

# Long-term risks of complicated grief and insomnia in student survivors of the Sewol ferry disaster in South Korea: A four-year observational follow-up study

So Hee Lee<sup>1</sup>, Yae Eun Seo<sup>1</sup>, Kyoung-Beom Kim<sup>2</sup>, Jin-Won Noh<sup>2\*</sup>, Eun Ji Kim<sup>3\*</sup>

## Abstract

**Background:** The Sewol ferry disaster in April 2014 resulted in the drowning of 304 people. Of the 325 students on board, 250 died and 75 were rescued.

The measure of stress caused by bereavement and sleep problems is common and can be a chronic health concern of disaster survivors. The aim of this study was to determine longitudinal predictive factors of complicated grief and insomnia among student survivors of the disaster.

**Methods:** This study centered on 67 student survivors who were enrolled in the disaster registry after graduating from their high school. The self-report data as presented by the participants were collected at baseline (27 months after the disaster, T1) and again at two years later (51 months after the disaster, T2). Thirty-one participants completed both T1 and T2 surveys. The noted predictive variables in this case were event-related rumination, coping strategy, social support, attachment, meaning in life, and adverse childhood experiences. The outcome variables were complicated grief and insomnia.

**Results:** Dysfunctional coping (T1) was positively associated with complicated grief (T2) (coefficient = 0.070;  $p < 0.001$ ). Intrusive rumination (T1) (coefficient = -0.114;  $p < 0.001$ ), social support (T1) (coefficient = -0.031;  $p < 0.001$ ), and meaning in life – search (T1) (coefficient = -0.082;  $p < 0.001$ ) were negatively associated with insomnia (T2). In contrast, dysfunctional coping (T1) (coefficient = 0.041;  $p = 0.012$ ), adverse childhood experiences (T1) (coefficient = 0.280;  $p = 0.007$ ), and insomnia (T1) (coefficient = 0.166;  $p < 0.001$ ) were positively associated with insomnia (T2).

**Conclusions:** Dysfunctional coping influenced how student survivors of the Sewol ferry disaster suffered from complicated grief and insomnia over time. In this case, the findings from the current study indicate that interventions that target coping strategies should be provided to improve the resolution of grief and sleep among survivors. [*Ethiop.J. Health Dev.* 2020;34(Special issue-3):97-106]

**Key words:** Sewol ferry disaster, student survivors, coping strategy, complicated grief, insomnia

## Introduction

The Sewol ferry sank off Jindo Island off South Korea on April 16, 2014, killing 304 people. Almost all of them were adolescents. Of the 325 students from the same high school who were on a class trip, 75 were rescued and 250 were killed in the accident. The ferry tragedy shocked and enraged the country, as it became clear that it was almost entirely man-made due to a combination of illegal redesigns, cargo overloading, an inexperienced crew member steering the vessel, and lax government regulations (1).

A follow-up study of psychological distress in high school survivors of the Sewol ferry disaster found that symptoms of complicated grief (CG) were exacerbated at the first anniversary of the disaster (2). Stress caused by bereavement, like other stressors, can increase the likelihood of the onset or worsening of other physical or mental disorders (3). Therefore, identifying related factors of CG and offering interventions to resolve grief might be very important for bereaved survivors of disasters.

A further study of student survivors of the Sewol ferry disaster suggests that factors associated with their CG at 20 months after the disaster were post-traumatic stress (PTS) symptoms and the quality of life in the relationship with parents(4). Additionally, a study of CG among parents bereaved by the Sewol ferry accident revealed that coping strategies moderated the

relationship between attachment styles and grief responses(5). People with highly avoidant attachment style avoidant attachment were associated with complicated grief when they try to use problem-focused coping strategies.

Sleep is one of the most common and chronic health concerns of disaster survivors. Short sleep duration, poor sleep quality, or both, are associated with chronic diseases and mortality in various populations (6). Sleep disturbances have also been linked to mental health problems, such as depression, perceived stress, and post-traumatic stress disorder (PTSD), particularly among disaster-affected populations (7).

From a search of the literature, it is noted that several studies have tried to find factors associated with insomnia in disaster survivors (8,9). Social support, especially emotional support, showed the strongest association with prolonged sleep difficulties among victims living at home around one to two years after the Great East Japan Earthquake and tsunami (8). One study determined the longitudinal trends in disaster-related insomnia among workers at nuclear power plants, and emphasized that experiences of life-threatening danger, witnessing the explosion, and social discrimination were associated with insomnia (9).

In addition to having a coping strategy and social support, several factors have been found to be

<sup>1</sup> Department of Psychiatry, National Medical Center, 245 Euljiro, Jung-gu, Seoul, KOREA

<sup>2\*</sup> Department of Health Administration, Dankook University, 119 Dan-daero, Sinan-dong, Dongnam-gu, Cheonan-si, Chungcheongnam-do, KOREA. \* E-mail: jinwon.noh@gmail.com

<sup>3\*</sup> Maumtodoc Mental Health Clinic, 174 Gwangdeok-daero, Danwon-gu, Ansan-si, Gyeonggi-do, KOREA.

\* Email: happymom.kim@gmail.com

positively or negatively related with the noted psychological outcomes that are experienced by people with traumatic experiences. An inability to find meaning in life has been identified as a significant predictor of depressive symptomatology, hopelessness and suicide, as well as substance abuse and emotional dysregulation after trauma or adverse events in such individuals (10,11). Notably, adverse childhood experiences (ACEs) are reported to be associated with insomnia among disaster survivors, and are also associated with negative health outcomes throughout the life course (12,13). Furthermore, it has been suggested that intrusive rumination predominates in the early post-traumatic period, leading progressively to elaborate rumination, and eventually leading to growth. However, the failure to move from intrusive rumination to deliberate rumination would be one way to develop negative outcomes, such as with the subsequent development of PTSD (14).

However, studies on the long-term follow-up outcomes of CG or insomnia among student survivors of the Sewol ferry disaster are insufficient. Furthermore, previous studies to find factors associated with mental health outcomes have been limited by cross-sectional designs. Longitudinal studies are needed to recognize risk factors and prevent poor mental health outcomes among survivors.

The objectives of the current study were to: (1) investigate symptoms of CG and insomnia in surviving students at 51 months after the Sewol ferry disaster; and (2) investigate the longitudinal predictors by examining associations between psychological variables obtained at 27 months (during first summer vacation after the graduation of high school) and CG, or insomnia at 51 months (two years after the first assessment) after the disaster among the student survivors.

## Methods

**Participants:** This study was conducted with survivors of the Sewol ferry disaster from Danwon High School in South Korea. Due to the small number of eligible participants, we tried to include as many as possible for this study rather than perform random or purposive sampling. When they graduated from high school, 67 of the 75 student survivors were enrolled in the disaster cohort study, a research project which collected data about mental health regularly from disaster affected populations. During their first summer vacation as university students, individuals who were enrolled were invited to participate in the present study. The invitation was performed via telephone by the former school psychiatrist and psychologists who had worked for the mental health center which had been established in the high school after the Sewol ferry accidents. All potential respondents had the opportunity to decline. Self-report data were collected at 27 months (T1) and 51 months (T2) after the disaster. Thirty-one participants completed both T1 and T2 surveys.

**Variables and measurements:** The outcome variables, CG and insomnia, were assessed at two time points, T1 and T2. To assess CG, we used the Inventory of

Complicated Grief (ICG), which is designed to evaluate indices of pathological grief – such as rage, disbelief and hallucinations – as experienced by the participant in relation to the deceased. It is a scale with proven internal consistency that allows traits of CG to be easily evaluated. This instrument contains 19 items regarding a respondent's bereavement-related ideas and behaviours, rated on a five-point Likert scale ranging from 1 ("never") to 5 ("always"). Respondents who scored more than 25 points were regarded as at an elevated risk of requiring clinical care (15). In this study, it was shown that the Cronbach's alpha for ICG was 0.91 for both T1 and T2.

The Insomnia Severity Index (ISI) was used to assess insomnia, which is a simple self-report evaluation instrument that tracks a participant's reaction to therapy. The tool was developed by Charles Morin, and has been translated into many languages. ISI consists of seven items that evaluate the severity of problems in starting sleep, sleep maintenance, early morning awakening problem, sleep dissatisfaction, interference of sleep difficulties with daytime functioning, and the degree of trouble or concern induced by sleep issues. Commonly adopted thresholds were used, with  $\geq 11$  suggesting sub-threshold insomnia and  $\geq 15$  suggesting clinical insomnia (16). In this study, it is noted that the Cronbach's alpha for ISI was 0.77 for T1 and 0.82 for T2.

In this context, the predictive variables were the event-related rumination, coping strategy, social support, attachment, meaning in life, and ACEs. The factors were evaluated only at T1.

The event-related rumination was measured by the Korean version of the Event-Related Rumination Inventory (K-ERRI), which assesses two factors of rumination: intrusive (e.g., "I thought about the event when I did not mean to") and deliberate (e.g., "I thought about whether I could find meaning from my experience") (17). The scale has 10 items for each factor. Response choices ranged from 0 ("not at all") to 3 ("often"). The score was calculated by averaging items, with a higher score indicating more rumination about a given event. In this study, it is noted that Cronbach's alpha for K-ERRI was 0.93.

The coping strategy was measured by the Brief Coping Orientation to Problems Experienced (Brief COPE) inventory, which is a questionnaire that consists of 28 statements that measure 14 strategies for coping with a difficult situation, including active coping, planning, positive re-evaluation, acceptance, a sense of humor, return to religion, seeking emotional support, seeking instrumental support, substitute activities, denial, discharge, substance use, cessation of operations, and blaming oneself (18). Answers were given according to a four-point scale, for which marginal points were used, ranging from 0-I ("never do it") to 4-I ("always do it"). The results were calculated as the sum of responses on a particular sub-scale. Based on the theoretical literature and several empirical studies, we grouped the 14 subscales into three categories: (1) problem-focused coping (active coping, planning,

instrumental support); (2) emotion-focused coping (positive reframing, humor, religion, acceptance, emotional support); and (3) avoidant coping (self-blame, behavioral engagement, substance abuse, self-distraction, denial, venting) (19). In this study, it is noted that the Cronbach's alpha for Brief COPE was 0.88.

Social support was measured by the Functional Social Support Questionnaire (FSSQ), which is a 14-item self-report questionnaire with excellent internal consistency ( $\alpha = 0.89$ ) in Korean samples. It was used to assess perceived social support (20). FSSQ asks participants to rate each item on a five-point Likert-type scale ranging from 1 ("much less than I would like") to 5 ("as much as I would like") (21). Total scores ranged from 11 to 70, with higher scores indicating a higher level of social support. A validation study demonstrates that this scale has a two-factor structure: confidant support or the ability to share important information, and affective support or emotional support. In this study, it is noted that Cronbach's alpha for FSSQ was 0.93.

Attachment was measured by the Experiences in Close Relationship Scale-Short Form (ECR-SF), a questionnaire that was developed to assess individual differences with respect to attachment-related anxiety (i.e., the extent to which people are insecure vs. secure regarding the availability of and responsiveness to the people they are romantically involved with) and attachment-related avoidance (i.e., the extent to which people feel uncomfortable being close to others vs. secure in depending on others) (22). We used 12 items rated on a scale ranging from 1 ("strongly disagree") to 7 ("strongly agree"). In this study, it is noted that Cronbach's alpha for ECR-SF was 0.80.

Meaning in life was measured by the Meaning in Life Questionnaire (MLQ), which assesses two aspects of meaning in life using 10 items rated from "absolutely true" to "absolutely untrue" on a seven-point scale (23). The Presence of Meaning sub-scale measures the extent to which participants think their lives are meaningful. The Search for Meaning sub-scale measures how committed and encouraged subjects are to seek meaning in their lives or to deepen their understanding of meaning. The initial validation research of MLQ demonstrated high internal consistency and test-retest reliability, as well as structural, convergent, and discriminant validity, with Cronbach's alpha varying from 0.82 to 0.86 and 0.86 to 0.87 for MLQ-P and MLQ-S, respectively. In this study, it is noted that Cronbach's alpha for MLQ was 0.90.

ACEs were measured by the Adverse Childhood Experiences Questionnaire (ACE-Q), which constitutes 10 items to assess adverse experience in childhood before age 18 (24). Items include personal abuse and neglect, as well as items in relation to other household members, such as domestic violence, mental illness, substance abuse, and incarceration. Each "yes" response to a type of trauma was added to ACE score, ranging from 0 to 10, with a higher score representing increased risk of ACEs. In this study, it is noted that Cronbach's alpha for ACEs was 0.67.

**Statistical analysis:** Descriptive analyses were performed to summarize general characteristics and psychological variables of the study participants, which were gathered at the first (T1) and second (T2) assessments. Since the victims and survivors of the disaster were the same grade in a single public school, the age was not adjusted in the statistical analysis. Results are presented as mean  $\pm$  standard deviation (SD). It is inappropriate to apply the linear model here, because the dependent variables ICG and ISI scores use count data, which violates the assumption of distribution. Therefore, univariable and multivariable Poisson regression analyses with log link function were conducted to determine unadjusted and adjusted longitudinal predictive factors of CG and insomnia among student survivors of the disaster. The severity of CG and insomnia (T2) for each of the participants was adjusted by including the first assessment (T1) of ICG and ISI score as an independent variable. Estimated unadjusted and adjusted coefficients with 95% confidence intervals (CI) are reported. To account for the standard error of coefficient being biased due to heteroscedasticity, the standard error was adjusted by White's correction. All statistical procedures were performed using Stata/MP 14.2 software (StataCorp, College Station, TX, USA). The threshold for statistical significance was set at  $p < 0.05$  (two-tailed).

#### **Ethical statement**

This study was approved by the Ethics Committee of the National Medical Center (IRB No. H-1505-054-002). Written informed consent was obtained from all participants. All participants were informed that they could withdraw from this study at any time.

#### **Results**

Psychological factor characteristics of study participants are summarized in Table 1. Of the 31 participants, 12 (38.71%) were male and 19 (61.29%) were female. The rate of participants suffering from CG was 16.1% at T1 and 22.6% at T2. Of all participants, 6.4% at T1 and 9.7% at T2 reported insomnia that needed clinical attention.

Table 1: Psychological factor characteristics of study participants

Variable	Sub-category	First assessment (T1)		Second assessment (T2)		p-value
		Mean	SD	Mean	SD	
Event-related rumination (K-ERRI)	Intrusive rumination (min = 0; max = 21)	5.00	5.65	N/A		
	Deliberate rumination (min = 0; max = 17)	6.32	5.27	N/A		
Coping strategy (Brief COPE)	Problem focused (min = 6; max = 20)	12.68	3.87	N/A		
	Emotion focused (min = 11, max = 28)	18.74	4.99	N/A		
	Dysfunctional (min = 12; max = 32)	19.32	5.88	N/A		
Social support (FSSQ)	(min = 32; max = 70)	55.03	10.47	N/A		
Attachment (ECR-SF)	Anxiety (min = 9; max = 40)	20.13	6.51	N/A		
	Avoidance (min = 7; max = 29)	17.39	6.15	N/A		
Meaning in life (MLQ)	Presence (min = 11; max = 33)	22.10	5.91	N/A		
	Search (min = 8; max = 31)	23.55	5.56	N/A		
Adverse childhood experiences (ACE-Q)	(min = 0; max = 4)	0.58	1.03	N/A		
Complicated grief (ICG)	(min = 0; max = 35)	12.87	10.88	13.77	11.63	0.560
Insomnia (ISI)	(min = 0; max = 16)	7.16	3.93	7.81	4.76	0.348

N = 31 (male = 12; female = 19)

K-ERRI = Korean Event-Related Rumination Inventory, Brief COPE = Brief Coping Orientation to Problems Experienced, FSSQ = Functional Social Support Questionnaire, ECR-SF = Experiences in Close Relationship Scale-Short Form, MLQ = Meaning in Life Questionnaire, ACE-Q = Adverse Childhood Experiences Questionnaire, ICG = Inventory of Complicated Grief, ISI = Insomnia Severity Index, N/A = not available, SD = standard deviation

The longitudinal psychological and demographic predictors associated with complicated grief are summarized in Table 2. Here, deliberate rumination (T1) (coefficient = 0.121;  $p = 0.016$ ) and attachment related anxiety (T1) (coefficient = 0.036;  $p = 0.038$ ) were positively associated with complicated grief (T1). Likewise, dysfunctional coping (T1) (coefficient = 0.070;  $p < 0.001$ ) was positively associated with complicated grief (T2). In this case, sex does not show a significant relationship with complicated grief (T1 and T2).

Table 3 summarizes the longitudinal psychological and

demographic predictors that are associated with insomnia. There was no psychological or demographic factor significantly associated with insomnia (T1). Intrusive rumination (T1) (coefficient = -0.114;  $p < 0.001$ ), FSSQ (T1) (coefficient = -0.031;  $p < 0.001$ ) and meaning in life – search (coefficient = -0.082;  $p < 0.001$ ) were negatively associated with insomnia (T2). In contrast, dysfunctional coping (T1) (coefficient = 0.041;  $p = 0.012$ ), adverse childhood experiences (T1) (coefficient = 0.280;  $p = 0.007$ ), and insomnia (T1) (coefficient = 0.166;  $p < 0.001$ ) were positively associated with insomnia (T2). There was no significant relationship between sex and insomnia (T1 and T2).

Table 2: The longitudinal psychological and demographic predictors associated with complicated grief

Variable	Sub-category	Baseline (27 months after the disaster; T1)				Two years later (51 months after the disaster; T2)			
		Coefficient	Robust SE	p-value	95% CI	Coefficient	Robust SE	p-value	95% CI
Sex	Male	0	(reference)			0	(reference)		
	Female	0.224	0.229	0.329	-0.225 0.673	0.190	0.235	0.421	-0.272 0.651
Event-related rumination (K-ERRI)	Intrusive rumination (min = 0; max = 21)	0.019	0.028	0.498	-0.036 0.074	-0.033	0.028	0.241	-0.088 0.022
	Deliberate rumination (min = 0; max = 17)	0.121	0.050	0.016	0.022 0.220	0.060	0.051	0.245	-0.041 0.161
Coping strategy (Brief COPE)	Problem focused (min = 6; max = 20)	0.047	0.044	0.285	-0.039 0.133	-0.068	0.047	0.150	-0.160 0.024
	Emotion focused (min = 11; max = 28)	-0.079	0.045	0.082	-0.168 0.010	0.070	0.037	0.060	-0.003 0.143
	Dysfunctional (min = 12; max = 32)	-0.001	0.026	0.983	-0.052 0.051	0.070	0.018	<0.001	0.034 0.105
Social support (FSSQ)	(min = 32; max = 70)	-0.012	0.012	0.347	-0.036 0.013	-0.012	0.009	0.221	-0.030 0.007
Attachment (ECR-SF)	Anxiety (min = 9; max = 40)	0.036	0.017	0.038	0.002 0.069	0.003	0.015	0.840	-0.027 0.033
	Avoidance (min = 7; max = 29)	-0.057	0.033	0.086	-0.121 0.008	0.009	0.029	0.755	-0.048 0.067
Meaning in life (MLQ)	Presence (min = 11; max = 33)	-0.053	0.047	0.259	-0.146 0.039	-0.008	0.033	0.822	-0.073 0.058
	Search (min = 8; max = 31)	-0.061	0.038	0.109	-0.136 0.014	-0.049	0.027	0.068	-0.102 0.004
Adverse childhood experiences (ACE-Q)	(min = 0; max = 4)	-0.209	0.174	0.231	-0.551 0.133	0.044	0.117	0.705	-0.185 0.273

Complicated grief (ICG)	(min = 0; max = 35)	N/A					0.022	0.012	0.058	-0.001	0.044
Insomnia (ISI)	(min = 0; max = 16)	0.039	0.032	0.214	-0.023	0.102	0.050	0.031	0.107	-0.011	0.111

K-ERRI = Korean Event-Related Rumination Inventory, Brief COPE = Brief Coping Orientation to Problems Experienced, FSSQ = Functional Social Support Questionnaire, ECR-SF = Experiences in Close Relationship Scale-Short Form, MLQ = Meaning in Life Questionnaire, ACE-Q = Adverse Childhood Experiences Questionnaire, ICG = Inventory of Complicated Grief, ISI = Insomnia Severity Index, N/A = not applicable, CI = confidence interval

**Table 3: The longitudinal psychological and demographic predictors associated with insomnia**

Variable	Sub-category	Baseline (27 months after the disaster; T1)					Two years later (51 months after the disaster; T2)				
		Coefficient	Robust SE	p-value	95% CI		Coefficient	Robust SE	p-value	95% CI	
Sex	Male	0	(reference)				0	(reference)			
	Female	-0.001	0.241	0.997	-0.473	0.471	0.197	0.183	0.282	-0.161	0.555
Event-related rumination (K-ERRI)	Intrusive rumination (min = 0; max = 21)	0.043	0.025	0.093	-0.007	0.093	-0.114	0.027	<0.001	-0.166	-0.061
	Deliberate rumination (min = 0; max = 17)	-0.022	0.033	0.512	-0.086	0.043	0.040	0.039	0.295	-0.035	0.116
Coping strategy (Brief COPE)	Problem focused (min = 6; max = 20)	0.072	0.040	0.071	-0.006	0.150	-0.011	0.035	0.758	-0.080	0.058
	Emotion focused (min = 11; max = 28)	-0.042	0.031	0.174	-0.103	0.019	0.044	0.027	0.104	-0.009	0.097
	Dysfunctional (min = 12; max = 32)	0.026	0.021	0.212	-0.015	0.067	0.041	0.016	0.012	0.009	0.073
Social support (FSSQ)	(min = 32; max = 70)	-0.002	0.007	0.708	-0.015	0.010	-0.031	0.009	<0.001	-0.049	-0.014
Attachment (ECR-SF)	Anxiety (min = 9; max = 40)	0.005	0.018	0.777	-0.031	0.041	0.012	0.015	0.406	-0.017	0.042

	Avoidance (min = 7; max = 29)	0.007	0.022	0.743	-0.036	0.050	-0.029	0.024	0.240	-0.077	0.019
Meaning in life (MLQ)	Presence (min = 11; max = 33)	-0.008	0.020	0.695	-0.048	0.032	0.052	0.028	0.063	-0.003	0.107
	Search (min = 8; max = 31)	0.001	0.021	0.955	-0.040	0.042	-0.082	0.018	<0.001	-0.117	-0.047
Adverse childhood experiences (ACE-Q)	(min = 0; max = 4)	-0.135	0.110	0.221	-0.351	0.081	0.280	0.104	0.007	0.076	0.485
Complicated grief (ICG)	(min = 0; max = 35)	-0.001	0.010	0.925	-0.022	0.020	0.002	0.008	0.769	-0.014	0.019
Insomnia (ISI)	(min = 0; max = 16)	N/A					0.166	0.028	<0.001	0.111	0.220

K-ERRI = Korean Event-Related Rumination Inventory, Brief COPE = Brief Coping Orientation to Problems Experienced, FSSQ = Functional Social Support Questionnaire, ECR-SF= Experiences in Close Relationship Scale-Short Form, MLQ = Meaning in Life Questionnaire, ACE-Q = Adverse Childhood Experiences Questionnaire, ICG = Inventory of Complicated Grief, ISI = Insomnia Severity Index, N/A = not applicable, CI = confidence interval

## Discussion

The primary finding of the current study is that the coping strategy, especially dysfunctional coping of student survivors at 27 months after the Sewol ferry disaster, was a significant predictor for both CG and insomnia at 51 months after the disaster. Moreover, variables, that predicted insomnia at 51 months after the disaster, were dysfunctional coping, low search for the meaning of life, low social support, low intrusive rumination, and high ACEs. These findings are similar to those of other studies conducted in a disaster-affected population, showing that a coping strategy can influence mental health outcomes (4,5,25-27). It has also been shown that maladaptive coping strategies can be a factor to further increase the survivor's vulnerability to developing the symptoms of PTSD (25). Survivors who did not have PTSD scored higher for active coping and self-distraction coping, while those with PTSD mostly used passive coping, religious coping, and substance use coping (26). Among medical rescue workers exposed to traumatic events, active coping was positively correlated with post-traumatic growth (27). The study of student survivors at 20 months after the Sewol ferry disaster suggested that PTSD was associated with their CG (4). Coping strategy had a moderating role in the relationship between attachment styles and CG among parents bereaved by the Sewol ferry accident (5). High problem-focused coping was related with CG in the bereaved parents with avoidant attachment after the disaster. Thus, effective screening and an awareness program regarding the promotion of positive coping strategies among vulnerable groups should be implemented and examined the effectiveness.

Findings obtained from the current study revealed that the search for meaning in life was negatively associated with insomnia. The search for meaning in life might have a positive function as a cognitive schema that enables late adolescents to identify and interpret information relevant to meaning-in-life judgments and to integrate their life experiences. These results are consistent with previous findings which show that the search for meaning has positive associations with well-being among late adolescents who already have substantial meaning in their lives (28).

Another important finding of the present study was that social support was negatively associated with insomnia. This result is in agreement with a study of the Great East Japan Earthquake and tsunami, which observed that a lack of social support has a stronger association with sleep difficulties than non-modifiable or hardly modifiable consequences caused directly by the disaster (8). Investigators of those studies suggested that a positive effect of social support on sleep could override the negative association between sleep difficulties and direct consequences of the disaster.

We found that ACE was positively associated with insomnia among disaster survivors. A systematic review found that ACE is associated with multiple sleep disorders and sleep disturbances in adulthood

(12). Several investigators have suggested that exposure to stress or trauma in childhood can cause general circadian dysregulation, thereby disrupting sleep regulation (13). In addition to ACEs' acute effects such as injury and physical trauma, they are associated with an increased risk of several negative health outcomes throughout the life course.

The finding that high intrusive rumination was associated with a low level of insomnia at 51 months after the disaster was somehow unexpected, because previous studies reported that people at high levels of rumination had stronger relationships between stress and pre-sleep arousal (29). There could be two explanations for this result. One is that other unknown confounding factors might lead to insomnia for student survivors after entering university. The other possibility is that survivors with high intrusive rumination might have already been medicated with sleeping aid pills from a drug store or psychiatry clinic. This relation should be enlightened by performing further follow-up studies on insomnia among student survivors.

Lastly, four years after the Sewol ferry disaster, 22.6% of surviving students were suffering from CG and 9.7% of them reported insomnia that needed clinical attention. One study monitored Sewol ferry high school survivors for 27 months to examine the course of their psychological symptoms and found that symptoms of CG were exacerbated at the first anniversary of the disaster (2). These symptoms seemed to subside after students graduated from high school. However, considering that the previous study revealed that 24.5% of surviving students were suffering from CG at 20 months after the Sewol ferry disaster, the rate of CG at 51 months after the disaster, 22.6%, is comparable to that (4). Therefore, further long-term follow-up studies on mental health status of student survivors are necessary. We should also pay attention to their general health conditions because both CG and insomnia can increase physical health risks and mental health problems (3,6).

## Limitations of this study

This study has several limitations. First, the lack of information on psychological variables prior to the disaster prevented controlling for pre-disaster mental health problems in our analyses. Furthermore, data in this study were gathered after survivors' graduation from high school, at least two years after the disaster. However, there were real barriers in accessing student survivors before graduating from their high school. They were taken care of by a school doctor, a psychiatrist working in a mental health center that was built immediately after the disaster. Second, survey participants who completed questionnaires at both time points were about 50% of all student survivors of the Sewol ferry disaster. The prevalence of CG and insomnia might have differed between people who responded to our survey and those who did not. Third, we were unable to use objective biological measures to evaluate the severity of mental health problems. Instead, we used self-report questionnaires. However,

the instruments used in this study had already been demonstrated to have reliability and validity.

### Conclusions

Despite these limitations, to the best of our knowledge, this is the first study to investigate the longitudinal role of coping strategy for CG and insomnia in student survivors of the Sewol ferry disaster. This study provides important implications for future studies. Improving coping strategies among victims in disaster-affected populations appears to be an important step in promoting health and recovery. It is necessary to deepen our understanding of ways to reinforce functional coping among survivors.

**Acknowledgments:** This study was supported by a grant from the Korean Mental Health Technology R&D Project, Ministry of Health & Welfare, Republic of Korea (HL19C0007).

### References

1. Lee S, Moh YB, Tabibzadeh M, Meshkati N. Applying the AcciMap methodology to investigate the tragic Sewol ferry accident in South Korea. *Applied Ergonomics*. 2017;59(Pt B):517-25.
2. Kim EJ, Nam HS, Kim HB, Chung U, Lee SH, Chae JH. A retrospective and prospective follow-up study of psychological distress in the Danwon High School survivors of the Sewol ferry disaster. *Psychiatry Investigation*. 2018;15(3):261-5.
3. Shear MK, Simon N, Wall M, Zisook S, Neimeyer R, Duan N, *et al.* Complicated grief and related bereavement issues for DSM- 5. *Depression and Anxiety*. 2011;28(2):103-17.
4. Lee SH, Nam HS, Kim HB, Kim EJ, Noh JW, Chae JH. Factors associated with complicated grief in students who survived the Sewol ferry disaster in South Korea. *Psychiatry Investigation*. 2018;15(3):254-60.
5. Huh HJ, Kim KH, Lee HK, Chae JH. Attachment styles, grief responses, and the moderating role of coping strategies in parents bereaved by the Sewol ferry accident. *European Journal of Psychotraumatology*. 2017;8(sup6):1424446.
6. Buxton OM, Marcelli E. Short and long sleep are positively associated with obesity, diabetes, hypertension, and cardiovascular disease among adults in the United States. *Social Science & Medicine*. 2010;71(5):1027-36.
7. Mohsenin S, Mohsenin V. Diagnosis and management of sleep disorders in posttraumatic stress disorder: A review of the literature. *The Primary Care Companion for CND Disorders*. 2014;16(6):10.4088/PCC.14r01663.
8. Matsumoto S, Yamaoka K, Inoue M, Inoue M, Muto S, Ishinomaki T. Implications for social support on prolonged sleep difficulties among a disaster-affected population: Second report from a cross-sectional survey in Ishinomaki, Japan. *PLoS One*. 2015;10(6):e0130615.
9. Ikeda A, Charvat H, Shigemura J, Kales SN, Tanigawa T. Longitudinal trends in disaster-related insomnia among Fukushima nuclear plant workers: The Fukushima Nuclear Energy Workers' Support Project study. *Sleep*. 2019;42(5):zsz043.
10. Blackburn L, Owens GP. The effect of self efficacy and meaning in life on posttraumatic stress disorder and depression severity among veterans. *Journal of Clinical Psychology*. 2015;71(3):219-28.
11. Marco JH, Perez S, Alandete JG, Moliner R. Meaning in life in people with borderline personality disorder. *Clinical Psychology & Psychotherapy*. 2015;24(1):162-70.
12. Kajeepeta S, Gelaye B, Jackson CL, Williams MA. Adverse childhood experiences are associated with adult sleep disorders: A systematic review. *Sleep Medicine*. 2015;16(3):320-30.
13. Greenfield EA, Lee C, Friedman EL, Springer KW. Childhood abuse as a risk factor for sleep problems in adulthood: Evidence from a US national study. *Annals of Behavioral Medicine*. 2011;42(2):245-56.
14. Cann A, Calhoun LG, Tedeschi RG, Kilmer RP, Gilrivas V, Vishnevsky T, *et al.* The core beliefs inventory: A brief measure of disruption in the assumptive world. *Anxiety, Stress & Coping*. 2010;23(1):19-34.
15. Prigerson HG, Maciejewski PK, Reynolds CF, Bierhals AJ, Newsom JT, Fasiczka A, *et al.* Inventory of Complicated Grief: A scale to measure maladaptive symptoms of loss. *Psychiatry Research*. 1995;9(1-2):65-79.
16. Bastien CH, Valleres A, Morin CM. Validation of the Insomnia Severity Index as an outcome measure for insomnia research. *Sleep Medicine*. 2001;2(4):297-307.
17. Cann A, Calhoun LG, Tedeschi RG, Triplett KN, Vishnevsky T, Lindstrom CM. Assessing posttraumatic cognitive processes: The Event Related Rumination Inventory. *Anxiety, Stress, and Coping*. 2011;24(2):137-56.
18. Carver CS. You want to measure coping but your protocol's too long: Consider the brief COPE. *International Journal of Behavioral Medicine*. 1997;4(1):92-100.
19. Schnider KR, Elhai JD, Gray MJ. Coping style use predicts posttraumatic stress and complicated grief symptom severity among college students reporting a traumatic loss. *Journal of Counseling Psychology*. 2007;54(3):344-50.
20. Suh SY, Im YS, Lee SH, Park MS, Yoo T. A study for the development of Korean version of the Duke-UNC Functional Social Support Questionnaire. *Journal of the Korean Academy of Family Medicine*. 1997;18(3):250-60.
21. Broadhead WE, Gehlbach SH, Gruy FD, Kaplan BH. The Duke-UNC Functional Social Support Questionnaire: Measurement of social support in family medicine patients. *Medical Care*. 1988;26(7):709-23.
22. Wei M, Russell DW, Mallinckrodt B, Vogel DL. The experiences in close relationship scale (ECR)-short form: Reliability, validity, and factor structure. *Journal of Personality Assessment*. 2007;88(2):187-204.

23. Steger MF, Frazier P, Oishi S, Kaler M. The meaning in life questionnaire: Assessing the presence of and search for meaning in life. *Journal of Counseling Psychology*. 2006;53(1):80-93.
24. Centers for Disease Control and Prevention (CDCP). About adverse childhood experiences (ACEs). 2019. [www.cdc.gov/violenceprevention/childabuseandneglect/acestudy/index.html](http://www.cdc.gov/violenceprevention/childabuseandneglect/acestudy/index.html).
25. Ehrenreich JH. Coping with disasters. A guide book to psychosocial intervention. Revised edition); 2001: 8. [https://pdfs.semanticscholar.org/558f/361a117703fb99006a1857e66673a88de68a.pdf?\\_ga=2.85878041.1402913520.1587203220-580399535.1586660067](https://pdfs.semanticscholar.org/558f/361a117703fb99006a1857e66673a88de68a.pdf?_ga=2.85878041.1402913520.1587203220-580399535.1586660067).
26. Baral IA, Bhagawati KC. Post traumatic stress disorder and coping strategies among adult survivors of earthquake, Nepal. *BMC Psychiatry*. 2019;19:118.
27. Ogińska-Bulik N, Zadworna-Cieślak M. The role of resiliency and coping strategies in occurrence of positive changes in medical rescue workers. *International Emergency Nursing*. 2018;39:40-5.
28. Li JB, Salcuni S, Delvecchio E. Meaning in life, self-control and psychological distress among adolescents: A cross-national study. *Psychiatry Research*. 2019;272:122-9.
29. Tousignant OH, Taylor ND, Suvak MK, Fireman GD. Effects of rumination and worry on sleep. *Behavior Therapy*. 2019;50(3):558-70.