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Internet-Based Trauma Recovery Intervention for Nurses: A Randomized Controlled Trial

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Keywords
Internet-based intervention · Mental health recovery · Nurses · Psychological trauma

Abstract
Introduction: Nurses, who care for patients with various traumas, may also experience post-traumatic stress disorder due to indirect or direct exposure to traumatic situations. This study examined the effectiveness of an Internet-based trauma recovery intervention for Korean nurses. ***Methods:*** This randomized controlled trial was conducted with 112 nurses aged 23–40 years who were randomly assigned to the intervention ($n = 56$) or control group ($n = 56$) from May 7 to December 20, 2020. Nurses in the intervention group attended eight sessions, and the same intervention was administered to the control group. Repeated measures were collected at pre-test, post-test 1 (immediately after the intervention), and post-test 2 (4 weeks after the intervention). A total of 102 nurses (intervention group: $n = 49$; control group: $n = 53$) were completed because 10 nurses dropped out before the first session. Data were analyzed using the χ^2 test, Fisher's exact test, *t*-test, Mann-Whitney U test, and repeated measures ANOVA (intention-to-treat and per protocol). ***Results:*** There were significant changes in functional health, resilience, post-traumatic stress, depressive symptoms, state anxiety, and trait anxiety over time and in the group-by-time interactions (intention-to-treat and per protocol). There was a significant difference in social support in the group-by-time interactions, but there were no significant changes between the two groups or over time (intention-to-treat and per protocol). ***Conclusion:*** The Internet-based trauma recovery nursing intervention is effective in clinical and community settings for nurses who cannot participate in fixed-schedule programs due to shift work. This study's findings are relevant for implementing Internet-based trauma recovery programs for nurses and the general population, including survivors and relatives of patients who suffered from COVID-19. This program will also be very useful for people in other high-stress situations. Nurse leaders should consider different populations and situations when offering effective coping strategies suitable for changing environments.

Introduction

Nurses, who are the closest caregivers to patients with various physical and psychological traumas [1], may experience post-traumatic stress disorder (PTSD) because of indirect or direct exposure to traumatic

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situations [2]. PTSD is characterized by the development of distressing psychological symptoms following exposure to traumatic events [3]. Nurses' trauma can not only cause physical and mental health problems (e.g., depressive symptoms, emotional trauma, and suicidal ideation) [4] but also directly and negatively affect patients [1]; it can cause nurses to become indifferent to patients, leading to falls and medication errors and a significant decrease in the quality of nursing care [1].

Considering nurses are on the frontline, providing direct care to patients at risk for COVID-19, they may experience PTSD symptoms due to increased workload, fatigue, and higher levels of stress [5]. In one study, approximately 13.3% of the 12,596 nurses surveyed self-reported experiencing trauma during the COVID-19 pandemic [6]. Furthermore, nurses providing direct patient care had high levels of depressive symptoms and anxiety due to fear of contracting COVID-19 and infecting others [7].

PTSD is detrimental to functional health and well-being [8]. In a long-term follow-up study of trauma-exposed individuals [9], 20% reported health problems. Protective factors against trauma symptoms include resilience and the ability to cope with stress [10, 11]. Nurses with high resilience experience fewer trauma symptoms and improved emotional health and well-being [12]. Complementary and alternative therapies for relaxation and stress management have been shown to support nurses' well-being [13]. Medland et al. [14] found that psychosocial wellness and coping skills programs, including bereavement support, stress management, self-care behavior coaching, and individual counseling, can support oncology nurses.

However, there are several barriers to providing trauma care to nurses, including time constraints, privacy concerns, lack of convenient and flexible access to education, and limited organizational support [15]. To overcome these barriers, alleviate post-traumatic stress (PTS) symptoms, and improve the functional health of nurses who have experienced trauma, an Internet-based trauma recovery nursing intervention (IBTRNI) was offered in Korea [16]. The IBTRNI, based on Swanson's [17] theory of caring, allows participants to objectively understand their trauma and create an environment in which they can care for themselves [16]. Particularly, the IBTRNI provides participants with methods and information to control their negative emotions and overcome their trauma [16]. This study evaluates the effectiveness of the IBTRNI in improving functional health, social support, resilience, PTS, depressive symptoms, and anxiety among Korean nurses.

This study used the intention-to-treat (ITT), last observation carried forward, and per protocol (PP) methods to unambiguously analyze the effect of the intervention. In a randomized control trial, ITT analysis is a group-defining strategy in which all initially randomly assigned participants are included in the analysis and not excluded, even if they do not participate in the intervention [18, 19]. The population of the PP analysis includes all participants who successfully completed the intervention, allowing the difference between the experimental and control groups after the intervention to be more clearly identified than ITT [18, 19].

Study Hypothesis

The experimental group that received the intervention will have an increase in functional health, social support, and resilience compared to the control group that did not receive the intervention. The experimental group that received the intervention will have a decrease in PTS, depressive symptoms, and anxiety compared to the control group that did not receive the intervention.

Methods

Design

This study used a parallel randomized controlled trial to measure PTS, resilience, and social support at 3 time points: pre-test, post-test 1 (immediately after the intervention), and post-test 2 (4 weeks after the intervention).

Sample Size Analysis

The sample size was determined to detect significant changes in PTS symptoms between an intervention group and a control group (effect size = 0.74) based on a previous study [20]. Power analysis indicated that 80 participants were sufficient to achieve 90% statistical power with a two-tailed α of 0.05 for significance. With an estimated dropout rate of 30%, a total sample size of 112 was planned.

Participants and Sampling

A total of 112 registered nurses were recruited for this study. Power analysis indicated that 80 participants would be sufficient to achieve 90% statistical power, with a two-tailed α of 0.05 for significance. With an estimated dropout rate of 30%, a total sample size of 112 patients was planned. Inclusion criteria included registered nurses who (1) were aged 23–40 years, (2) had access to the program via a computer or mobile device, (3) understood the purpose of the study and voluntarily consented to participate, (4) were diagnosed with severe mental illness and taking medication for their treatment, and (5) self-scored greater than 80% (64 points) on the Korean version of the PTSD Checklist for DSM-5 (PCL-5) [21].

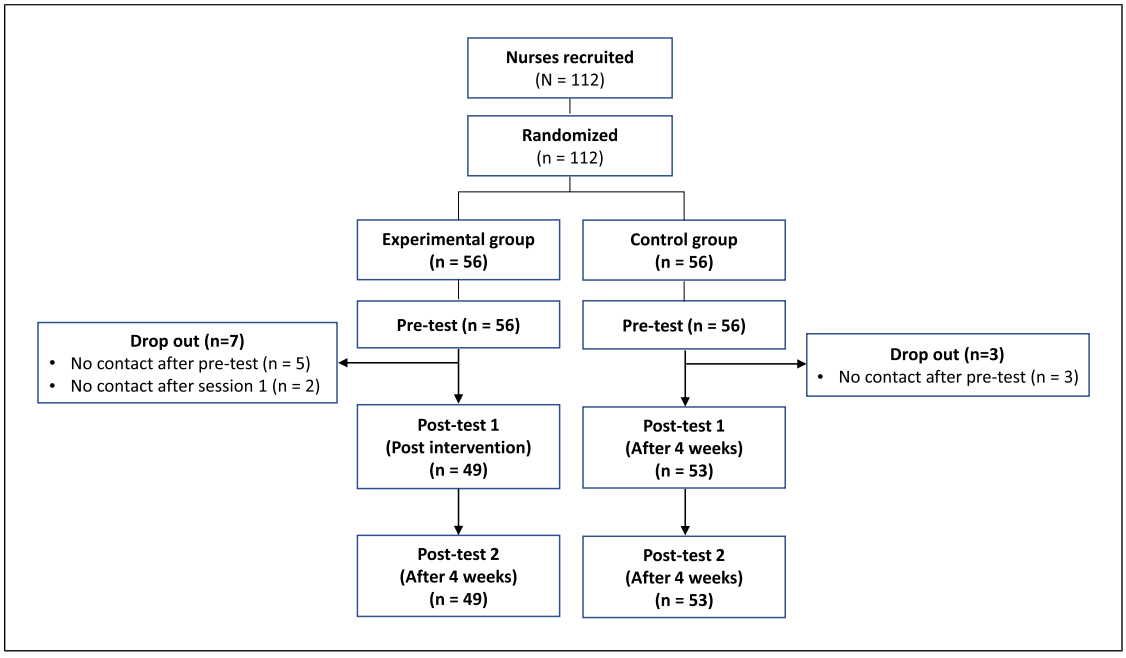


Fig. 1. CONSORT flow diagram of this study.

Randomization and Blinding

Participants were randomly assigned to blocks of equal sample size using the Research Randomizer "random sequence generator" (https://www.randomizer.org/). An independent researcher verified that enrolled participants met the selection criteria and generated an allocation sequence using an opaque sealed envelope of the same shape, with the serial number recorded according to the random allocation sequence. An independent nurse opened the envelope and administered the intervention.

The 112 enrolled participants were randomized to intervention (n = 56) and control (n = 56) groups. All enrolled nurses met the study requirements. After the pre-test and session 1, 10 participants did not respond and were subsequently excluded (intervention group = 7, control group = 3). The final sample comprised 102 nurses (intervention group: 49; control group: 53) (Fig. 1).

The recruitment notice divided the program participation period into two phases so that participants were unaware of whether they were in the experimental or control group. The intervention was provided to the experimental group first, and after all questionnaires were completed, the same program was provided to the control group by only URL using e-mail and mobile phone.

All procedures, including recruitment, group assignment, intervention, and outcome data collection, were conducted online. The nurse who facilitated the program, the researcher who assessed the outcomes, and the participants in both groups were unaware of the group assignment, were blinded, and their allocation was concealed.

Data Collection and Procedures

Participants were recruited from the following two online nursing communities: "Meetings Representing Nurses," the largest nursing community in Korea with 95,440 registered members and an average of 12,712 active members per day, and the "I am a Nurse" community, with 34,796 registered members and an average of 150 active members per day.

A recruitment notice was posted on the online community portals. Participants read the description in the notice and watched a video introducing the program. Further, they accessed a URL sent by the researcher using a computer or mobile device, completed the PCL-5 questionnaire, and provided information about their age and whether they were taking psychotropic medications. The researcher screened participants based on the inclusion criteria. No participant had a total PCL-5 score of 64 or higher; therefore, none were in the high-risk group. Those who passed the screening signed an informed consent form after accessing the URL.

To ensure complete enrollment of the planned sample size, data were collected from May 7 to December 20, 2020. All participants completed the questionnaire 3 times: pre-test (May 7 to July 17, 2020), post-test 1 (from June 3 to September 4, 2020), and post-test 2 (from July 6 to December 20, 2020).

Intervention: Internet-Based Trauma Recovery Nursing Intervention Program

The IBTRNI is an Internet-based caregiving intervention with eight sessions of 30 min each, consisting of five steps – "Maintaining Belief," "Being With," "Knowing," "Doing For," and "Enabling" – based on Swanson's theory of caring [16].

In the "Maintaining Belief" step, it is vital to trust the participant [22]. In this study, trust between researchers and participants was established throughout the session through the response letter [16]. In the "Being With" step, it is important for the researcher to be emotionally supportive of the participant [22]. Participants who received the response letter in this study

expressed that they shared their experiences and emotions with the nurse [16]. In the "Knowing" step, it is important to try to understand the meaning of the event [22]. Therefore, we attempted to understand the participants' responses to traumatic events rather than avoiding or emphasizing traumatic experiences [16]. In the "Doing For" step, it is important that the researcher provides care for the participants [22]. Therefore, we provided the participants with evidence, information, and knowledge to help them set goals for self-improvement [16]. In the "Enabling" step, it is important to help participants solve problems on their own [22]. Therefore, we provided them with effective communication skills and stress management strategies that they could implement to change their daily lives [16] (online suppl. material; for all online suppl. material, see https://doi.org/10.1159/000540350).

Participants completed the program 1 to 2 times per week. The researcher sent the URL of each session to the participant, who then accessed it via a computer or mobile device (online suppl. material 1). For each session, the researcher communicated with the participant via a computer or mobile device using a standardized response letter developed by the research team. We tailored the response letters for each session so that any nurse, novice or advanced, could run this program (online suppl. material 2).

The nurse who facilitated the program was part of the research team and developed the program. Therefore, she understood and implemented it accurately. Moreover, she worked in both open and closed psychiatric wards and was a trained mental health nurse certified to facilitate participation.

Ethics

This study was approved by the Institutional Review Board of Yonsei University Health System (No. Y-2019-0083). This study was registered at ClinicalTrials.gov-U.S. National Library of Medicine (clinical trial registration number: NCT04989582) and is available online.

All participants were informed of the purpose and need for the study, method of data collection, time required, right to refuse participation, right to withdraw from the study at any time without adverse consequences, confidentiality of personal information, and expected benefits. Individuals who voluntarily expressed their intention to participate were enrolled after receiving a participation manual and online consent form. All consent forms and questionnaires were completed online, allowing participants to respond at a convenient pace.

The consent forms, questionnaires, and related data were stored on a computer with restricted access that was encrypted for security. The researchers' contact details were provided to clarify any queries they may have. The collected consent forms and questionnaires will be destroyed after 3 years, in accordance with the guidelines of the Research Ethics Committee. Participants received monetary compensation for their cooperation.

Outcome Measures

Baseline data on participants' general, clinical, and nursing career-related characteristics were gathered. General and clinical characteristics of the participants included age, gender, religion, marital status, education level, current employment, monthly income, smoking status, drinking status, disease (yes/no), and exercise (yes/no). Participants reported their work experience, region, type of organization, department, position, and type of work.

Functional Health

This study used the Functional Health Pattern Assessment Screening Tool (FHPAST) developed by Jones et al. [23] and translated by Keum and Kim [24]. The FHPAST is a 57-item self-report questionnaire on a 4-point Likert scale ranging from 1 (never) to 4 (routinely). An average score of 3 or higher indicates a functional health level and readiness for health promotion [23]. Cronbach's α was 0.70~0.90 in Jones' [25] study and 0.93 in this study.

Social Support

The Social Provision Scale developed by Cutrona and Russell [26] and translated into Korean by Yoo and Lee [27] was also used in this study. This instrument has 24 self-reported questions on a 4-point Likert scale ranging from 0 (not at all) to 3 (very much). The total score ranges from 24 to 96, with higher scores indicating greater social support. Cronbach's α was 0.92 in Cutrona and Russell's [26] study and 0.90 in this study.

Resilience

The Connor-Davidson Resilience Scale developed by Connor and Davidson [28] was used in this study. The Korean version of this instrument was obtained from the authors. This tool consists of 25 self-reported questions on a 5-point Likert scale ranging from 0 (not at all true) to 4 (true most of the time). The total score ranges from 0 to 100, with higher scores indicating greater resilience. Cronbach's α was 0.89 in Connor and Davidson's [28] study and 0.92 in this study.

Post-Traumatic Stress

A measure to assess PTS was developed by Weathers et al. [29]. It was revised and supplemented with the PCL-5 by Weathers et al. [30] according to the revised DSM-5 criteria for PTS. In this study, the Korean version of the PCL-5 by Kim et al. [21] was used. This tool measures the level of distress caused by stressful experiences in the past month. It is useful for individual screening and diagnostic assessment of PTSD and for monitoring changes in PTSD symptoms. It comprises 20 self-report questions on a 5-point Likert scale ranging from 0 (not at all) to 4 (extremely). The total score ranges from 0 to 80, with higher scores indicating higher PTS. Cronbach's alpha for the PCL-5 was 0.79 in the Weathers et al. [29] study and 0.92 in the present study.

Depressive Symptoms

The Korean version of Radloff's [31] Center for Epidemiologic Studies Depression scale (CES-D), adapted by Chon and Rhee [32], was used. This scale, which measures the degree of depressive symptoms over the past week, comprises 20 self-reported questions on a 4-point Likert scale ranging from 0 (rarely or never) to 3 (all the time). The total score ranges from 0 to 60, with higher scores indicating higher levels of depressive symptoms. Cronbach's α was 0.89 in Radloff's [31] study and 0.93 in this study.

Anxiety

The State-Trait Anxiety Inventory (STAI) developed by Spielberger et al. [33] and translated by Kim and Shin [34] was used. This is a self-reported tool rated on a 4-point Likert scale ranging from 1 (not at all) to 4 (very much), with 40 self-reported questions – 20 items for state anxiety (STAI-I; the degree to which people currently feel anxious) and 20 items for characteristic

anxiety (STAI-II; the degree to which people generally feel anxious). The total score ranges from 20 to 80, with higher scores indicating higher levels of anxiety. Cronbach's α values for state and trait anxiety were 0.92 and 0.89, respectively, in the original study and 0.94 and 0.92, respectively, in this study.

Data Analysis

Data were analyzed using IBM SPSS Statistics for Windows version 27 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to present the participants' general characteristics as frequencies, percentages, means, and standard deviations. A homogeneity test was performed, and the participants' general and clinical characteristics were assessed using the χ^2 test, Fisher's exact test, and *t*-test. The normality test of functional health, social support, resilience, PTS, depressive symptoms, and anxiety between the intervention and control groups was analyzed using the Shapiro-Wilk test. In the ITT, PTS ($p = 0.003$), depressive symptoms ($p < 0.001$), and trait anxiety ($p = 0.048$) were not normally distributed. In PP, PTS ($p = 0.004$) and depressive symptoms ($p < 0.001$) were not normally distributed. However, repeated measures ANOVA is such that the F-statistic power does not change by the violation of normality and is robust to non-normality when the sphericity assumption is met [35]. Therefore, repeated measures ANOVA was performed in this study to examine the effects of IBTRNI according to ITT, with the last observation carried forward and PP. In case of deviation from sphericity, ANOVA was computed using the relevant Huynh-Feldt epsilon value (ε). Independent *t*-test and Mann-Whitney U test were also used to examine the differences between the intervention and control groups at post-test 1 and post-test 2 from pre-test.

The statistical significance level was set at 0.05. Effect sizes for *t*-tests were reported as Cohen's d [36]; 0.0–0.19 = trivial effect size (T); 0.20–0.49 = small effect size (S); 0.50–0.79 = medium effect size (M); greater than 0.80 = large effect size (L). Effect sizes for *F*-tests were reported as partial eta-squared (ηp^2): $\eta p^2 < 0.019$ = trivial effect size (T); $0.020 < \eta p^2 < 0.059$ = small effect size (S); $0.006 < \eta p^2 < 0.139$ = medium effect size (M); $\eta p^2 > 0.14$ = large effect size (L) [37].

Results

General, Clinical, and Nursing Career-Related Characteristics

The participants' general and clinical characteristics are shown in Table 1. The mean age of the nurses was 30.77 ± 4.73 years in the intervention group and 31.36 ± 4.33 years in the control group. The percentage of nurses who drank one or more alcoholic drinks at least once a week was 47.3%, and approximately 8.9% had cardiovascular, gynecological, digestive, or endocrine system diseases.

The participants' nursing career-related characteristics are shown in Table 1. Regarding the type of organization, 50 (44.6%) worked in tertiary referral hospitals, 55 (49.2%) in hospitals, and 7 (6.2%) in other organizations, including schools and health centers. Among hospital workers, 34 (30.3%) nurses worked in general wards, 24 (21.5%) in special wards (intensive care unit, operating room, emergency room), and 54 (48.2%) in outpatient wards.

At baseline, there were no statistically significant differences in general, clinical, and Nursing career-related characteristics between the intervention and control groups. Thus, the two groups were homogeneous before the intervention (Table 1). Therefore, changes in the dependent variable did not have confounding effects due to the participants' general, clinical, and nursing career-related characteristics.

Functional Health, Social Support, Resilience, PTS, Depressive Symptoms, and Anxiety over Time and between the Two Groups

Tables 2 and 3 and Figure 2 provide the descriptive statistical overview and inferential indices in the ITT and PP analyses.

Self-reported functional health and resilience increased over time (medium effect size), but more so in the intervention group (medium effect size) than in the control group in ITT and PP analysis.

Self-reported social support did not change over time (small effect size); social support increased in the intervention group (small effect size) compared to the control group in ITT and PP analysis.

Self-reported PTS decreased over time (medium effect size), but more so in the intervention group (medium effect size), and remained unchanged in the control group in ITT and PP analysis.

Depressive symptoms, state anxiety, and trait anxiety, as rated self-reported, decreased over time (medium effect size), but more so in the intervention group (large effect size), and remained unchanged in the control group in ITT and PP analysis.

Functional Health, Social Support, Resilience, PTS, Depressive Symptoms, and Anxiety over Time and within the Two Groups.

Tables 4 and 5 provide mean differences at post-test 1 and post-test 2 from pre-test and the overview effect sizes of variables for two groups. Self-reported functional health and resilience increased (medium to large effect size) in the intervention group in ITT and PP analysis. Social support, rated self-reported, increased (medium effect size) in the intervention group in ITT analysis but not in PP analysis.

PTS, rated self-reported, decreased (small to medium effect size) in the intervention group in ITT and PP analysis. There is a difference in the effect size in ITT and PP analysis.

Depressive symptoms, rated self-reported, decreased (medium to large effect size) in the intervention group in

Table 1. Baseline demographic, clinical, and nursing career-related characteristics of the participants (N = 112)

Variables	Total (N = 112)	Exp. (n = 56)	Cont. (n = 56)	χ^2 or t	p value
		n (%) or m (SD)			
Age, years (range: 22–40)	31.06 (4.52)	30.77 (4.73)	31.36 (4.33)	$t(100) = 0.69$ (d = 0.13, T)	0.493
Gender					
Men	4 (3.6)	3 (5.4)	1 (1.8)	1.04	0.618[a]
Women	108 (96.4)	53 (94.6)	55 (98.2)	df = 1	
Religion					
Yes	56 (50.0)	29 (51.8)	27 (48.2)	0.14	0.850[a]
No	56 (50.0)	27 (48.2)	29 (51.8)	df = 1	
Marital status					
Single	69 (61.6)	39 (69.6)	30 (53.6)	3.11	0.211
Married	40 (35.7)	16 (28.6)	24 (42.9)	df = 2	
Separated, widowed, or divorced	3 (2.7)	1 (1.8)	2 (3.6)		
Education level					
College or higher	86 (76.8)	41 (73.2)	45 (80.4)	0.80	0.502[a]
Graduate school or higher	26 (23.2)	15 (26.8)	11 (19.6)	df = 1	
Current employment					
Current	101 (90.2)	51 (91.1)	50 (89.3)	0.10	1.00[a]
None or past	11 (9.8)	5 (8.9)	6 (10.7)	df = 1	
Smoking					
Non-smoker	97 (86.6)	47 (83.9)	50 (89.3)	0.69	0.580[a]
Current smoker	15 (13.4)	9 (16.1)	6 (10.7)	df = 1	
Drinking					
Past drinker	48 (42.9)	21 (37.5)	27 (48.2)	1.31	0.340[a]
Alcohol drinker	64 (57.1)	35 (62.5)	29 (51.8)	df = 1	
Disease					
Yes	11 (9.8)	8 (14.3)	3 (5.4)	2.52	0.203[a]
No	101 (90.2)	48 (85.7)	53 (94.6)	df = 1	
Exercise					
Yes	44 (39.3)	20 (35.7)	24 (42.9)	0.60	0.562[a]
No	68 (60.7)	36 (64.3)	32 (57.1)	df = 1	
Position					
General nurses	94 (83.9)	45 (80.4)	49 (87.5)	1.06	0.441[a]
Senior nurses or higher	18 (16.1)	11 (19.6)	7 (12.5)	df = 1	
Type of organization					
Tertiary referral hospitals	50 (44.6)	25 (44.6)	25 (44.6)	2.85	0.241
Hospitals	55 (49.2)	28 (50.0)	27 (48.2)	df = 2	
Other organizations	7 (6.2)	3 (5.4)	4 (7.2)		
Type of work					
Shift work	74 (66.1)	40 (71.4)	34 (60.7)	1.43	0.318[a]
Full-time employees	38 (33.9)	16 (28.6)	22 (39.3)	df = 1	
Working experience					
<3 years	21 (18.8)	12 (21.4)	9 (16.1)	0.82	0.845
3–5 years	23 (20.5)	10 (17.9)	13 (23.2)	df = 3	
5 ~ <10 years	38 (33.9)	19 (33.9)	19 (33.9)		
≥10 years	30 (26.8)	15 (26.8)	15 (26.8)		

Exp., intervention group; Cont., control group; M, mean; SD, standard deviation; d, Cohen's d; T, trivial effect size. [a]Fisher's exact test.

Table 2. Overview of the inferential indices by ITT analysis

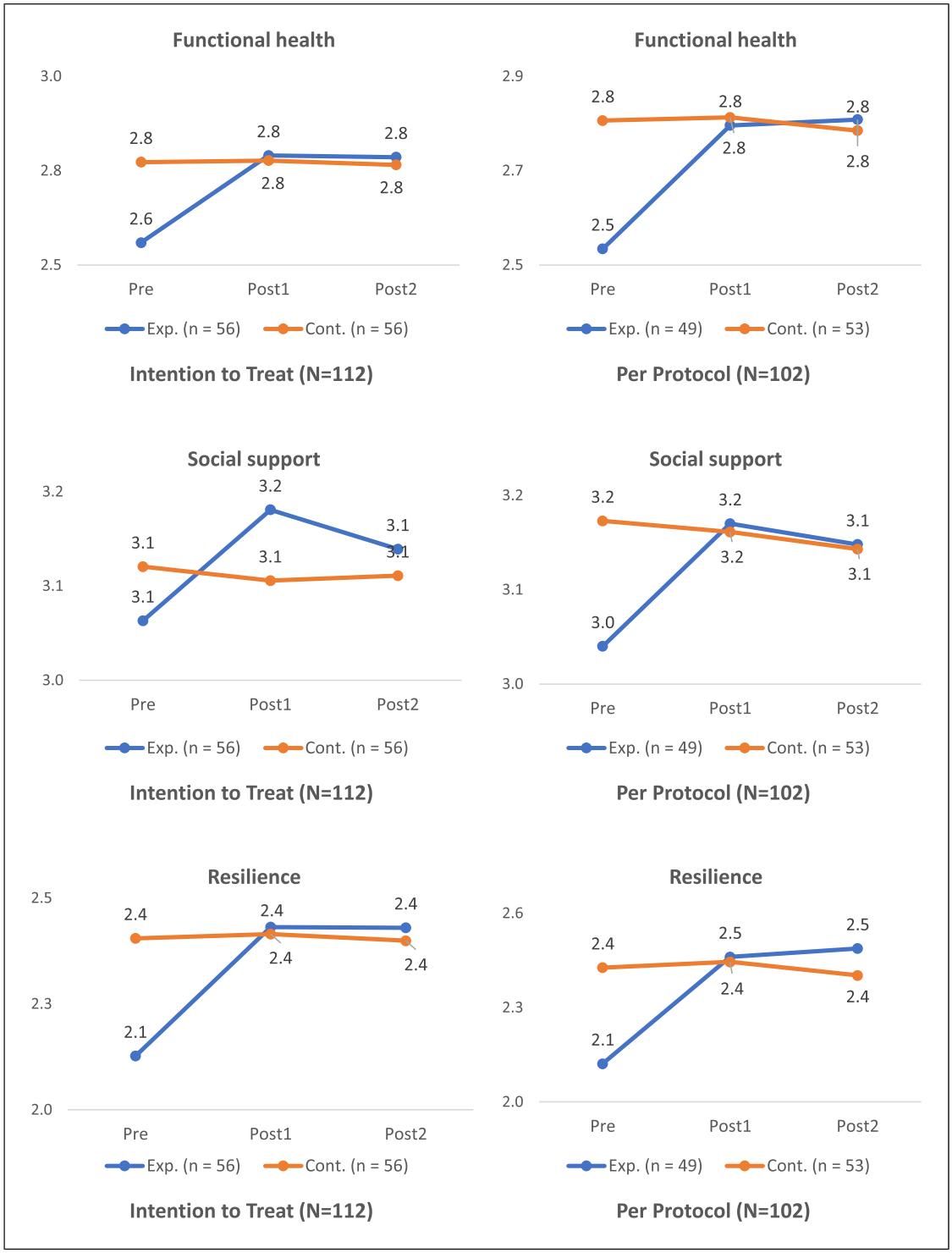
Inferential statistics							
Variables	time		group		time × group interaction		Huynh-Feldt ε
	F	ηp² (ES)	*F*	ηp² (ES)	*F*	ηp² (ES)	
Functional health	*F*(1.77, 194.85) = 4.29**	0.115 (M)	*F*(1, 110) = 1.104	0.010 (S)	*F*(1.77, 194.85) = 1461**	0.117 (M)	0.886
Social support	*F*(1.82, 199.71) = 2.22	0.020 (S)	*F*(1, 110) = 0.07	0.001 (S)	*F*(1.81, 199.71) = 3.69*	0.032 (S)	0.908
Resilience	*F*(1.75, 192.67) = 10.79***	0.089 (M)	*F*(1, 110) = 0.90	0.008 (S)	*F*(1.75, 192.67) = 10.48***	0.087 (M)	0.876
Post-traumatic stress	*F*(1.71, 188.57) = 7.03**	0.060 (M)	*F*(1, 110) = 0.33	0.003 (S)	*F*(1.71, 188.57) = 7.45**	0.063 (M)	0.857
Depressive symptoms	*F*(1.77, 195.08) = 7.25**	0.062 (M)	*F*(1, 110) = 0.67	0.006 (S)	*F*(1.77, 195.08) = 14.66***	0.118 (M)	0.887
State anxiety	*F*(1.79, 196.90) = 13.19***	0.107 (M)	*F*(1, 110) = 0.44	0.004 (S)	*F*(1.79, 196.90) = 17.03***	0.134 (M)	0.895
Trait anxiety	*F*(1.53, 168.73) = 13.87***	0.112 (M)	*F*(1, 110) = 0.71	0.006 (S)	*F*(1.53, 168.73) = 17.38***	0.136 (M)	0.767

ES, effect size; T, trivial effect size; S, small effect size; M, medium effect size; L, large effect size. *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.

Table 3. Overview of the inferential indices by PP

Inferential statistics							
Variables	time		group		time × group interaction		Huynh-Feldt ε
	F	ηp² (ES)	*F*	ηp² (ES)	*F*	ηp² (ES)	
Functional health	*F*(1.83, 182.59) = 16.38***	0.141 (L)	*F*(1, 100) = 2.29	0.022 (S)	*F*(1.83, 182.59) = 18.52***	0.156 (L)	0.913
Social support	*F*(1.85, 184.70) = 2.48	0.024 (S)	*F*(1, 100) = 0.45	0.005 (T)	*F*(1.85, 184.70) = 4.48*	0.043 (S)	0.924
Resilience	*F*(1.78, 177.46) = 12.13***	0.108 (M)	*F*(1, 100) = 0.709	0.007 (T)	*F*(1.78, 177.46) = 12.94***	0.115 (M)	0.887
Post-traumatic stress	*F*(1.74, 174.10) = 7.67**	0.071 (M)	*F*(1, 100) = 0.530	0.005 (T)	*F*(1.74, 174.10) = 7.40**	0.069 (M)	0.870
Depressive symptoms	*F*(1.82, 182.02) = 8.28**	0.076 (M)	*F*(1, 100) = 2.41	0.024 (S)	*F*(1.82, 182.02) = 16.87***	0.144 (L)	0.910
State anxiety	*F*(1.86, 185.68) = 15.75***	0.136 (M)	*F*(1, 100) = 1.51	0.015 (T)	*F*(1.86, 185.68) = 24.00***	0.194 (L)	0.928
Trait anxiety	*F*(1.57, 157.02) = 16.03***	0.138 (M)	*F*(1, 100) = 1.00	0.010 (T)	*F*(1.57, 157.02) = 21.15***	0.175 (L)	0.785

T, trivial effect size; S, small effect size; M, medium effect size; L, large effect size. *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.



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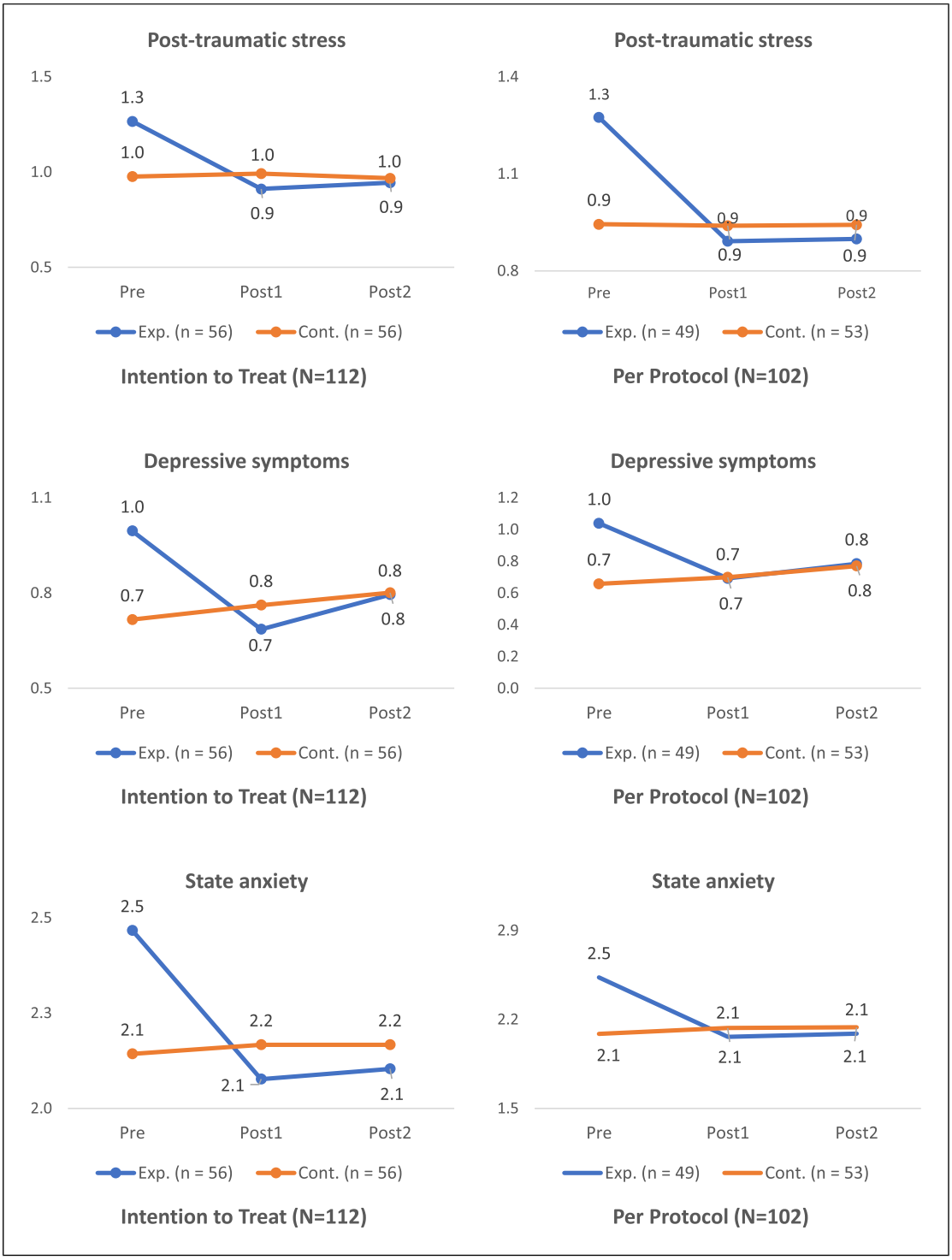

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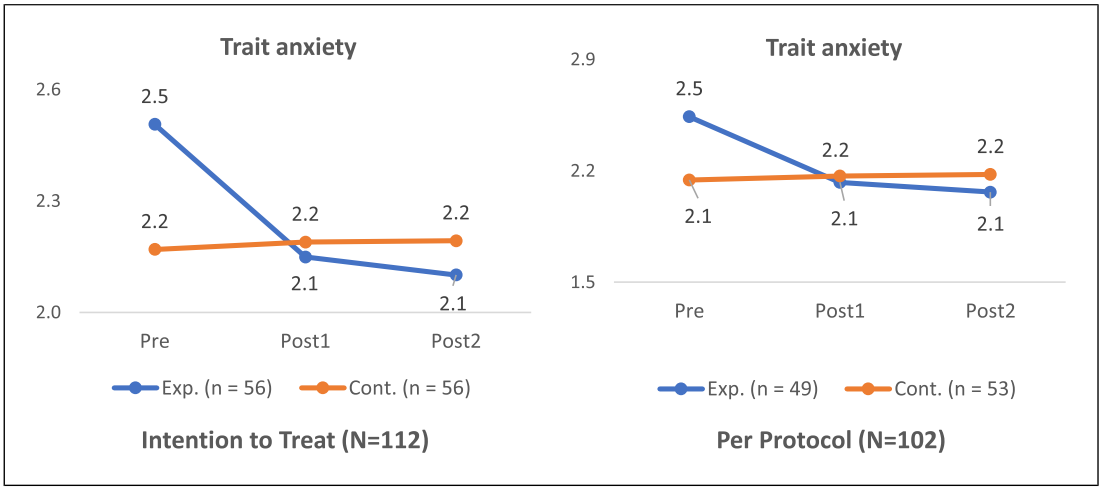

Fig. 2. Descriptive statistical overview of functional health, social support, resilience, post-traumatic stress, depressive symptoms, and state and trait anxiety by ITT analysis and PP. Measurements were done before (pre-test), at the end of the program (post-test 1), and 4 weeks after the program completion (post-test 2). Exp., intervention group; Cont., control group.

ITT and PP analysis. There is a difference in the effect size in ITT and PP analysis. State and trait anxiety, rated self-reported, decreased (large effect size) in the intervention group in ITT and PP analysis.

Discussion

Based on Swanson's theory of caring, this randomized controlled trial evaluated the effects of the IBTRNI on nurses at 3 time points: pre-test, post-test 1, and post-test 2. The results presented demonstrate that for nurses with experiences of trauma, their health function, resilience, and social support can improve with the IBTRNI. Additionally, this intervention can reduce PTS symptoms, depressive symptoms, and anxiety.

The IBTRNI was effective in improving the mental health status of nurses. Reductions in state and trait anxiety and PTS scores were observed at post-test 2, compared with at pre-test for the intervention group. Similarly, resilience improved significantly over time in the intervention group. Depressive symptoms, anxiety, and PTS among nurses increased and resilience decreased when face-to-face contact became difficult because of the COVID-19 pandemic [5, 7, 38]. Melnyk et al. [39] reported that mindfulness and cognitive-behavioral therapy-based interventions for nurses reduced depressive symptoms and anxiety and increased resilience, which is consistent with the present results. However, individuals, including nurses, may find it difficult to seek expert counseling and to talk about various stressful or traumatic events. To compensate for this limitation, this study was conducted online using a computer or mobile device, thereby eliminating the need for a mediator. Online intervention is flexible and confidential; thus, it can reduce self-stigma and increase help-seeking intentions compared with formal care settings [40]. Online psychological interventions also help alleviate PTSD, depressive symptoms, and anxiety [41, 42]. Therefore, online psychological intervention programs must be expanded, so that nurses can obtain help for their problems, regardless of time and place.

The nurses who received the IBTRNI had significantly higher functional health scores than those in the control group; the scores increased from pre-test to post-test 1 and then to the post-test 2 stages. Nurses who work shifts experience high levels of stress and are at increased risk for cardiovascular disease, metabolic disorders, breast cancer, sleep disturbances, and difficulties with family and social relationships [43]. During the COVID-19 pandemic, nurses experienced physical health problems related to psychological distress (e.g., headache, insomnia, and throat pain) [38]. Our findings confirm that psychological support and interventions significantly improve their overall functional health. Additionally, considering that nurses who directly care for patients also manage their own health, encouraging health-promoting behaviors through appropriate nutrition and exercise is necessary, as this also affects patient care [44].

Social support improved considerably over time, with the intervention group showing significantly greater improvement than the control group. During the initial stages of the pandemic, nurses directly caring for COVID-19 patients in

Table 4. Effect sizes for mean comparison of variables between experimental and control group at post-test (post-test 1) and follow-up (post-test 2) from pre-test by ITT analysis (N = 112)

Variables	Differences	Exp. (n = 56)	Cont. (n = 56)	Within group		Cohen's d (ES)
		mean (SD)		t/Z	p value	
Functional health	Post1-Pre	0.23 (0.06)	0.00 (0.03)	−4.74	<0.001	−0.897 (L)
	Post2-Pre	0.23 (0.05)	−0.01 (0.00)	−4.06	<0.001	−0.768 (M)
Social support	Post1-Pre	0.12 (0.01)	−0.01 (0.04)	−2.81	0.006	−0.531 (M)
	Post2-Pre	0.08 (0.00)	−0.01 (0.03)	−1.49	0.139	−0.282 (S)
Resilience	Post1-Pre	0.30 (−0.05)	0.01 (0.05)	−3.52	0.001	−0.665 (M)
	Post2-Pre	0.30 (−0.02)	−0.01 (−0.02)	−3.70	<0.001	−0.699 (M)
Post-traumatic stress	Post1-Pre	−0.35 (−0.04)	0.02 (0.04)	−3.97	<0.001	0.756 (M)
	Post2-Pre	−0.32 (−0.04)	−0.01 (0.09)	−3.12	0.002	0.477 (S)
Depressive symptoms	Post1-Pre	−0.31 (−0.08)	0.05 (0.01)	−4.94	<0.001	0.972 (L)
	Post2-Pre	−0.20 (−0.03)	0.08 (−0.01)	−3.03	0.002	0.669 (M)
State anxiety	Post1-Pre	−0.39 (−0.02)	0.02 (0.06)	4.84	<0.001	0.914 (L)
	Post2-Pre	−0.36 (0.00)	0.02 (0.00)	4.42	<0.001	0.836 (L)
Trait anxiety	Post1-Pre	−0.36 (−0.01)	0.02 (−0.01)	−4.21	<0.001	0.832 (L)
	Post2-Pre	−0.41 (−0.04)	0.02 (−0.04)	−4.14	<0.001	0.864 (L)

Measurements were done before (Pre), at the end of the program (Post1), and 4 weeks after the program completion (Post2). Exp., Intervention group; Cont., control group; SD, standard deviation; ES, effect size; T, trivial effect size; S, small effect size; M, medium effect size; L, large effect size.

Table 5. Effect sizes for mean comparison of variables between experimental and control group at post-test (post-test 1) and follow-up (post-test 2) from pre-test by PP (N = 102)

Variables	Differences	Exp. (n = 49)	Cont. (n = 53)	Within group		Cohen's d (ES)
		mean (SD)		t/Z	p value	
Functional health	Post1-Pre	0.26 (0.06)	0.01 (0.04)	4.98	<0.001	0.987 (L)
	Post2-Pre	0.27 (0.06)	−0.02 (0.01)	4.87	<0.001	0.965 (L)
Social support	Post1-Pre	0.13 (0.02)	−0.01 (0.04)	2.73	0.008	0.545 (M)
	Post2-Pre	0.11 (0.02)	−0.03 (0.03)	2.22	0.029	0.440 (S)
Resilience	Post1-Pre	0.34 (−0.09)	0.02 (0.06)	3.53	0.001	0.700 (M)
	Post2-Pre	0.37 (−0.06)	−0.02 (−0.01)	4.42	<0.001	0.876 (L)
Post-traumatic stress	Post1-Pre	−0.38 (−0.02)	0.00 (0.02)	−3.57	<0.001	−0.739 (M)
	Post2-Pre	−0.38 (−0.04)	0.00 (0.09)	−3.28	0.001	−0.551 (M)
Depressive symptoms	Post1-Pre	−0.35 (−0.06)	0.04 (0.01)	−4.94	<0.001	−1.030 (L)
	Post2-Pre	−0.25 (0.00)	0.11 (−0.02)	−3.990	<0.001	−0.843 (L)
State anxiety	Post1-Pre	−0.47 (0.00)	0.05 (0.07)	−5.73	<0.001	−1.136 (L)
	Post2-Pre	−0.44 (0.03)	0.05 (0.01)	−5.40	<0.001	−1.070 (L)
Trait anxiety	Post1-Pre	−0.41 (0.00)	0.03 (−0.01)	−4.80	<0.001	−0.950 (L)
	Post2-Pre	−0.47 (−0.03)	0.03 (−0.05)	−5.12	<0.001	−1.015 (L)

Measurements were done before (Pre), at the end of the program (Post1), and 4 weeks after the program completion (Post2). Exp., intervention group; Cont., control group; SD, standard deviation; ES, effect size; T, trivial effect size; S, small effect size; M, medium effect size; L, large effect size.

high-risk environments had increasing workloads and low levels of professional training [45]; subsequently, they found it challenging to sustain their work owing to deficient social support [46]. Therefore, to maintain trust between participants and therapists, a standardized response letter format was used for each session to facilitate understanding of personal stories and provide support through online interactions.

There are several limitations to this study. First, participants in the control group in this study did not receive any intervention while the experimental group received the intervention. Therefore, the control condition was not an active control condition [47], which limits the robustness of the pattern of results. Second, this study was conducted during the 2020 pandemic. However, it was not possible to confirm how long nurses would participate in COVID-19 clinical work at that time. Therefore, future research needs to identify the physical, mental, and social health status of nurses according to the period of exposure to work in disaster situations such as COVID-19. Finally, the variables used in this study to identify psychiatric symptoms were not assessed by professionals and relied solely on self-declaration. Considering that the handling of psychiatric labels during the COVID-19 pandemic and subsequent social restrictions was sloppy and unprofessional [48], future studies should include evaluation of psychiatric symptoms by professionals.

Conclusion

This study examined the feasibility of using the IBTRNI for nurses. It found that the theory-based program positively affected PTS, functional health, resilience, social support, depressive symptoms, and anxiety of nurses. To further evaluate its effects, we recommend that the intervention be tested with other sample groups (patients, adults, adolescents), with longer-term follow-up (3 months or more), using other methods (face-to-face or group intervention). The IBTRNI should also be used to further educate nurses so that mental health nurses can help trauma victims in clinical and community settings.

Statement of Ethics

All procedures involving human participants were conducted in accordance with the ethical standards of the Institutional Review Board of Yonsei University Health (IRB No. Y-2019-0083) and the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This study was registered at ClinicalTrials.gov – US National Library of Medicine (clinical trial registration number: NCT04989582) and is available online. Written informed consent was obtained from all the participants.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

All the listed authors meet the authorship criteria according to the latest guidelines of the International Committee of Medical Journal Editors and are in agreement with the manuscript. S.K., J.P., W.L., and G.K. were responsible for the concept and design of this study. S.K., W.L., and G.K. performed the data collection. S.K., J.P., and G.K. were responsible for the data analysis and interpretation. G.K. wrote the manuscript under the supervision of S.K. All the authors contributed to and approved the final manuscript.

Data Availability Statement

The data that support the findings of this study are not publicly available due to their containing information that could compromise the privacy of research participants but are available from the corresponding author G.K. upon reasonable request.

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