et al., 2015). The Cronbach’s alpha of PHQ-9 in the present study was 0.823, which suggests good psychometric properties.

2.6. Generalized anxiety disorder

The presence of anxiety was assessed using the GAD-7 scale (Spitzer et al., 2006). The scale has good psychometric properties in the general population (Löwe et al., 2008). It has also been used to measure generalized anxiety disorder following exposure to a disaster (Dorahy et al., 2015; Lowe et al., 2016; Pollack et al., 2016; Yun et al., 2018). Each GAD-7 question is scored from 0 (not at all) to 3 (nearly every day), which makes 21 the highest possible score. The scores of 5,10 and 15 represent the thresholds of mild, moderate and severe anxiety, respectively. In order to maximize the sensitivity and specificity for detecting an anxiety problem, this study uses the cutoff threshold ≥ 8 as an anxiety case (Kroenke et al., 2007). The Cronbach’s alpha of GAD7 in

the present study was 0.881.

2.7. Statistical analysis

Data were analyzed using the STATA statistical software. Descriptive analyses were conducted to determine the demographic characteristics of the respondents and the rates of PTSD, depression, and anxiety. The associations between demographic variables and the presence of PTSD, depression, and anxiety were examined using the x^2 test. Multiple regression analysis was performed to examine the predictors of PTSD, depression, and anxiety.

3. Findings

Respondents were students in senior high schools around the earthquake epicenter who were exposed to the December 2016 earthquake. No new students had joined the schools between the earthquake and the time when the study was conducted. More than half of the respondents were girls (65.7%). Their mean age was 16.7 years old (SD = 0.7). On average, they have 3.1 siblings (SD ± 1.8). More than half (61.1%) were in the 11th grade. Details of demographic characteristics of students are presented in Table 1.

3.1. The impact of the disaster

The vast majority of the students reported that they felt afraid while the earthquake happened (95.3%), did not attend the school for a few days after the earthquake (89.7%) and were afraid to stay inside a building following the earthquake (81.9%). More than two-thirds (70%) of them had to temporarily or permanently move somewhere else because of the earthquake, and almost half (46.7%) had their homes destroyed or damaged. Some students also suffered the death of close family members (3.7%), were injured and hospitalized (9.9%), or lost a member of their extended family (11.2%). Details on the proportions of each item of the disaster impact are presented in Table 2.

3.2. Prevalence of PTSD, depression and anxiety

More than half (58.3%) of the students met the PTSD criteria according to the screening tool used. Intrusion was found among 95% of the students, while hypervigilance and avoidance were found among 87.5% and 64.2%, respectively. The proportion of girls with PTSD was significantly higher than the boys (73.3% vs. 26.7%, $x^2 = 11.276$, $p = 0.001$). Depression was found among 16.8% of the respondents. Almost half (48.3%) did not have any symptoms of depression, while 34.9%, 13.1%, 2.8% and 0.9% of the students fell into the categories of mild, moderate, moderately severe and severe depression, respectively. The proportion of girls with depression was larger than that among the boys (74.1% vs. 25.9%), but this was not statistically significant ($p = 0.157$). Furthermore, only 2.2% of the overall sample populations were free from any of the three PTSD symptom clusters, while 7.2% had one cluster and 32.4% had two clusters that meet the PTSD sub-cluster criteria. Finally, more than half (58.3%) of the students were found to suffer from PTSD.

Table 1
Demographic Characteristic of the Respondents.

Variable	% or SD
Mean of age	16.7 ± 0.7
Female gender	65.70%
Mean number of siblings	3.1 ± 1.8
Mean age of father	45.3 ± 13.7
Mean age of mother	40.3 ± 10.9
Father's education: high school or less	83.10%
Mother's education: high school or less	83.80%
Grade	
10	38.9%
11	61.1%
PTSD	
Intrusion	95%
Avoidance	64.2%
Hypervigilance	87.5%
Depression	
No symptom	48.3%
Mild	34.9%
Moderate	13.1%
Moderately severe	2.8%
Severe depression	0.9%
Anxiety	
No symptom	43%
Mild	31.5%
Moderate	20.2%
Severe anxiety	5.3%

Table 2
Impact of the Disaster Questionnaires.

Questions	Percentage of "Yes"
With regard to the recent earthquake, have you experienced?	
Feeling afraid during the earthquake	95.9
School absence due to the earthquake	89.7
Being afraid to stay inside a building following the earthquake	81.9
Being temporarily displaced	70
Having witnessed someone who was injured or trapped	53.3
Feeling stressed after the earthquake	52.9
Having you home damaged	46.7
A neighbor or friend being injured or having died	44.2
A member of your extended family being injured	33
A member of your nuclear family being injured	29.9
Being trapped in the ruins	18
A member of your extended family having died	11.2
Being injured	9.9
A member of your nuclear family having died	3.7

3.3. Comorbidity and predictors of PTSD, depression and anxiety

The comorbidity between PTSD, depression and anxiety was observable and the associations between them were significant. The prevalence of comorbid conditions was 14.3% between PTSD and depression, 24.9% between PTSD and anxiety and 13.1% between depression and anxiety. The prevalence of comorbidity among all three variables was 11.2%. PTSD was significantly associated with depression ($x^2 = 19.4$, $p = 0.001$), anxiety ($x^2 = 23.5$, $p = 0.001$) and other demographic variables. Nevertheless, regression analyses confirmed that only a few variables remained significant predictors for PTSD, depression and anxiety. Being a girl, having depression, having directly witnessed someone being injured, having a member of the nuclear family who was injured and being afraid of staying inside a building remained as significant predictors for PTSD. Having a member of the nuclear family who had been injured and feeling stressed after the earthquake were the only significant predictors for depression. Lastly, being a girl, having been injured, having had one's home destroyed and feeling afraid of staying indoors following the earthquake predicted the presence of anxiety disorders. The summary of the statistical analyses of the variables that predict PTSD, depression, and anxiety are presented in Table 3.

4. Discussion

The prevalence rates of PTSD, depression, and anxiety in the present study were 58.3%, 16.8% and 32.1%, respectively. The findings were inconsistent with those from previous studies. The finding that more than half of adolescents had PTSD in the present study is among the highest rates that have been found to date. An earlier systematic review suggests that the prevalence of PTSD among victims of a disaster

Table 3
Binomial Logistic regression analysis for PTSD Depression and Anxiety.

Variables	β	SE	*P* value	AOR	95% CI
PTSD					
Being a Girl	0.71	0.27	0.007	2.04	1.21 - 3.44
Having depression	1.43	0.44	0.001	4.17	1.78 - 9.79
Having witnessed someone being injured or trapped	0.55	0.26	0.34	1.73	1.04 - 2.88
Member of nuclear family being injured	0.85	0.31	0.006	2.33	1.28 - 4.25
Being afraid to stay inside a building following the earthquake	1.63	0.35	0.001	5.10	2.58 - 10.10
Depression					
Member of nuclear family being injured	89	0.31	0.004	2.43	1.32 - 4.48
Feeling stressed after the earthquake	1.04	0.34	0.002	2.83	1.46 - 5.49
Anxiety					
Being a girl	0.70	0.29	0.017	2.02	1.14 - 3.60
Injured	117	0.41	0.004	3.23	1.44 - 7.23
Home being damaged	0.77	0.26	0.003	2.17	1.30 - 3.61
Being afraid to stay inside a building following the earthquake	1.22	0.43	0.005	3.38	1.44 - 7.91

Abbreviation: PTSD Post-Traumatic Stress Disorder, SE Standard Error, AOR Adjusted Odds Ratio, CI Confidence Interval.

usually ranges between 30% and 40% (Neria et al., 2008). Some recent studies found a much lower prevalence, such as 23.4% at four years after an earthquake (Liu et al., 2018), or only around 13.10% at three years after an earthquake (Jin et al., 2018). Nevertheless, there are reports that suggest a rate of between 50% and 68% for PTSD among children exposed to the 2010 earthquake in Haiti (Blanc et al., 2015) and 57.5% among adolescent victims of the tornado in Yancheng City in the Summer of 2016 (Xu et al., 2018). The inconsistency between studies might be explained by various factors including the different tools used to examine PTSD, the period after exposure, the severity of the disaster, previous traumatic experience and other socio-demographic variables, all of which require further investigation. After all, symptom severity of PTSD improves over time and the prevalence reduces by approximately 50% from one to six months after the traumatic exposure (Hiller et al., 2016).

The finding that 16.8% adolescents had depression in the present study was consistent with a report from a meta-analysis, which suggests rates of 7.5% to 44.8% for depression among children following a natural disaster (Tang et al., 2014). Nevertheless, a rate as high as 58.7% had been reported for depression among adolescents exposed to a tornado (Xu et al., 2018). This study, however, was conducted only three months after the disaster.

The anxiety rate of 32.1% in the present population was inconsistent with earlier studies. Using a similar tool that used in the present study (GAD-7), Pietzak et al. found a rate of anxiety as low as 1.8% following Hurricane Ike in 2008 (Pietrzak et al., 2012), while a the study in China found a rate of 37.6% (Pan et al., 2015), which is even higher than the one in our study. Furthermore, to date, although there are many studies in the subject, it seems that there is no systematic review or meta-analysis existing on the prevalence rate of anxiety or generalized anxiety disorder among children and adolescents following disaster or any traumatic event.

The comorbidities between PTSD, depression and anxiety are evident. PTSD tends to be comorbid with both depression and anxiety, just as depression and anxiety tend to be comorbid with one another. The finding of 11.2% comorbidity between the three conditions is within the range reported after the Wenchuan earthquake, which suggested comorbidity rates of 8% (Fan et al., 2011) and 16% (Pan et al., 2015). Furthermore, the study conducted six months following the earthquake (Fan et al., 2011) found comorbidity rates of 13.3% between PTSD and anxiety, (compared with 24.9% in the present study), 8.6% between PTSD and depression (14.3% in the present study) and 18.3% between anxiety and depression (13.1% in present study). Such variances might be explained by the differing settings, conditions before and after the disaster, severity of the disaster and cultural background of the respondents. Further studies should address factors that might determine different rates of mental disorders following such a disaster.

Based on logistic regression analysis, it was found that gender was associated with both PTSD and anxiety, but not with depression. The fact that girls are more likely to suffer from PTSD and anxiety has been reported previously (Giannopoulou et al., 2006; Zhang et al., 2011). Reports about the poor association between gender and depression also exist (Pan et al., 2015; Zhang et al., 2011). Furthermore, having family members who were injured during the earthquake was associated with PTSD and depression, but not with anxiety. The fear of staying inside a building following the earthquake was associated with both PTSD and anxiety. This is theoretically appropriate, as fear is a component of both PTSD and anxiety disorder. Having been physically injured was also associated with having PTSD, depression and anxiety, the finding of which consistent with previous reports (Pan et al., 2015; Zhang et al., 2011). Nevertheless, regression analysis confirmed that having been injured was significantly associated only with the presence of anxiety and not with PTSD or depression.

Despite these interesting findings, several limitations of the study should also be underlined. The nature of the cross-sectional design does not provide information on the changes in mental health problems over time. Any changes in the prevalence of mental disorders cannot therefore be observed. Secondly, although the instruments used in the present study have satisfactory psychometric properties, they were meant as a screening measure to identify potential clinical cases of mental disorders. Using a standard clinical interview would be significant to assess the prevalence of PTSD, depression and anxiety among adolescents in this region.

5. Conclusions

The present study reported on the prevalence and determinants of PTSD, depression and anxiety among adolescents six months after experiencing the 2016 Aceh earthquake in the Pidie Jaya district of Indonesia. It was found that PTSD, depression and anxiety symptoms were prevalent mental disorders among Indonesian adolescents following the earthquake. These mental disorders were significantly associated with exposure to the earthquake. The findings have significant implications for disaster preparedness, mental and psychological interventions, mental health prevention and future research. With regard to disaster preparedness, the students should be provided with proper information on disaster and how to respond to it properly. During the event of an earthquake, for instance, they should know where to move

Table 4
Symptoms of PTSD, Depression and Anxiety associated with Characteristics and Impact of Earthquake in Adolescents following 2016 Aceh Earthquake, Indonesia (n = 321).

	PTSD (n = 187, 58.3%)			Depression (n = 54, 16.8%)			Anxiety (n = 103, 32.1%)		
Variable	n	%	x2	n	%	x2	n	%	x2
Gender			11.276***			2,006			9.596**
Female	137	42.7		40	12.5		80	24.9	
Male	50	15.6		14	4.4		23	7.2	
Age (years)			5.356**			7.498*			11.662**
16	78	24.3		25	7.8		46	14.3	
17	94	29.3		21	6.5		43	13.4	
18	15	4.7		8	2.5		14	4.4	
Grade			2.778			4.551*			3.744
10	80	24.9		28	8.7		48	15	
11	107	33.3		26	8.1		55	17.1	
Impact of Disaster									
Injured			4.098*			5.287*	19	5.9	12.145***
Yes	24	7.5		10	3.1		84	26.2	
No	163	50.8		44	13.7				
Trapped in the ruins			4.501*			1,582			0.186
Yes	41	12.8		13	4		20	6.2	
No	146	45.5		41	12.8		83	25.9	
Witnessed someone injured or trapped			6.668**			4.68*			1,512
Yes	111	34.6		36	11.2		60	18.7	
No	76	23.7		18	5.6		43	13.4	
Member of nuclear family passed away			1.437			2.429			3.941*
Yes	9	2.8		4	1.2		7	2.2	
No	178	55.5		50	15.6		96	29.9	
Member of nuclear family Injured			12.106***			10.306**			5.768*
Yes	70	21.8		26	8.1		40	12.5	
No	117	36.4		28	8.7		63	19.6	
Member of extended family passed away			2.087			0.199			0.301
Yes	25	7.8		7	2.2		13	4	
No	162	50.5		47	14.6		90	28	
Member of extended family Injured			6.084*			1,749			9.288**
Yes	72	22.4		22	6.9		46	14.3	
No	115	35.8		32	10		57	17.8	
Neighbour or friend injured or passed away			1.446			0.112			1.14
Yes	88	27.4		25	9		50	15.6	
No	99	30.8		29	7.8		53	16.5	
Home damaged			4.759*			5.395*			16.343***
Yes	97	30.2		33	10.3		65	20.2	
No	90	28		21	6.5		38	11.8	
Temporarily displaced			1.482			1.829			0.987
Yes	136	42.4		42	13.1		76	23.7	
No	51	15.9		12	3.7		27	8.4	
Feeling afraid during the earthquake			4.209*			0.020			6.401*
Yes	183	57		52	16.2		103	32.1	
No	4	1.2		2	0.6		0	0	
Feeling stressed after the earthquake			22.603***			11.618**			31.561***
Yes	120	37.4		40	12.5		78	24.3	
No	67	20.9		14	4.4		25	7.8	
School absence due to the earthquake			25.967***			1,963			12.477***
Yes	171	53.3		48	15		96	29.9	
No	16	5		6	1.9		7	2.2	
Feel afraid to stay indoors following the earthquake			1.444			0.581			3.264
Yes	171	53.3		50	15.6		97	30.2	
No	16	5		4	1.2		6	1.9	

*p < .05; **p < .01; ***p < 0.001.

or hide and how to respond with it. Specific mental and psychological interventions should be provided for adolescents who either have or are at risk for developing mental disorders. Psychological first aid can be considered as one of the early interventions for disaster survivors. Health facilities should be improved to have a fortified mental health service. School mental health services should be part of the routine health care system to help mental health prevention goals. Lastly, future studies should consider various variables such as the influence of local wisdom in disaster preparedness, social support following a disaster, and local culture and mental health-seeking behaviors, all of which were not addressed in the present study.

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Conflict of interest

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