



# Factors Influencing Post-Traumatic Growth in Surviving Students of the Sewol Ferry Disaster: A Long-Term Follow-Up Study

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**Objective** Disaster survivors often experience negative impacts on their mental health, but some may also exhibit posttraumatic growth, overcoming adversity, and finding positive outcomes. This study aimed to identify psychological factors influencing posttraumatic growth (PTG) among students who survived the Sewol ferry disaster.

**Methods** The study used a longitudinal design. Data were collected at 6-month intervals between high school graduation and 6 years after the ferry disaster. Data were obtained from 48 adolescents who completed self-report measures of rumination, meaning in life, coping, PTG, family adaptability and cohesion. Generalized estimating equation models were fitted to 11 waves of follow-up data.

**Results** Intrusive rumination (coefficient [coef]=0.165;  $p<0.001$ ; 95% confidence interval [CI] 0.081–0.250) and deliberate rumination (coef=0.554;  $p<0.001$ ; 95% CI 0.376–0.732) were significantly associated with PTG. Concerning meaning in life, the presence of meaning (coef=0.312;  $p<0.001$ ; 95% CI 0.189–0.435) and the search for meaning (coef=0.216;  $p=0.001$ ; 95% CI 0.093–0.340) were also significantly associated with PTG. Finally, the problem-focused (coef=0.682;  $p=0.011$ ; 95% CI 0.153–1.210) and emotion-focused (coef=0.736;  $p=0.009$ ; 95% CI 0.186–1.285) coping strategies both showed significant associations with PTG.

**Conclusion** The results of this study indicate that rumination, meaning in life, and adaptive coping (including cognitive and emotional coping) were protective factors for mental health problems among adolescents who survived the Sewol ferry disaster. These psychological factors may promote PTG over time.

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**Keywords** Coping; Meaning in life; Posttraumatic growth; Rumination; Sewol ferry disaster.

## INTRODUCTION

The Sewol ferry disaster of 2014 was a tragic incident in which a South Korean passenger ship capsized and sank, with only about one-third of those onboard surviving. The event led to an outpouring of sadness and anger across South Ko-

rea. The primary causes of the disaster are believed to have been overloading and modifications made to the ferry that led to a loss of stability during a sudden turn. Furthermore, the initial response and rescue efforts appeared inadequate; survivors were inside the submerged vessel for a considerable period, pointing to a failure of crisis management. Of the passengers, the majority of whom were high school students on a field trip, only 75 survived. The school's vice principal subsequently committed suicide, followed by a number of parents of the 250 deceased students (Ansan mental health trauma center).<sup>1</sup>

Adolescents who have lived through a disaster may experience symptoms of depression, anxiety, and posttraumatic stress.<sup>2</sup> These symptoms may become chronic, such that disasters can have enduring consequences for survivors' well-being. Factors associated with the posttraumatic stress symptoms of the student survivors of the Sewol ferry disaster included the number of previous traumatic events experi-

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enced, the levels of peer and social support, peritraumatic dissociation, negative beliefs, and emotional difficulties.<sup>3</sup> A cross-sectional study of the surviving students conducted 28 months after the disaster demonstrated that posttraumatic embitterment was associated with the degree of meaning in life, and this relationship was mediated by social support.<sup>4</sup>

After a disaster, some individuals exhibit posttraumatic growth (PTG), leading to positive changes in various areas of their lives.<sup>5</sup> Research on PTG among adolescent survivors of natural disasters suggests that the subjective experience of the disaster, posttraumatic stress symptoms following its occurrence, and coping mechanisms employed influence the likelihood of PTG.<sup>6</sup> Another study tracked adolescents for up to 18 months after an earthquake, analyzing how cognitive processes such as rumination impacted PTG and posttraumatic stress disorder. There has also been research on the impact of family functioning on PTG in adolescents, particularly focusing on teenagers infected with coronavirus disease-2019. The study in question used latent profile analysis to evaluate the influence of family functioning on discrete categories of trauma response (“growth”, “struggling”, and “pain”).<sup>7</sup> Adolescence is a particularly unique stage of development, characterized not only by biological maturation but also by challenges and tasks such as the development of personal identity, the formation of intimate relationships, and the establishment of independence and autonomy. Therefore, experiencing serious negative events like trauma during this period can lead to significant changes throughout a person’s life. Therefore, research on the factors influencing posttraumatic growth in the surviving students of the Sewol ferry disaster is significant.<sup>8</sup> Nevertheless, research on factors related to PTG among adolescent survivors of disasters is relatively scarce.

Therefore, in this long-term follow-up study, we aimed to identify factors influencing PTG among adolescent survivors of the Sewol ferry disaster. We hypothesized that coping strategies, rumination, meaning in life, and family functioning could be factors influencing posttraumatic growth in the surviving students of the Sewol Ferry disaster. The results could inform intervention programs and strategies for young disaster survivors dealing with trauma.

## METHODS

### Study sample and design

In February 2016, upon graduating from high school, students who survived the Sewol ferry incident were enrolled in a study tracking individuals affected by disasters. The study involved follow-up assessments of mental health conducted once or twice per year. A psychiatrist who served as the school doctor at the survivors’ high school contacted potential par-

ticipants, explained the purpose of the study to them, and supervised the consent process. The high school established a mental health center within school grounds after the incident and provided psychological counseling for the surviving students until they graduated.

The survey used instruments designed specifically for adolescents at the time of the participants’ graduation from high school, with an adult mental health scale used frequently in cohort studies of disaster survivors employed thereafter. We analyzed data collected from surviving students between early 2016 and 2021. A scale assessing family functioning, which was included only in the adolescent test battery, was administered at the time of study registration. Due to concerns about study dropouts, some questionnaires administered during the initial survey were omitted from the follow-up investigations, including the scale evaluating coping strategies. A total of 70 student survivors were registered during the study period, although we only analyzed the data of the 48 survivors who completed the adolescent mental health questionnaire.

### Outcome measures

The Post-Traumatic Growth Inventory-Short Form (PTGI-SF) is an abbreviated 10-item version of the original 21-item PTGI, which is used to measure positive psychological changes following a negative life event.<sup>9</sup> The PTGI-SF uses a 6-point Likert scale ranging from 0 (I did not experience this change as a result of my crisis) to 5 (I experienced this change to a very great degree as a result of my crisis). Total scores range from 0 to 50, with higher scores indicating a greater degree of positive change. A validation study of the Korean translation of the PTGI-SF confirmed that it has good psychometric properties.<sup>10</sup> The Cronbach’s alpha coefficient (coef) was 0.883 at baseline in the present study.

### Independent variables

To assess coping strategies, we used the abbreviated version of the Coping Orientation to Problems Experienced Inventory (Brief COPE) instrument developed by Carver.<sup>11</sup> The Brief COPE was designed to evaluate coping in response to stress and challenging situations. It consists of 28 items that assess a range of coping strategies commonly employed in response to stressors, namely problem-focused coping (active coping, planning, and instrumental support), emotion-focused coping (positive reframing, humor, religion, acceptance, and emotional support), and dysfunctional coping (self-blame, behavioral disengagement, substance abuse, self-distraction, denial, and venting). Each item is evaluated on a 4-point Likert scale, and higher scores reflect greater use of coping strategies. The Korean version of the Brief COPE has good psychometric properties (Cronbach’s  $\alpha > 0.70$ ).<sup>12</sup> The Cronbach’s

alpha coef was 0.890 at baseline in the present study.

To measure event-related rumination, the Korean version of the Event Related Rumination Inventory (K-ERRI) was employed. This scale comprises 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”) rumination subscales, both of which include 10 items. The items are rated on a 4-point Likert scale ranging from 0 (not at all) to 3 (often). Therefore, total scores range from 0 to 60, and higher scores indicate more severe rumination.<sup>13</sup> The K-ERRI has good psychometric properties (Cronbach’s  $\alpha=0.95$ ).<sup>14</sup> The Cronbach’s alpha coef was 0.904 at baseline in the present study.

To assess family cohesion and adaptability, the Family Adaptability and Cohesion Evaluation Scales III (FACES III) was employed. This scale is suitable for individuals aged >12 years.<sup>15</sup> Respondents rate the veracity of 20 statements (e.g., “It is hard to identify the leaders in our family; family members ask each other for help”) using a 5-point Likert scale ranging from 1 (almost never) to 5 (almost always). Total scores range from 20 to 100, and higher scores indicate greater family cohesion and adaptability. The Korean version of the FACES III has acceptable psychometric properties (Cronbach’s  $\alpha=0.77-0.81$ , varying according to the number of family members).<sup>16</sup> The Cronbach’s alpha coef was 0.968 at baseline in the present study.

To evaluate the degree to which the participants were actively searching for meaning in their lives, the Meaning in Life Questionnaire (MLQ)<sup>17</sup> was used. The MLQ comprises Presence of Meaning and Search for Meaning subscales. The Presence of Meaning subscale assesses how meaningful respondents perceive their lives to be (e.g., “I understand my life’s meaning”), and the Search for Meaning subscale assesses how actively they seek meaning or purpose in their life (e.g., “I am looking for something that makes my life feel meaningful”). A total of 10 items are scored on a 7-point Likert scale ranging from 1 (absolutely untrue) to 7 (absolutely true). Total scores range from 10 to 70, and higher scores indicate greater meaning, or a more extensive search therefore, in one’s life. The Korean version of the MLQ has good psychometric properties (Cronbach’s  $\alpha=0.89$ ).<sup>17</sup> The Cronbach’s alpha coef was 0.902 at baseline in the present study.

#### Covariates

The covariates in our analyses included birth year (1997 or 1998), sex (male or female), type of health insurance (national health insurance or “other” [medical aid or chose not to respond]), and coresiding with parents (yes or no). The South Korean medical aid program is analogous to Medicaid in the United States and can serve as a proxy measure for poverty.<sup>18</sup>

#### Analytical approach and statistics

Descriptive statistics were generated for baseline sociodemographic characteristics and psychometric scale scores. The results are presented as the median and interquartile range (IQR) for numerical data and as the frequency and percentage for categorical data. To analyze the relationships between PTGI-SF and sociodemographic characteristics, a two-sample Wilcoxon rank-sum test was performed. To identify the relationships between PTGI-SF and baseline psychometric scale scores, Spearman’s rank correlation coefs ( $\rho$ ) were calculated. To identify factors associated with PTGI-SF among the students who survived the Sewol ferry disaster, a series of generalized estimating equation (GEE) models were fitted to 11 waves of follow-up data. The Huber–White sandwich estimator was used to calculate the heteroskedasticity-robust standard error. The threshold for statistical significance was set at  $p<0.05$  (two-tailed test).<sup>19</sup> All statistical analyses were carried out using Stata/MP software (ver. 17.0; Stata Corp., College Station, TX, USA).

#### Ethical considerations

The study protocol was reviewed and approved by the Institutional Review Boards of The Catholic University of Korea Seoul St. Mary’s Hospital (approval no. KC15OIMI0261) and the National Medical Center (approval no. H-1505-054-002). Written consent was obtained from all participants, who were informed that they could withdraw from the study at any time.

## RESULTS

#### Baseline participant characteristics

Table 1 shows the baseline PTGI-SF scores of the 48 survivors according to their sociodemographic characteristics. The median PTGI-SF scores were higher in younger individuals (23.0; IQR: 26.0), males (18.5; IQR: 17.5), those covered by national health insurance (24.5; IQR: 7.0), and those not residing with their parents (25.0; IQR: 3.0).

#### Relationships between baseline psychometric scale scores and PTG

Table 2 summarizes the relationships between PTG and psychometric scale scores at baseline, measured approximately 18 months after the disaster. The median PTGI-SF score at baseline was 17.0 (IQR: 19.0). Rumination (K-ERRI deliberate rumination subscale and total scores), meaning in life (MLQ total score), and coping strategy (Brief COPE problem-focused subscale, emotion-focused subscale, and total scores) were significantly associated with baseline PTGI-SF ( $p<0.05$ ).

**Factors associated with PTG**

Table 3 summarizes the results of the GEE models used to identify factors associated with PTGI-SF among student survivors of the Sewol ferry disaster. The models estimate time-varying psychometric scale scores over 11 follow-up waves, except for Brief-COPE and FACES-III, which are time-fixed

at baseline. The intrusive rumination K-ERRI subscale score (coef=0.165; p<0.001; 95% confidence interval [CI] 0.081–0.250), deliberate rumination K-ERRI subscale score (coef=0.554; p<0.001; 95% CI 0.376–0.732), and total K-ERRI score (coef=0.214; p<0.001; 95% CI 0.142–0.287) were significantly associated with PTG. The presence of meaning MLQ subscale

**Table 1.** Posttraumatic growth by sociodemographic characteristics among surviving students of the Sewol ferry disaster

| Variable                 | N (%)     | Posttraumatic growth (total score of PTGI-SF) |      |     |     |        |       |
|--------------------------|-----------|---|------|-----|-----|--------|-------|
|                          |           | Median  | IQR  | Min | Max | z      | p     |
| Birth year               |           |   |      |     |     |        |       |
| 1997                     | 41 (85.4) | 16.0  | 17.0 | 0   | 37  | -0.863 | 0.400 |
| 1998                     | 7 (14.6)  | 23.0  | 26.0 | 5   | 36  |        |       |
| Sex                      |           |   |      |     |     |        |       |
| Male                     | 24 (50.0) | 18.5  | 17.5 | 0   | 36  | 0.000  | 0.999 |
| Female                   | 24 (50.0) | 15.5  | 20.0 | 0   | 37  |        |       |
| Type of health insurance |           |   |      |     |     |        |       |
| NHI                      | 10 (20.8) | 24.5  | 7.0  | 6   | 32  | 2.428  | 0.014 |
| Others                   | 38 (79.2) | 13.0  | 17.0 | 0   | 37  |        |       |
| Coresidence with parents |           |   |      |     |     |        |       |
| Yes                      | 43 (89.6) | 16.0  | 17.0 | 0   | 37  | -1.386 | 0.174 |
| No                       | 5 (10.4)  | 25.0  | 3.0  | 6   | 31  |        |       |

PTGI-SF, Post-Traumatic Growth Inventory-Short Form; IQR, interquartile range; NHI, national health insurance

**Table 2.** Psychometric assessment scale scores at baseline and their relationship with posttraumatic growth

| Variable                                     | Median | IQR  | Min | Max | Spearman's rho | p      |
|--|--------|------|-----|-----|----------------|--------|
| Rumination (K-ERRI)                          |        |      |     |     |                |        |
| Intrusive rumination                         | 2.5    | 5.5  | 0   | 21  | 0.199          | 0.174  |
| Deliberate rumination                        | 5.0    | 7.5  | 0   | 17  | 0.516          | <0.001 |
| Total score                                  | 8.5    | 12.0 | 0   | 34  | 0.544          | <0.001 |
| Meaning in life (MLQ)                        |        |      |     |     |                |        |
| Presence of meaning                          | 22.0   | 7.0  | 11  | 35  | 0.203          | 0.166  |
| Search of meaning                            | 24.0   | 7.0  | 8   | 31  | 0.246          | 0.092  |
| Total score                                  | 45.0   | 12.0 | 19  | 65  | 0.290          | 0.046  |
| Coping strategy (Brief-COPE)                 |        |      |     |     |                |        |
| Problem focused                              | 12.5   | 7.0  | 6   | 20  | 0.362          | 0.014  |
| Emotion focused                              | 19.0   | 10.0 | 10  | 28  | 0.383          | 0.009  |
| Dysfunctional                                | 17.0   | 10.0 | 12  | 33  | 0.014          | 0.926  |
| Total score                                  | 52.0   | 19.0 | 31  | 73  | 0.336          | 0.023  |
| Family adaptability and cohesion (FACES-III) |        |      |     |     |                |        |
| Adaptation                                   | 32.0   | 10.5 | 10  | 50  | 0.219          | 0.136  |
| Cohesion                                     | 33.0   | 10.0 | 10  | 50  | 0.210          | 0.153  |
| Total score                                  | 66.5   | 19.0 | 20  | 100 | 0.209          | 0.154  |
| Posttraumatic growth (PTGI-SF)               |        |      |     |     |                |        |
| Total score                                  | 17.0   | 19.0 | 0   | 37  | N/A            | N/A    |

IQR, interquartile range; K-ERRI, Korean version of the Event-Related Rumination Inventory; MLQ, Meaning in Life Questionnaire; Brief-COPE, abbreviated version of the Coping Orientation to Problems Experienced Inventory; FACES-III, Family Adaptability and Cohesion Evaluation Scales III; PTGI-SF, Post-Traumatic Growth Inventory-Short Form; N/A, not applicable

**Table 3.** Factors associated with posttraumatic growth among surviving students of the Sewol ferry disaster

| Variable  | Coef  | Robust SE | p      | LL     | UL    |
|---|-------|-----------|--------|--------|-------|
| Rumination (K-ERRI)                                     |       |           |        |        |       |
| Intrusive rumination (min=0; max=21)                    | 0.165 | 0.043     | <0.001 | 0.081  | 0.250 |
| Deliberate rumination (min=0; max=17)                   | 0.554 | 0.091     | <0.001 | 0.376  | 0.732 |
| Total score (min=0; max=34)                             | 0.214 | 0.037     | <0.001 | 0.142  | 0.287 |
| Meaning in life (MLQ)                                   |       |           |        |        |       |
| Presence of meaning (min=11; max=35)                    | 0.312 | 0.063     | <0.001 | 0.189  | 0.435 |
| Search of meaning (min=8; max=31)                       | 0.216 | 0.063     | 0.001  | 0.093  | 0.340 |
| Total score (min=19; max=65)                            | 0.174 | 0.031     | <0.001 | 0.113  | 0.234 |
| Coping strategy (Brief-COPE) (baseline)                 |       |           |        |        |       |
| Problem focused (min=6; max=20)                         | 0.682 | 0.270     | 0.011  | 0.153  | 1.210 |
| Emotion focused (min=10; max=28)                        | 0.736 | 0.280     | 0.009  | 0.186  | 1.285 |
| Dysfunctional (min=12; max=33)                          | 0.078 | 0.205     | 0.705  | -0.325 | 0.480 |
| Total score (min=31; max=73)                            | 0.246 | 0.105     | 0.019  | 0.040  | 0.451 |
| Family adaptability and cohesion (FACES-III) (baseline) |       |           |        |        |       |
| Adaptation (min=10; max=50)                             | 0.151 | 0.120     | 0.208  | -0.084 | 0.385 |
| Cohesion (min=10; max=50)                               | 0.099 | 0.141     | 0.482  | -0.177 | 0.374 |
| Total score (min=20; max=100)                           | 0.067 | 0.068     | 0.321  | -0.065 | 0.200 |

Models were adjusted for birth year, sex, type of health insurance, and whether coresidence with parents. Coef, coefficient; SE, standard error; LL, lower limit of 95% CI; UL, upper limit of 95% CI, CI, confidence interval; K-ERRI, Korean version of the Event-Related Rumination Inventory; MLQ, Meaning in Life Questionnaire; Brief-COPE, abbreviated version of the Coping Orientation to Problems Experienced Inventory; FACES-III, Family Adaptability and Cohesion Evaluation Scales III

score (coef=0.312;  $p<0.001$ ; 95% CI 0.189–0.435), search for meaning MLQ subscale score (coef=0.216;  $p=0.001$ ; 95% CI 0.093–0.340), and total MLQ score (coef=0.174;  $p<0.001$ ; 95% CI 0.113–0.234) were also significantly associated with PTGI-SF. Finally, the problem-focused Brief COPE subscale score (coef=0.682;  $p=0.011$ ; 95% CI 0.153–1.210), emotion-focused Brief COPE subscale score (coef=0.736;  $p=0.009$ ; 95% CI 0.186–1.285), and total Brief COPE score (coef=0.246;  $p=0.019$ ; 95% CI 0.040–0.451) showed significant associations with PTGI-SF.

## DISCUSSION

Our analysis showed that factors influencing PTG among student survivors of the Sewol ferry disaster over a 6-year period included rumination, meaning in life, and coping mechanisms.

Problem- and emotion-focused coping were associated with PTG, whereas dysfunctional coping styles, including self-blame, behavioral disengagement, substance abuse, self-distraction, denial, and venting were not. These results align with findings from studies on positive changes arising in response to disasters.<sup>20</sup> Specifically, adaptive coping was found to be crucial in reducing stress, and higher resilience and positive coping promoted PTG. In contrast, avoidance coping in-

creased stress. Approach-focused coping, exemplified by proactive behaviors, seeking social support, and facing the reality of the situation, are associated with greater resilience. Similarly, active strategies such as problem-focused and active-relational coping are associated with greater PTG.<sup>21</sup>

We also found that both intrusive and deliberate rumination were associated with PTG among the adolescent survivors of the Sewol ferry disaster. Intrusive rumination refers to a type of posttraumatic symptom where distressing thoughts arise involuntarily after a trauma, while deliberate rumination involves a conscious effort to reflect on the experience.<sup>13</sup> Research on the relationship between rumination and posttraumatic growth has shown inconsistent results. Studies on children and adolescents who experienced natural disasters generally reported that only deliberate rumination predicted posttraumatic growth.<sup>22,23</sup> However, a two-year follow-up study found that only initial intrusive rumination predicted posttraumatic growth in the same sample.<sup>24</sup> Another study examined the influence of rumination over time following a trauma and found that intrusive rumination was the best predictor of posttraumatic growth immediately after the trauma, while deliberate rumination became the strongest predictor as more time passed.<sup>25</sup> Our study analyzed all the follow-up data without considering the time variable, which may explain why both intrusive and deliberate rumination were found

to be associated with posttraumatic growth.

Moreover, we observed that both the presence of and search for meaning in life were associated with PTG. In line with research on tornado survivors, meaning in life was positively associated with both resilience and PTG.<sup>26</sup> Similarly, a systematic review and meta-analysis demonstrated a clear correlation between meaning in life and PTG in cancer patients.<sup>27</sup>

Finally, family adaptability and cohesion did not contribute to the PTG of the student survivors in our study. Previous research revealed that environmental, familial, and social factors play roles in PTG in children and adolescents.<sup>6</sup> In this study, family functioning was assessed only at the time of study registration. Therefore, caution is needed when interpreting this result, which could have been influenced by both the specific characteristics of the disaster survivors and the research methodology. According to a study tracking adolescents for up to 30 months after the Wenchuan earthquake, social support initially facilitated PTG but was later found to have no effect and ultimately became a hindrance to further growth.<sup>28</sup>

The limitations of this study were as follows. First, we analyzed the data of only a subset of 48 participants, i.e., those who completed the adolescent mental health questionnaire, from among the 70 who initially registered for the study. Therefore, the findings cannot be generalized to all adolescent disaster survivors. Second, we used self-report questionnaires, such that the results reflect the survivors' subjective perceptions. Third, the study commenced approximately 1 year and 8 months after the ferry disaster, i.e., at the time when the surviving students were graduating from high school. Therefore, data were not obtained immediately or 1 year after the incident. Notably, the South Korean government established a research fund for the first-ever longitudinal study on the experiences of disaster survivors following the Sewol ferry disaster. Fourth, this study cannot be considered as an entirely non-interventional observational study because of the ongoing involvement of a psychiatrist, who provided periodic support to the surviving students and collected data during discussions held once or twice a year even after their graduation.

In conclusion, this study analyzed data collected over a 6-year period from students who survived the Sewol ferry disaster, in which two-thirds of the passengers lost their lives. We found that factors associated with PTG included rumination, meaning in life, and cognitive and emotional coping. These research findings have clinical implications, suggesting that to promote posttraumatic growth in adolescents who have experienced disasters, it is necessary to implement interventions that encourage the use of rumination, efforts to find meaning in life, and the acquisition of adaptive coping skills.

## Availability of Data and Material

The datasets generated or analyzed during the study are not publicly available due to the lack of consent from the subjects, but are available from the corresponding author on reasonable request.

## Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

## Author Contributions

Conceptualization: So Hee Lee, Eun Ji Kim, Jeong-Ho Chae, Myong-Wuk Chon. Data curation: Eun Ji Kim, Jeong-Ho Chae. Formal analysis: Kyoung-Beom Kim, Jin-Won Noh. Funding acquisition: So Hee Lee, Kyoung-Beom Kim, Jin-Won Noh, Jeong-Ho Chae. Investigation: Kyoung-Beom Kim, Jin-Won Noh. Methodology: So Hee Lee, Jin-Won Noh. Project administration: So Hee Lee, Eun Ji Kim, Jeong-Ho Chae. Supervision: Jin-Won Noh, Eun Ji Kim, Jeong-Ho Chae. Visualization: Kyoung-Beom Kim, Jin-Won Noh. Writing—original draft: So Hee Lee, Kyoung-Beom Kim, Jin-Won Noh, Myong-Wuk Chon. Writing—review & editing: Eun Ji Kim, Jeong-Ho Chae.

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