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Openness to discussing mental health is negatively associated with suicidal ideation among South Korean college students

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Abstract

Background College students are particularly vulnerable to mental health challenges, including depression, anxiety, and suicidal ideation. This study aims to (1) examine the prevalence of suicidal ideation and describe perceived barriers to mental health service utilization among South Korean college students, and (2) identify factors associated with suicidal ideation.

Methods A total of 572 undergraduate students completed an online survey assessing depression and generalized anxiety, which were measured using the International Depression Questionnaire (IDQ) and International Anxiety Questionnaire (IAQ). Suicidal ideation was assessed using items determining the lifetime experience and recency of serious thoughts of taking one's own life. Openness to discussing mental health difficulties and perceived barriers to accessing mental health services were also measured. Logistic regression analyses were conducted to identify factors associated with suicidal ideation.

Results Regarding suicidal ideation, 8.4% of students reported experiencing it in the past month, while 15.7% reported experiencing it within the past year. The prevalence of depression was 4.7% and anxiety was 5.4%, with 2.8% of participants meeting criteria for both depression and anxiety. The most commonly cited barriers to mental health service utilization were high costs (69.2%), uncertainty about where to seek help (63.5%), and concerns about disclosure of personal information (57.3%). After controlling for sex, satisfaction with current economic status, and depression and generalized anxiety symptom severity, lower ease of discussing mental health difficulties was significantly associated with suicidal ideation.

Conclusion These findings highlight that openness to discussing mental health plays a protective role in suicidal ideation among South Korean college students.

Clinical trial number Not applicable.

Keywords Anxiety, Depression, Suicidal ideation, Barriers to mental health services, College students

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Background

Suicide is a major public health issue in South Korea. South Korea has the highest suicide rate among OECD member countries at 25.2 per 100,000 of the population, which is more than double the OECD average of 11.1 [1]. According to Korean national mortality statistics, suicide ranks as the leading cause of death among individuals in their twenties and thirties [2].

Suicidal ideation often precedes suicide attempts and death by suicide [3–5], meaning that identifying those experiencing suicidal ideation can help to prevent suicidal behaviour. Prior research has identified multiple contributors to suicidal ideation in young adults, including female sex, younger age, depressive symptoms, anxiety, perceived stress, and socioeconomic status [6–8]. The presence of a psychiatric disorder (e.g., major depression, generalized anxiety, posttraumatic stress disorder, substance use disorder) is also a very powerful predictor of both suicidal ideation and suicidal attempts [9, 10].

Suicidality and its risk factors can be substantially influenced by socioeconomic and cultural contexts [10]. In particular, openness in discussing mental health concerns may buffer the impact of stress by facilitating access to social support and encouraging adaptive coping and help-seeking behaviors [11]. In contrast, reluctance or fear of discussing mental health difficulties may intensify feelings of isolation and exacerbate psychological distress, especially in sociocultural contexts where mental health problems are stigmatized or considered taboo [12]. However, openness to discussing mental health difficulties remained underexamined in terms of its protective role against suicidal ideation, particularly in East Asian cultural contexts where emotional disclosure is constrained by social norms.

Many college students experiencing psychiatric distress encounter barriers to mental health care. Commonly reported obstacles include a preference for self-reliance, perceived stigma relating to mental illness, and low awareness of mental health issues and resources [13]. Practical constraints such as high treatment costs, long wait times, and limited time to attend therapy also reduce students' help-seeking [14]. These challenges are amplified in Korean and other East Asian contexts where mental health stigma is perceived as a threat to individual adaptation and social integration, further discouraging help-seeking behaviors [15, 16]. Cultural emphasis on familial obligations and community harmony may also exacerbate the suppression of individual emotional needs [17, 18], leading to lower engagement with mental health services compared to Western cultures [19]. Together, these barriers contribute to a large treatment gap: only a small fraction of Korean students with significant distress ultimately use professional mental health services [20, 21].

Consequently, this study aims to (1) examine the prevalence of suicidal ideation and describe perceived barriers to mental health service utilization among South Korean college students, and (2) identify factors associated with suicidal ideation. In doing so, this study seeks to provide evidence to guide culturally sensitive approaches to improving mental health among college students.

Methods

Participants and procedures

Participants ($N = 572$) were recruited between May and July 2023 through an anonymous online survey advertised on Everytime (https://everytime.kr/), an online community exclusively for college students accessible via mobile applications and websites. More than 80% of Korean college students use Everytime, making it a widely representative platform for reaching this population. inclusion criteria were that participants were (1) Korean nationals aged 19–39 years, (2) currently enrolled as an undergraduate student, and (3) capable of completing the survey in Korean. Ethical approval for the study was granted by the Institutional Review Board (IRB) at Yonsei University Health System (IRB approval number: 2022-3690-005).

Measures

Depression The International Depression Questionnaire (IDQ) is a 10-item self-report questionnaire that assess all diagnostic requirements of depressive disorder, as outlined in the 11th version of the International Classification of Diseases (ICD-11) [22]. In this study, we used the Korean version of the IDQ translated and adapted according to the WHO guideline. Nine items measure symptom frequency over the past two weeks, rated on a 5-point Likert scale ranging from 0 (Never) to 4 (Every day). One item assesses functional impairment across major life domains (Yes/No). For descriptive analyses, we calculated (1) whether participants met ICD-11 diagnostic criteria for depression, which required five or more symptoms rated as nearly every day or every day (ratings of 3 or 4) including at least one core symptom (item 1 or 2), along with functional impairment, and (2) the total symptom severity score by summing responses across all nine symptom items, with higher scores indicating greater severity. For regression analyses examining contributors to suicidal ideation, a modified depression severity score was used by summing responses from items 1–5 and 7–9, excluding item 6 (suicidal ideation) to avoid conceptual overlap with the outcome variable. Cronbach's α of the IDQ in this study was 0.902.

Generalized anxiety The International Anxiety Questionnaire (IAQ) is a 9-item self-report questionnaire that assesses all diagnostic requirements of generalized

anxiety disorder, as outline in the ICD-11 [22]. In this study, we used the Korean version of the IAQ translated and adapted according to the WHO guideline. Eight items measure symptom frequency over the past several months, rated on a 5-point Likert scale (0 = Never to 4 = Every day). One item assesses functional impairment across major life domains (Yes/No). For descriptive analyses, we calculated (1) whether participants met ICD-11 diagnostic criteria for generalized anxiety, which required four or more symptoms rated as nearly every day or every day (ratings of 3 or 4), including at least one core symptom (item 1 or 2), along with functional impairment, and (2) the total symptom severity score by summing responses across all eight symptom items (items 1–8), with higher scores indicating greater severity. For regression analyses, the generalized anxiety severity score, calculated as the sum of items 1–8, was used as a continuous variable. Cronbach's α of the IAQ in this study was 0.887.

Suicidal ideation To assess suicidal ideation, participants were first asked, *"Have you ever experienced serious thoughts about taking your own life?"* Those who responded "yes" were subsequently asked to indicate when they most recently experienced such thoughts, with timeframes ranging from within 2 weeks to more than 1 year ago. Current suicidal ideation was defined as suicidal ideation occurring within the past month, including responses of "within the past 2 weeks" and "2 weeks to 1 month ago". Suicidal ideation within the past year was defined as suicidal ideation occurring within the past 12 months, excluding responses indicating that suicidal thoughts occurred more than 1 year ago.

Openness to discussing mental health issues The openness of discussing mental health difficulties was measured using a single-item question: *"Do you find it easy to talk about your own mental difficulties when they arise?"* Respondents rated their agreement on a 4-point Likert scale ranging from 1 ("Not at all") to 4 ("Very much so"). Higher scores indicated greater openness and willingness to express mental health challenges.

Perceived barriers to accessing mental health services Perceived barriers to accessing mental health services were assessed using a researcher-developed checklist of 16 binary (yes/no) items, developed mainly based on the Korea Institute for Health and Social Affairs (KIHASA) report on mental health service accessibility [23]. The checklist captured a broad range of perceived barriers to mental health service use across personal, social, and structural domains. Specifically, the items reflected barriers related to accessibility (e.g., high cost, not sure where to look, no time available, long waiting times, inconvenient service hours, and inconvenient facilities or location), worries or fears (e.g., worries about records having a negative impact on life, worries about others' perceptions, worries about family disapproval or discovery, fear of psychological treatment itself, and fear of personal information disclosure), beliefs about mental health (e.g., beliefs that mental health problems should be handled independently, uncertainty regarding the seriousness of one's mental health issues or beliefs that problems would improve naturally over time) and trust issues (e.g., doesn't seem helpful, doubt that service providers will understand my issues).

Socio-demographic characteristics Sociodemographic variables included sex, age, university region, living alone, and satisfaction with current economic status (ranging from 1 to 5, with higher scores indicating greater satisfaction).

Analysis

All statistical analyses were conducted using IBM SPSS Statistics for Windows, Version 28.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to characterize the sociodemographic and psychological characteristics of participants overall and stratified by suicidal ideation status (within the past month and within the past year). Prevalence rates were calculated for both suicidal ideation timeframes for participants meeting ICD-11 diagnostic criteria for depression and generalized anxiety.

Perceived barriers to accessing mental health services were analyzed descriptively. For each of the 16 barrier items, frequencies and percentages were calculated based on binary (yes/no) responses. To examine associations between each perceived barrier and suicidal ideation, univariate logistic regression analyses were conducted for both timeframes, with each barrier item analyzed separately. Odds ratios (ORs) with 95% confidence intervals (CIs) were reported for each barrier.

To identify factors associated with suicidal ideation, separate logistic regression analyses were conducted for two outcomes: past-month and past-year suicidal ideation. For each outcome, univariate logistic regression analyses were first performed to examine the association between each variable and the respective outcome. Subsequently, multivariate binary logistic regression analyses were conducted with variables selected based on univariate associations. Adjusted odds ratios (Adj ORs) with 95% CIs were reported for the multivariate models. Multicollinearity among variables was assessed using variance inflation factors (VIFs), with VIF values greater than 10 indicating potential multicollinearity.

Results

Table 1 shows demographic and psychological characteristics of the sample. Regarding suicidal ideation, 8.4% had experienced suicidal ideation within the past month, and 15.7% had experienced suicidal ideation within the past year. The prevalence of depression was 4.7% and anxiety was 5.4%, with 2.8% of participants meeting criteria for both depression and anxiety. For the overall sample, the mean depression severity score was 7.95 (standard deviation [SD] = 6.59, median = 6, interquartile range [IQR] = 3–11) and the mean anxiety severity score was 7.48 (SD = 6.00, median = 6, IQR = 3–11). Among those with suicidal ideation within the past month (n = 48), the mean depression severity score was 18.23 (SD = 8.38, median = 18, IQR = 12–23) and the mean anxiety severity score was 15.56 (SD = 6.22, median = 16, IQR = 11–19). Among those with suicidal ideation within the past year (n = 90), the mean depression severity score was 15.56 (SD = 8.24, median = 15, IQR = 8–22) and the mean anxiety severity score was 13.82 (SD = 6.42, median = 13.50, IQR = 9–18.25).

Barriers to accessing mental health services

Table 2 presents the perceived barriers to accessing mental health services. The most frequently endorsed barriers in the total sample were high cost (69.2%), not sure where to look (63.5%), and concerns about disclosure of personal information (57.3%). In the univariate logistic regression analyses, none of the barriers were significantly associated with suicidal ideation within the past month or within the past year.

Factors associated with suicidal ideation

The logistic regression analyses examining factors associated with suicidal ideation are presented in Table 3. In univariate analyses, lower satisfaction with current economic status, lower ease of discussing mental health difficulties, and greater depression and anxiety severity were significantly associated with both suicidal ideation within the past month and within the past year. Additionally, female sex was significantly associated with suicidal ideation within the past year (OR = 1.880, $p < .05$).

In the multivariate models, which included selected variables simultaneously, both models were statistically significant ($p < .001$). Ease of discussing mental health difficulties remained significantly associated with both suicidal ideation within the past month (Adj OR = 0.654, $p < .05$) and within the past year (Adj OR = 0.712, $p < .05$), even after controlling for sex, economic satisfaction with current status, depression and anxiety severity.

Discussion

The most novel and informative finding of this study is that greater openness in discussing mental health difficulties was independently associated with lower odds of suicidal ideation among South Korean college students, even after accounting for the severity of depression and anxiety symptoms. This association was evident for both

Table 1 Socio- demographic and psychological characteristics of the participants

Characteristic	Category	Total (n = 572)	Suicidal ideation within the past month (n = 48)	Suicidal ideation within the past year (n = 90)
		n(%)		
Sex	Male	138 (24.1)	9 (18.8)	14 (15.6)
	Female	434 (75.9)	39 (81.3)	76 (84.4)
Age (years)		22.87 ± 2.65	22.62 ± 2.84	22.66 ± 2.66
	19–29	560 (97.9)	47 (97.9)	89 (98.9)
	30–39	12 (2.1)	1 (2.1)	1 (1.1)
Region of University	Capital area	258 (45.1)	20 (41.7)	38 (42.2)
	Others	314 (54.9)	28 (58.3)	52 (57.8)
Living status	Living alone	171 (29.9)	14 (29.2)	30 (33.3)
	Living with others	401 (70.1)	34 (70.8)	60 (66.7)
Satisfaction with the current economic status		3.15 ± 1.02	2.42 ± 0.90	3.25 ± 0.99
Depression	Meeting ICD-11 diagnostic criteria for depression	27 (4.7)	16 (33.3)	19 (21.1)
Generalized anxiety	Meeting ICD-11 diagnostic criteria for generalized anxiety	31 (5.4)	15 (31.3)	20 (22.2)
Ease of discussing mental difficulties		2.26 ± 0.81	1.85 ± 0.80	2.32 ± 0.81
	Strongly disagree	103 (18.0)	19 (39.6)	28 (31.1)
	Disagree	247 (43.2)	17 (35.4)	41 (45.6)
	Agree	191 (33.4)	12 (25.0)	19 (21.1)
	Strongly agree	31 (5.4)	0 (0.0)	2 (2.2)

Table 2 Barriers to mental health service use and their associations with suicidal ideation

Barriers	Total (*n* = 572)	Suicidal ideation within the past month (*n* = 48)		Suicidal ideation within the past year (*n* = 90)	
	n(%)	OR	95% CI	OR	95% CI
Expensive	396(69.2)	0.59	0.325–1.085	0.69	0.430–1.099
Not sure where to look	363(63.5)	0.87	0.474–1.590	0.78	0.509–1.191
No time available	323(56.5)	0.90	0.499–1.635	0.73	0.467–1.152
Long waiting times	202(35.3)	1.01	0.542–1.864	1.07	0.672–1.712
Inconvenient service hours	197(34.4)	0.61	0.310–1.203	0.79	0.483–1.281
Inconvenient facilities or location of the institution	158(27.6)	1.49	0.800-2.775	1.22	0.750–1.995
Worries about records having a negative impact on life	287(50.2)	0.57	0.309–1.046	0.80	0.511–1.261
Worries about others' perceptions	260(45.5)	0.85	0.464–1.539	0.69	0.433–1.092
Worries about family disapproval/discovery	256(44.8)	1.05	0.579–1.898	0.93	0.593–1.470
Fear of psychological treatment itself	248(43.4)	0.57	0.301–1.070	0.68	0.426–1.084
Fear of personal information disclosure	328(57.3)	0.95	0.525–1.729	1.20	0.759–1.907
Mental health issues are something individuals should handle on their own	234(40.9)	0.86	0.465–1.574	1.07	0.676–1.683
Unclear how serious mental health issues are	223(39.0)	1.13	0.620–2.058	1.11	0.703–1.757
Mental health problems will naturally improve over time	182(31.8)	1.60	0.873–2.917	1.29	0.808–2.071
Doubt that service providers will understand my issues	186(32.5)	0.84	0.441–1.612	0.98	0.608–1.593
Doesn't seem helpful	163(28.5)	1.20	0.641–2.253	0.90	0.540–1.490

Note: Each barrier item was analyzed separately using univariate logistic regression models

* $p<.05$, ** $p<.01$, *** $p<.001$

Table 3 Logistic regression analysis of suicidal ideation

Variable (Characteristic)		Suicidal ideation within the past month (*n* = 48)		Suicidal ideation within the past year (*n* = 90)	
		OR (95% CI)	Adj OR (95% CI)	OR (95% CI)	Adj OR (95% CI)
Sex†	Female	1.415(0.667–3.001)	1.174(0.501–2.756)	1.880(1.026–3.445)*	1.830(0.914–3.663)
Age†		0.961(0.853–1.082)	-	0.963(0.881–1.053)	-
Region of university	Capital	1.165(0.640–2.121)	-	0.870(0.552–1.372)	-
Living status	Living alone	0.963(0.503–1.844)	-	1.209(0.748–1.955)	-
Satisfaction with current economic status		0.466(0.345–0.630)***	0.656(0.456–0.942)*	0.612(0.509–0.737)***	0.765(0.583–1.002)
Depression severity score (IDQ, item 6 excluded)		1.230(1.171–1.295)***	1.141(1.040–1.251)**	1.156(1.117–1.196)***	1.113(1.034-1.200)**
Generalized anxiety severity score (IAQ)		1.225(1.165–1.288)***	1.071(0.973–1.178)	1.163(1.124–1.203)***	1.091(1.012–1.176)*
Ease of discussing mental difficulties		0.488(0.329–0.725)***	0.654(0.430–0.996)*	0.513(0.403–0.655)***	0.712(0.513–0.989)*
Model Fitting Information			-2LL = 230.580		-2LL = 368.515
Pseudo R-Square			Cox & Snell=0.159 Nagelkerke=0.363		Cox & Snell=0.202 Nagelkerke=0.348

Note: Adj OR: Adjusted odds ratios for multivariate model

† Reference group: Sex(Male), Region of university (non-capital), Living status (Living with others)

* $p<.05$, ** $p<.01$, *** $p<.001$

past-month and past-year suicidal ideation, suggesting the potential importance of disclosure-related processes in preventing suicidal ideation.

Before interpreting these associations, it is important to situate the findings within the broader epidemiological context reported in this study. Approximately 8.4% of participants reported experiencing suicidal ideation within the past month, and 15.7% reported it within the past year. These prevalence rates are broadly consistent with international estimates exceed the global average reported in a recent meta-analysis, which found 10.6% of past-year prevalence of suicidal ideation among 634,662 university students across 36 countries [24]. Although lower than 42.1% prevalence reported among individuals in their 20s and 30s during the COVID-19 pandemic in South Korea [25], the observed prevalence nonetheless highlights the ongoing vulnerability of Korean college students to suicidal ideation in the post-pandemic era. Given the high prevalence of suicidal ideation and established progression from suicidal ideation to suicide attempts [26, 27], identifying modifiable priority targets

associated with suicidal ideation is essential for culturally responsive suicide prevention.

In addition to suicidal ideation prevalence, this study provides a description of perceived barriers to mental health service utilization among South Korean college students. The most frequently endorsed barriers were high costs, uncertainty about where to seek help, concerns about confidentiality, time constraints, and worries about negative consequences related to medical records. These results are consistent with findings among Hungarian medical students [28], Pakistani students [29], and Chinese college students [30], highlighting that structural and stigma-related obstacles to mental health service utilization are globally prevalent. However, despite their high prevalence, none of the perceived barriers were significantly associated with suicidal ideation. These findings suggest that although perceived barriers may hinder access to mental health services, they may not, in isolation, differentiate students with suicidal ideation from those without. This underscores the importance of considering additional psychosocial and interpersonal processes beyond service-related obstacles. The absence of significant associations between perceived barriers and suicidal ideation may, in part, reflect limitations in measurement. Because barriers were assessed using individual items rather than a validated composite scale, further research using psychometrically validated measures is needed to clarify whether specific barrier dimensions are associated with suicidal ideation.

However, given these barriers, digital mental health interventions have been proposed as promising strategies to expand access to services while mitigating concerns about cost, inconvenience, and stigma [31]. Studies have shown that young people, including university students, are receptive to digital health platforms and tele-mental health services, which have been shown to be effective in reducing depressive symptoms [32, 33]. However, ensuring data protection and privacy will be crucial to building trust and sustaining engagement in the digital mental health interventions.

Against this backdrop, openness in discussing mental health difficulties emerged as a key factor distinguishing students with and without suicidal ideation. This finding extends prior literature on stigma and barriers to help-seeking by highlighting personal comfort with mental health disclosure as a distinct and potentially modifiable protective factor [34]. Recent research has shown that disclosure of mental health difficulties can serve as a form of help-seeking behavior that moderates the relationship between psychological distress and suicidal ideation [12], and that sharing emotional struggles may provide stress-buffering effects that protect against the deterioration of mental health [11].

Consistent with this interpretation, a substantial proportion of participants with elevated depressive or anxiety symptoms reported difficulty discussing mental health concerns. Among participants classified as depressed according to the IDQ, 40% strongly disagreed that they found it easy to discuss mental health difficulties, compared to 16.9% among those without depression. Similar patterns were observed among those classified as anxious according to the IAQ. However, the proportion of students who reported ease in discussing mental health difficulties was low across all groups, indicating a pervasive discomfort with mental health disclosure. This widespread reluctance to openly discuss mental health concerns may reflect cultural attitudes toward emotional expression and help-seeking.

These findings may be interpreted within the developmental and sociocultural context of South Korea. Late adolescence and early adulthood are marked by prolonged and cumulative academic stress that often begins during secondary education and continues into college life [35, 36]. Given the relatively low utilization of mental health services among Korean adolescents (6.6%) [20] and adults (22%) [21], psychological distress may remain unaddressed and persist over extended periods. At the same time, Confucian values emphasizing emotional restraint, social harmony, and family reputation may further discourage open discussion of psychological distress. In collectivistic cultural contexts, mental health difficulties are often perceived as reflecting not only on the individual but also on their family, potentially intensifying reluctance to disclose emotional struggles or seek help [12, 37]. Previous research has documented that Korean college students often cope with mental health difficulties through self-reliance and avoidance rather than disclosure, reflecting deeply embedded cultural norms around emotional expression [38]. Within this context, fostering environments that enhance open communication about mental health may be especially challenging yet critically important for suicide prevention.

Consistent with prior research, greater depression severity was associated with suicidal ideation across both timeframes, and greater anxiety severity was associated with past-year suicidal ideation. Although the IDQ measures depressive symptoms over the past two weeks and excludes suicidal ideation items, its association with suicidal ideation across both recent and longer timeframes suggests that short-term symptom severity may index more enduring psychological vulnerability.

Taken together, the descriptive findings on suicidal ideation prevalence and service barriers, combined with the novel identification of disclosure-related openness as a protective factor, suggest that suicide prevention efforts in university settings should extend beyond expanding service availability alone. While digital mental health

interventions may help address logistical and stigma-related barriers [31–33], parallel efforts to foster safe, nonjudgmental environments that encourage open discussion of mental health concerns may be equally critical, particularly in culturally sensitive contexts such as South Korea.

Several limitations should be acknowledged. The cross-sectional design precludes causal inference and limits conclusions regarding temporal ordering. Differences in assessment timeframes between symptom measures and suicidal ideation introduce temporal mismatch and the possibility of reverse or bidirectional associations. Additionally, the use of an online convenience sample with a predominance of female participants may limit generalizability.

By employing IDQ and IAQ, the study aligns with current international diagnostic frameworks and extends their application to the investigation of suicidal ideation in young adults. Importantly, however, the present analyses examine associations rather than predictive performance. As this study did not evaluate screening accuracy, further longitudinal and predictive validation studies (e.g., receiver operating characteristic [ROC]/area under the curve [AUC], optimal cut-off values, or comparisons with PHQ-9 or GAD-7) are required to establish their utility for such purposes.

Conclusion

Despite these limitations, this study contributes novel evidence that openness to discussing mental health difficulties is an independent protective correlate of suicidal ideation among South Korean college students. Beyond symptom reduction, interventions and institutional efforts that foster supportive environments for open mental health communication may represent a culturally sensitive and impactful component of suicide prevention strategies in university settings.

Author contributions

SP, JP, HJL, JYC, and SHC conceptualized and designed the study, collected and analyzed the data, and drafted the manuscript. PH, TK and MS contributed to data acquisition and interpretation. PH, TK, MS, JYC, and SHC provided critical revisions. SHC supervised the project and provided guidance. All authors have read and approved the final manuscript and meet the ICMJE criteria for authorship.

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Data availability

The dataset generated and/or analyzed during the current study are not publicly available due to subject confidentiality but are available from the corresponding author on reasonable request and with a data sharing agreement in place.

Declarations

Ethics approval and consent to participate

Ethical approval for this study was obtained from the Institutional Review Board of the Yonsei University Health System (Registration number: 2022-3690-005) in South Korea. All procedures were conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants before participation in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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