Research Square

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Long-Term Effects of the Coronavirus Pandemic on Depression, Resilience, and Quantitative Electroencephalography Characteristics in Community-Dwelling Older Adults

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Abstract

Background

In this exploratory study, we investigated depression, resilience, and quantitative electroencephalography (QEEG) in community-dwelling older adults after the coronavirus disease (COVID-19) pandemic to provide evidence for psychosocial interventions to restore mental health in older adults, a particularly vulnerable population, after experiencing a disaster.

Methods

This study, conducted between April 2023 and March 2024, included 104 older adults (≥ 65 years) residing in Seoul, South Korea. Depression (Korean version of Centre for Epidemiological Studies and Depressive Symptomatology [CES-D]) and resilience (Youth Korea Resilience Quotient-27) were measured using structured questionnaires. QEEG was used to obtain delta waves as an indicator of physical stress and tension and high-beta waves as an indicator of mental stress and distraction.

Results

Resilience and QEEG were compared among four depression groups: no depression (CES-D score < 16; Mean, 7.37 ± 3.83 points), possible depression (≥ 16; 18.40 ± 1.45 points), probable depression (≥ 21; 22.23 ± 1.01 points), and definite depression (≥ 25; 30.92 ± 9.09 points). Resilience was significantly lower in the possible depression (108.40 ± 9.96 points), probable depression (104.15 ± 6.96 points), and definite depression (99.13 ± 8.91 points) groups than in the no depression group (116.84 ± 9.79 points) ($F = 16.836$, $p < 0.001$). Among QEEG variables, delta waves (left: $F = 4.225$, $p = 0.007$; right: $F = 5.310$, $p = 0.002$), and high-beta waves (left; $F = 4.254$, $p = 0.007$) differed significantly among groups, while high-beta waves showed no significant differences.

Conclusions

Our findings suggest that a systematic psychosocial approach is needed to continuously monitor mental health in older adults during and after disasters and to support older adults with low resilience.

Background

The frequent occurrence of various disasters worldwide, including natural disasters and novel infectious diseases, is accompanied by a growing interest in their short- and long-term effects on physical and psychosocial health [1]. Recently, as a social disaster with a global impact, the coronavirus disease 2019 (COVID-19) pandemic sparked several societal changes, including in public health, economic, and cultural changes. The major changes in daily life caused by the spread of COVID-19 have exerted

substantial effects on physical and mental health, such as depression, lethargy, loneliness, and anxiety [2–6]. Consequently, several authors have highlighted the need for appropriate psychosocial interventions for long-term trauma and mental health problems caused by COVID-19 [1, 5, 7–9].

In particular, older adults, one of the most vulnerable groups to disasters, require an urgent healthcare response during outbreaks of novel and emerging diseases [10]. For example, 8 of 10 people who died due to COVID-19 were older adults aged ≥ 65 years, demonstrating their vulnerability to disasters [6, 11, 12]. Characteristics of older adults, such as physical weakness, chronic disease, and social isolation, contribute to greatest risks of worsening physical health, worsening of existing diseases, weakening of connections with family and the local community, and a lack of economic and social resources [1, 13].

COVID-19 is an infectious disease caused by the transmission of the severe acute respiratory syndrome coronavirus-2 [14]. During the COVID-19 pandemic, South Korea mandated social distancing, activity restrictions, and isolation for the whole population to prevent spread. This resulted in comprehensive restrictions on the activities of community-dwelling older adults, including decreased social relationships, physical activity, religious activities, and social gatherings, which negatively impacted their physical, social, and psychological health [1, 6, 11]. As older adults constitute a high-risk group for mortality, they were subject to strict measures designed to protect them from COVID-19 [15]. Although most quarantine regulations were dropped by late April 2022, even after the pandemic, people continued voluntary efforts to adhere to infection control measures, including surveillance of respiratory symptoms, wearing masks, and minimizing gatherings. This continued adaptation has led to a “post-corona” or “new normal” era. Notably, mental health risk signals may be unclear at the height of a disaster, when efforts are focused on overcoming the event, and may become more prominent in the period following a prolonged disaster [1]. Hence, mental health problems after a disaster may be pronounced in older adults who already have health vulnerabilities [1, 6, 13].

Disasters are a source of stress and exacerbate mental-health problems (such as depression) in older adults. Accordingly, the ratio of the population at risk of depression during the pandemic was five times higher than pre-COVID levels [15]. Older adults experienced depression due to prolonged periods of isolation at home resulting from social distancing, self-quarantine, and the closure of senior welfare facilities [16]. Depression was particularly prevalent among those aged 80 years and older who had lost their spouses, had a low economic status, and perceived their health to be poor [16]. Depression persistently threatens the mental health of older adults who have experienced the COVID-19 pandemic, leads to geriatric diseases, including dementia or other forms of cognitive dysfunction, impairs life expectancy and quality of life, and increases social costs [12]. However, the treatment service referral rate for depression in older adults is low, despite its high prevalence, indicating the urgent need for basic interventions and preventive approaches to alleviate depression and improve resilience in older adults after a public health emergency [12, 15].

Systematic analyses of long-term effects of the pandemic on older adults are lacking. Therefore, in this study, we performed an exploratory analysis of depression, resilience, and quantitative

electroencephalography (QEEG) in community-dwelling older adults after the COVID-19 pandemic to provide evidence for psychosocial interventions required to restore mental health in older adults, a vulnerable group, after a social disaster. Specifically, we aimed to 1) measure levels of depression, resilience and QEEG in older adults, 2) investigate the relationships among depression, resilience, and QEEG in older adults, and 3) investigate differences in resilience and QEEG in older adults depending on the level of depression.

Materials and Methods

Study design and participants

This cross-sectional descriptive survey included older adults (≥ 65 years old) living in Seoul who voluntarily expressed their desire to participate in the study based on participant recruitment notices at elderly welfare centers or similar locations. All participants consented to participate in the questionnaire and QEEG measurements after receiving a detailed verbal explanation of the study. Individuals taking psychotropic drugs or receiving psychotherapy and persons with cognitive impairment were excluded to ensure accurate measurement of depression and other variables. To ensure sufficient statistical power in the analysis of variance (ANOVA), 105 participants were enrolled. One participant provided insincere responses; therefore, data from the remaining 104 participants were included in the final analysis.

Research instruments

General characteristics

The general participant characteristics included age, sex, religion, subjective health status, economic status, and residence type.

Depression

Depression was measured using the Korean version of the Center for Epidemiological Studies and Depressive Symptomatology (CES-D), developed in 1971 by the U.S. National Institute of Mental Health and by Cho and Kim. The CES-D has been shown to be reliable and valid [17], with a Cronbach's α of 0.90 at the time of development [17] and 0.94 in this study. This scale is used for convenient self-reported depression screening in various groups in South Korea, including middle-aged women and older adults. The instrument consists of 20 self-reported questions on an individual's condition during the previous week. Responses to each question are assigned to a 4-point Likert scale (0–3 points) as follows: "very rarely" (< 1 day per week), "sometimes" (1–2 days per week), "frequently" (3–4 days per week), or "most of the time" (≥ 5 days per week). In this study, a CES-D score of < 16 points was defined as "no depression," ≥16 points as "possible depression," ≥21 points as "probable depression," and ≥ 25 points as "definite depression" [18, 19].

Resilience

Resilience was measured using the Youth Korea Resilience Quotient-27 (YKRQ-27) developed by Shin et al. [20]. This instrument comprises 27 items that measure an individual's ability to overcome hardship, adapt to their environment, and grow mentally. This instrument includes three dimensions representing the components of resilience: control (impulse control, cause analysis, and emotional control), positivity (optimism, life satisfaction, and gratitude), and social skills (communication, empathy, and relationship skills). Each item is rated on a 5-point Likert scale (1 = not at all; 5 = definitely yes), with higher scores indicating higher resilience. The scale had a Cronbach's α of 0.86 at the time of development [20] and 0.94 in this study.

Quantitative electroencephalography

QEEG was performed using a portable 2-channel QEEG device (NeuroBrain, Neuro21, Seoul, Korea), developed at the Korea Research Institute of Brain Science by a board-certified researcher. According to the International 10–20 displacement system, two electrodes were used to simultaneously measure the left and right brainwaves from Fp1 and Fp2 in the frontal lobe, and the measurements were checked in real-time on a monitor connected to a laptop [21]. In this study, QEEG was used to analyze physical stress and tension based on delta waves, and mental stress and distraction based on high-beta waves [21]. Generally, delta waves are < 10 μV while alert and with eyes closed, and readings > 10 μV are associated with increased sympathetic nervous system response, increased heart rate due to physiological causes, muscle tension, feelings of tiredness, and increased skin sensitivity, corresponding to physical stress, fatigue, eye strain, and physical tension. Thus, high delta wave activity indicates high physical stress and tension [22]. High-beta waves are related to psychological instability with eyes closed and left-right symmetry is important. High-beta wave activity (≥ 1 μV) indicates high mental stress and distraction, and is associated with mental lethargy, increased pressure in a given situation, sensitivity, irritability, lack of focus, and impaired sleep quality [22]. NeuroBrain has shown a reliability of 0.945 ($p < 0.01$) for EEG signals when used with a function generator (33120A, HP, Santa Rosa, CA, USA) and attenuator (984A, Kikusui, Yokohama, Japan) [21, 23].

Data collection

The study was conducted between April 2023 and March 2024. Data were collected through structured questionnaires and QEEG device. Although depression (CES-D) and resilience (YKRQ-27) were measured using self-reported instruments, given that the participants were older adults, when necessary, the questionnaire was read by a trained surveyor assisting the study and responses were collected verbally. QEEG was performed while the participants were alert and at rest, without any discomfort. The researcher visited the elderly welfare center at a prearranged time, responded to the questionnaires in a 1:1 setting, and underwent QEEG measurements. The entire process required approximately 10–15 minutes per participant. For each participant, we explained the results of their questionnaires and QEEG

findings and provided a report on the results. All participants were provided a small gift as a token of appreciation.

Data analysis

Data were analyzed using SPSS Statistics ver. 22.0 (IBM, Armonk, NY, USA). General characteristics were analyzed using descriptive statistics. Cronbach's α was used to determine the reliability of the measurement instruments. Pearson's correlation coefficients were used to analyze correlations between variables, and ANOVA was used for comparisons among groups. Statistical significance was defined as $p < 0.05$.

Results

General characteristics

The general characteristics of the participants are shown in Table 1. The participants mostly included older adult women (n = 89; 85.6%) in their 70s (n = 49; 47.2%) or 80s (n = 39; 37.5%). Among the participants, 21 were Christians (20.2%), 27 were Buddhists (26.0%), and 49 were non-religious (47.1%). Subjective health status was most frequently 'average' (n = 65; 62.5%), with similar numbers of participants whose subjective health status was "very high" or "high" (n = 21; 20.2%) or "low" or "very low" (n = 18; 17.3%). The most frequent economic status was "average" (n = 68; 65.4%), followed by "very high" or "high" (n = 28; 27.0%). Among the participants, 70 (67.3%) lived at home with their family and 30 (28.8%) lived alone.

Table 1
General characteristics of participants (N = 104)

Characteristics	Categories	n (%)
Sex	Men	15 (14.4)
	Women	89 (85.6)
Age (years)	60s	12 (11.5)
	70s	49 (47.2)
	80s	39 (37.5)
	90s	4 (3.8)
Religion	Christianity	21 (20.2)
	Buddhism	27 (26.0)
	Catholicism	7 (6.7)
	None	49 (47.1)
Subjective health status	Very high	8 (7.7)
	High	13 (12.5)
	Average	65 (62.5)
	Low	14 (13.5)
	Very low	4 (3.8)
Economic status	Very high	9 (8.7)
	High	19 (18.3)
	Average	68 (65.4)
	Low	5 (4.8)
	Very low	3 (2.9)
Residence type	Home (Living with family)	70 (67.3)
	Living alone	30 (28.8)
	Other	4 (3.8)

Variables

As shown in Table 2, the mean ± standard deviation depression score was 13.53 ± 9.49 points (range, 0–60 points). The mean total resilience score was 112.00 ± 11.39 points (range, 27–135 points), and for each of the three dimensions, the mean control score was 40.87 ± 4.28 points, positivity was 34.95 ±

4.49 points, and social skills was 36.17 ± 4.35 points. In QEEG, the delta wave (left) and delta wave (right), representing physical stress and tension, were 20.38 ± 17.38 and 19.96 ± 16.36 μV, respectively. The high-beta wave (left) and high-beta wave (right), representing mental stress and distraction, were 1.46 ± 1.04 and 1.46 ± 0.74 μV, respectively.

Table 2
Variables (N = 104)

Variables	Mean ± SD	Min	Max	Range	Items
Depression	13.53 ± 9.49	1	58	0–60	20
Resilience	112.00 ± 11.39	76	134	27–135	27
Control	40.87 ± 4.28	21	45	9–45	9
Positivity	34.95 ± 4.49	19	44	9–45	9
Social skills	36.17 ± 4.35	18	45	9–45	9
Quantitative electroencephalography					
Delta wave (left)	20.38 ± 17.38	2	71	≤ 10	-
Delta wave (right)	19.96 ± 16.36	2	71	≤ 10	-
High-beta wave (left)	1.46 ± 1.04	0	8	≤ 1	-
High-beta wave (right)	1.46 ± 0.74	0	4	≤ 1	-
SD, standard deviation					

Correlations

Table 3 presents the results of correlation analyses of the main variables. Depression was negatively correlated with resilience ($r = -0.642$, $p < 0.001$) but positively correlated with delta waves (left and right) and high-beta waves (left and right) (both $p < 0.01$). Among the QEEG variables, delta waves (left and right) were positively correlated with high-beta waves (left and right) ($p < 0.01$). In contrast, resilience showed no correlation with any of the QEEG variables (all $p > 0.05$).

Table 3
Correlations (N = 104)

Variables	r (*p*)					
	Depression	**Resilience**	**Delta wave (left)**	**Delta wave (right)**	**High-beta wave (left)**	**High-beta wave (right)**
Depression	1	-0.642 (< 0.001)**	0.267 (0.006)**	0.276 (0.005)**	0.258 (0.008)**	0.208 (0.034)*
Resilience		1	-0.134 (0.176)	-0.087 (0.381)	-0.176 (0.073)	-0.050 (0.616)
Delta wave (left)			1	0.885 (< 0.001)**	0.800 (< 0.001)**	0.724 (< 0.001)**
Delta wave (right)				1	0.705 (< 0.001)**	0.826 (< 0.001)**
High-beta wave (left)					1	0.727 (< 0.001)**
High-beta wave (right)						1
*<.05, **<.01						

Differences in depression, resilience, and QEEG depending on depression group

The resilience and QEEG results were analyzed in detail in the four depression groups: no depression (CES-D score < 16), possible depression (CES-D score ≥ 16), probable depression (CES-D score ≥ 21), and definite depression (CES-D score ≥ 25). As shown in Table 4, significant between-group differences were observed in depression ($F = 131.375$, $p < 0.001$), with the possible depression group (n = 15, mean depression score = 18.40 ± 1.45 points), probable depression group (n = 13, 22.23 ± 1.01 points), and definite depression group (n = 12, 30.92 ± 9.09 points) showing significantly higher scores than those in the no depression group (n = 64, mean depression score = 7.37 ± 3.83 points). Similarly, there were significant between-group differences in resilience ($F = 16.836$, $p < 0.001$), with the possible depression group (mean resilience score = 108.40 ± 9.96 points), probable depression group (104.15 ± 6.96 points), and definite depression group (99.13 ± 8.91 points) showing significantly lower scores than those in the no depression group (116.84 ± 9.79 points). Among the QEEG variables, the delta waves (left; $F = 4.225$, $p = 0.007$), delta waves (right; $F = 5.310$, $p = 0.002$), and high-beta waves (left; $F = 4.254$, $p = 0.007$) showed significant between-group differences, whereas high-beta waves (right: $F = 2.209$, $p = 0.092$) did not show significant between-group differences.

Table 4
Comparison of depression, resilience, and QEEG among depression groups (N = 104)

Variables	Mean ± SD				F (*p*)†
	no depression (n = 64)	possible depression (n = 15)	probable depression (n = 13)	definite depression (n = 12)	
Depression	7.37 ± 3.83[a]	18.40 ± 1.45[b]	22.23 ± 1.01[c]	30.92 ± 9.09[d]	131.375 (< 0.001)** a < b,c < d
Resilience	116.84 ± 9.79[a]	108.40 ± 9.96[b]	104.15 ± 6.96[c]	99.13 ± 8.91[d]	16.836 (< 0.001)** a > b,c > d
Control	42.22 ± 3.80[a]	40.47 ± 3.36[b]	39.00 ± 2.86[c]	36.21 ± 5.16[d]	9.703 (< 0.001)** a,b > d
Positivity	37.09 ± 3.58[a]	33.73 ± 2.81[b]	31.23 ± 2.77[c]	29.08 ± 3.78[d]	26.000 (< 0.001)** a > b,c > d
Social skills	37.53 ± 3.92[a]	34.20 ± 5.60[b]	33.92 ± 3.23[c]	33.83 ± 3.13[d]	6.256 (0.001)** a > b,c > d
Quantitative EEG					
Delta wave (left)	16.62 ± 12.94	19.24 ± 14.60	30.25 ± 26.46	30.88 ± 22.50	4.225 (0.007)**
Delta wave (right)	16.40 ± 12.10[a]	17.26 ± 14.19[b]	30.51 ± 23.84[c]	30.84 ± 21.11[d]	5.310 (0.002)** a < c,d
High-beta wave (left)	1.22 ± 0.62[a]	1.53 ± 0.75[b]	1.90 ± 1.13[c]	2.17 ± 2.09[d]	4.254 (0.007)** a < d

**<0.01, †Scheffé test

SD, standard deviation

Variables	Mean ± SD				F (*p*)[†]
	no depression (n = 64)	possible depression (n = 15)	probable depression (n = 13)	definite depression (n = 12)	
High-beta wave (right)	1.33 ± 0.65	1.52 ± 0.76	1.73 ± 0.93	1.78 ± 0.86	2.209 (0.092)
[**]<0.01, [†]Scheffé test					
SD, standard deviation					

Discussion

In this study, we performed an exploratory analysis of depression, resilience, and QEEG in community-dwelling older adults after the COVID-19 pandemic to provide evidence for psychosocial interventions required to restore mental health in this population. The cohort included 40 participants (38.5%) with depression symptoms, with 15 individuals (14.4%) in the possible depression group (CES-D score ≥ 16), 13 (12.5%) in the probable depression group (CES-D score ≥ 21), and 12 (11.5%) in the definite depression group (CES-D score ≥ 25). The cutoff for depression screening in the original CES-D was 16 points; however, in Korean standardization studies, the cutoff point for the CES-D in South Korea was 21 points for local epidemiological surveys and 25 points for diagnosing major depressive disorder [17, 19]. A previous study [19] reported prevalence rates of 15.0% for possible depression, 8.9% for probable depression, and 5.9% for definite depression, calculated based on the CES-D criteria, among 847 community-dwelling older adults participating in the 2007 Community Health Survey, indicating that the proportion of participants with depression was higher in the present study. Similarly, compared with the mean CES-D score of 7.68 ± 0.31 points across all participants in a previous study [19], the mean score of all participants in this study was much higher, at 13.53 ± 9.49 points.

Although a direct comparison of depression scores among studies is not possible due to differences in group composition and situational factors, such as the COVID-19 pandemic, these results confirm that approximately 12–25% of older adults (≥ 65 years old) do not meet the diagnostic criteria for major depressive disorder but show depressive symptoms or depressive mood [19, 24]. Compared with that in other age groups, depression in old age is characterized by much worse physical and psychological risks and sequelae, including anxiety, cognitive impairment, and high suicide rates [19]. Consequently, older adults are more vulnerable to prolonged disasters, such as the COVID-19 pandemic, in terms of survival and adaptation to lifestyle changes. Therefore, interventions and active community-based approaches are particularly important for the early discovery and timely treatment of depression in this population.

In this study, depression was negatively correlated with resilience, indicating that the groups with higher depression scores had, on average, lower resilience. This suggests that individuals with a certain level of resilience are less likely to suffer from depression under the same hardships [25]. Therefore, when

developing prevention and active interventions for depression in community-dwelling older adults who have experienced a public health emergency, such as the COVID-19 pandemic, we propose a psychosocial approach focused on the concept of resilience to depression. In an integrative review [6], maintaining physical activity and daily routines were found to have a major impact on resilience among older adults during the COVID-19 pandemic. Given that resilience is an important factor in the well-being and quality of life of older individuals [6], decreased resilience has serious implications for this population during a pandemic or similar situation involving prolonged lifestyle changes and activity restrictions. Additionally, mental health support strategies and interventions aimed at improving personal resilience, which plays a key role in psychological stability and recovery, should be developed for older adults to prevent the onset, persistence, or worsening of severe depression during or after a disaster that causes a decline in social support, such as a shortage of care or supporting family, collapse of local networks, or lack of resources due to the disaster [1]. Such strategies can include a post-hoc response to depression or preventive and early response systems in the case of disasters expected to occur frequently in the future.

Among the QEEG variables, we observed a positive correlation between delta waves (left, right), representing physical stress and tension, and high-beta waves (left, right), representing mental stress and distraction, consistent with previous findings [26]. In particular, in a previous study [26], QEEG analyses of carers between 52 and 72 years old revealed delta wave activity, representing physical stress and tension, with value of 24.38 ± 15.21 (left) and 27.52 ± 14.71 μV (right). In our study, community-dwelling older adults who had experienced a pandemic exhibited delta wave (left, right) activity of 30.25 ± 26.46 and 30.51 ± 23.84 μV, respectively, in the probable depression group and 30.88 ± 22.50 and 30.84 ± 21.11 μV, respectively, in the definite depression group, indicating far higher physical stress and tension compared with estimates in the previous study. However, direct comparisons were limited by differences between study populations (e.g., participants in the previous study were carers) [26]. Nevertheless, considering that both studies involved older adults of a similar age group, delta wave activity was higher than 10 μV, the cut-off for a positive result, and higher levels of depression were associated with a decreased ability to withstand physical stress and tension.

The previous study [26] also reported high-beta wave (left, right) activity (representing mental stress and distraction) of 1.42 ± 0.62 and 1.67 ± 0.63 μV, on average. In comparison, high-beta activity (left, right) in our study was 1.90 ± 1.13 and 1.73 ± 0.93 μV, respectively, in the probable depression group and 2.17 ± 2.09 and 1.78 ± 0.86 μV, respectively, in the definite depression group, indicating far higher mental stress and distraction than in the previous study [26]. Although activity < 1 μV is preferable, participants in both studies showed activity ≥ 1 μV, and higher levels of depression were associated with worse mental stress and distraction among older individuals. Thus, despite the limited scope for comparisons, considering the differences in the study populations and other factors, these findings based on QEEG provide an objective measure of the mental state of the elderly population. In the future, analogous studies should be performed to enable direct comparisons of the conditions of older adults during and after various disasters. This work is expected to inform the development of interventions required for the early detection of new mental health symptoms or strategies for monitoring and early responses after a

disaster in regular community-dwelling older adults who are not in the high-risk mental health group and therefore do not currently require immediate diagnosis and treatment.

However, the following limitations must be considered when interpreting and generalizing the results of this study. For example, there were differences in the number of participants across groups based on depression levels. Owing to differences in depression levels, the results for QEEG indicators cannot be directly compared with those of previous studies. Future research should include a larger sample size and account for various demographic characteristics. Furthermore, as this study was a cross-sectional survey, the generalizability of the findings is limited. Future studies using a prospective longitudinal design with repeated objective measurements are needed to characterize changes in the mental health of older adults resulting from disaster experiences. Finally, based on the results of this study, we propose research that evaluates the effectiveness of psychosocial interventions for the recovery of mental health in older adults from the perspective of resilience.

Conclusions

In conclusion, we analyzed depression, resilience, and QEEG data for community-dwelling older adults after the COVID-19 pandemic and investigated differences in resilience and QEEG depending on depression levels. Direct comparisons were limited owing to the lack of previous studies systematically analyzing the same variables. Nevertheless, our study makes several important contributions; in addition to self-report measurements to investigate mental health factors in older adults after a disaster, we used objective QEEG tests to compare indices representing physical stress, tension, mental stress, and distraction among depression groups. Based on our findings, we propose that more systematic efforts should be directed towards monitoring the onset, persistence, and worsening of new mental health symptoms in community-dwelling older adults and towards supporting older adults with low resilience, even after the end of a disaster, such as the COVID-19 pandemic.

Abbreviations

CES-D Centre for Epidemiological Studies and Depressive Symptomatology; COVID-19, coronavirus disease; QEEG, quantitative electroencephalography; YKRQ-27, Youth Korea Resilience Quotient-27

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the principles of the Declaration of Helsinki and approved by the Institutional Review Board of the Seoul University of Buddhism (No. 27004121AN01-202303-HR-

072-01). Before participating in the study, we explained all the aspects of the study to the participants. Informed consent was obtained from all the participants involved in the study.

Consent for publication

Not applicable.

Competing Interests

The authors declare no conflicts of interest.

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Author Contribution

The authors confirm their contributions to the paper as follows: study conception and design: W.H.W. and S.H.K.; data collection: K.J.B. and L.W.W.; analysis and interpretation of results: W.H.W., K.J.B., L.W.W., and S.H.K.; draft manuscript preparation: W.H.W. and S.H.K. All authors reviewed the results and approved the final version of the manuscript.

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Availability of Data and Materials

Data supporting the findings of this study are available from the corresponding author, S.H.K., upon reasonable request.

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