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App-Assisted TF-CBT-Based Intervention as Add-on to Inpatient Treatment Reduces Children's Post-Traumatic Stress Symptoms and Post-Traumatic Cognitions

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Abstract: Previous studies suggested that trauma-focused cognitive behavior therapy (TF-CBT) is effective in reducing symptoms of post-traumatic stress disorder (PTSD) and depression in children and adolescents. However, the effects of app-assisted TF-CBT-based interventions in psychiatric clinics compared to treatment-as-usual (TAU) are under-explored. The purpose of this study was to reveal the added value of the app-assisted TF-CBT-based intervention as an add-on to TAU. The digitalized measures of the Child and Adolescent Trauma Screen (CATS), The Adolescent Dissociative Experience Scale (A-DES), Short Moods and Feelings Questionnaire (SMFQ), PTSD Checklist (PCL-5), and Children's Post-Traumatic Cognitions Inventory (CPTCI) were applied at baseline and post-treatment. The app-assisted TF-CBT-based group participants started with higher levels of negative alterations in cognition and mood compared to TAU participants but at post-treatment, no significant differences were observed between the app-assisted TF-CBT and TAU groups. Within the app-assisted TF-CBT group, post-treatment scores were significantly lower in post-traumatic stress symptoms, intrusion symptoms, alterations in arousal and reactivity, overall post-traumatic cognitions, and belief in being "a fragile person in a scary world". Within the TAU group, post-treatment scores were notably lower just in dissociation and intrusion symptoms. The study suggests that app-assisted TF-CBT-based intervention can be effective in addressing specific trauma-related symptoms. The findings imply the necessity for screening for traumatic experiences, incorporating trauma-informed care, implementation of TF-CBT into treatment protocols, utilization of app-assisted interventions, tailoring interventions to individual needs, and comprehensive assessment and monitoring of treatment progress.

Keywords: app-assisted; TF-CBT; post-traumatic stress; post-traumatic cognitions; treatment

1. Introduction

Traumatic experiences like abuse, natural disasters, or loss of loved ones, may result in numerous harmful consequences on mental health [1–4], 2.6 times increasing the risk of depressive disorders [5], not to mention post-traumatic stress disorder (PTSD) [6,7].

Numerous studies revealed that Trauma-Focused Cognitive Behavioral Therapy (TF-CBT) is effective in reducing symptoms of post-traumatic stress disorder (PTSD) and depression [8]. The efficacy of TF-CBT for children has shown large improvements in posttraumatic stress symptoms and secondary symptoms at 12-month follow-up [9]. Some studies found it to be effective in lowering anxiety symptoms [10]. Research evidenced that even shortened versions of TF-CBT, consisting of eight sessions, are effective in reducing PTSD and depression symptoms in adolescents with multiple

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trauma exposure in low- and middle-income countries [11]. The efficacy of TF-CBT for children was supported by meta-analyses, which showed large effect sizes for posttraumatic growth and emotional management, and moderate to large effects for PTSD and depression [12].

However, little is known about whether digitalized TF-CBT-based interventions delivered in psychiatry units where the participation of caregivers is limited or impossible, could also contribute to children's mental health. Therefore, the purpose of this study was to reveal the efficacy of app-assisted TF-CBT-based intervention. Prior studies suggested that children's post-traumatic stress disorder symptoms, dissociation symptoms, moods and feelings, perceived social support, and post-traumatic cognitions could be significant indicators of children's mental health, so these indicators were chosen to examine the response to app-assisted TF-CBT-based intervention.

1.1. Trauma-Focused Cognitive Behavior Therapy

TF-CBT was designed to help children and adolescents who have been exposed to traumatic events and struggle with the psychological consequences of traumatic experiences [13–15]. TF-CBT incorporates various components aimed at addressing trauma-related symptoms, including psychoeducation about trauma, learning to apply relaxation techniques, cognitive restructuring, exposure to trauma-related memories and thoughts, trauma narrative, and strengthening of emotional regulation skills with the help of mindfulness exercises [14,16–18], which are an integral part of TF-CBT, helping develop present-moment awareness and acceptance of the experience. These exercises include mindful breathing (noticing each inhale and exhale without judgment, which helps cultivate a sense of grounding in the present moment), a guided meditation promoting self-awareness and relaxation, and observing thoughts and emotions as they arise, without getting caught up in them. Mindfulness exercises in TF-CBT aim to empower children to build resilience for the future by developing adaptive emotional regulation skills.

TF-CBT has been tested in various randomized trials and evidence supports its superiority in the treatment of children's traumas [19]. The TF-CBT proved to be effective in decreasing symptoms of PTSD among adjudicated girls who are victims of domestic minor sex trafficking [20]. The TF-CBT resulted in substantial reductions in both maternal and self-reported severity of sheltered children's PTSD symptomology [21]. The efficacy of TF-CBT for children in randomized controlled trials was confirmed by systematic reviews and meta-analyses [22].

Previous research suggested that TF-CBT is an effective treatment option for children and adolescents in clinical trials, particularly for PTSD, depression, anxiety, and abuse-related symptoms [23–25]. Recent studies provided some evidence of telehealth-based TF-CBT applications, which were proven to be efficient in the case studies [26], including treatment of adolescent PTSD [24], or trials with different samples [27], including children with autism [28], or young people in foster care [29].

TF-CBT is typically delivered by trained mental health professionals. The effect of digitalized TF-CBT intervention, including audiotaped mindfulness exercises for children is still under-researched. The applications of app-assisted TF-CBT-based interventions in children's psychiatric clinics compared to treatment-as-usual is also not enough explored.

1.2. Post-Traumatic Stress

Numerous research has demonstrated that children's exposure to traumatic events significantly impacts mental health [30–33] and might result in the development of PTSD or complex PTSD [2], which refers to a condition signifying that a child has experienced distress and impairment in functioning following exposure to emotionally overwhelming incidents [6]. Common symptoms in children who exhibit symptoms of post-traumatic stress are re-experiencing, including flashbacks, nightmares, intrusive thoughts, avoidance of reminders of the trauma, arousal, and reactivity related to the traumatic event, distorted self-views or worldviews, and persistent negative emotions [34–41]. Research also evidenced that not all children who experience trauma will develop post-traumatic stress symptoms, and individual responses can vary depending on protective factors, but these factors are still under-researched [42]. Earlier research also confirmed that TF-CBT is efficient in decreasing symptoms of PTSD [8,9]. However, it is not clear whether app-assisted TF-CBT-based

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intervention can significantly reduce the symptoms of PTSD, and which group of PTSD symptoms it targets the most.

1.3. Post-Traumatic Cognitions

On the whole, TF-CBT incorporates cognitive-behavioral techniques to help individuals process and cope with traumatic experiences [13,14,43]. It focuses on addressing the cognitive distortions and negative beliefs that may result from the trauma. Earlier research evidenced that due to traumatic experiences, children may develop numerous negative cognitions [44,45]. Children might develop negative beliefs about themselves, including a negative self-view [46]. Traumatic experiences might also contribute to a negative worldview [4,46–48]. Addressing post-traumatic cognitions is fundamental in helping children recover from the impact of traumatic experiences, and TF-CBT intends to identify maladaptive cognitions and help children develop more adaptive thought patterns and coping mechanisms [10,48–53]. Several clinical trials suggested that post-traumatic cognitions are important treatment targets [1,54,55]. However, it is not clear whether app-assisted TF-CBT-based intervention could substantially improve the cognitions of children hospitalized in psychiatry units.

1.4. Dissociation Symptoms

Next, previous studies also evidenced that traumatic experiences might be related to dissociation symptoms, including depersonalization, derealization, amnesia, identity confusion, flashbacks, or difficulty concentrating [56,57], referring to a disconnection between an individual's thoughts, identity, consciousness, or memory, which can be a coping mechanism in response to traumatic events [58–62]. Traumatic experiences can lead to dissociation as a way for the child to mentally escape from it. Nonetheless, research suggested that not all traumatized children will exhibit dissociative symptoms, and symptoms would vary among individuals [62,63]. Early disruptions in attachment can contribute to dissociation [60,64]. Individuals with pre-existing mental health issues, such as anxiety or depression, may be more susceptible to dissociative symptoms [59], and there may be neurological and genetic factors that contribute to vulnerability [61,65]. Prior research evidenced that TF-CBT is effective in reducing dissociation symptoms in individuals with a history of trauma [20] and that CBT intervention augmented with techniques targeting dissociative symptoms leads to significant improvements in dissociation severity among voice hearers with psychosis and a history of interpersonal trauma [66]. However, the value of app-assisted TF-CBT-based intervention in diminishing dissociation symptoms is not sufficiently explored.

1.5. Emotional States

Another indicator of children's mental health, including PTSD, is emotional states [67]. Facing stressful challenges without adequate coping mechanisms may increase children's withdrawal or irritability [58]. Numerous studies evidenced that traumatic experiences may play a role in shaping a child's emotional state, not to mention the impact of illness or hospitalization itself, fatigue, treatment procedures, or physical discomfort [68] and monitoring children's moods and feelings could provide significant information on mental health conditions [69,70]. Previous studies suggested that TF-CBT can be effective in reducing negative moods, as it addresses the intercorrelation of mood, thinking, and behavior, and several studies have proven the efficacy of TF-CBT in treating depression [8,11]. On the whole, CBT is based on the premise that negative thinking contributes to negative moods, and more adaptive ways of thinking can improve emotional states [71]. However, not much is known about the efficacy of app-assisted TF-CBT-based intervention in improving emotional states as compared to treatment-as-usual in psychiatry units.

The purpose of this study was to reveal the efficacy of app-assisted TF-CBT-based intervention as an add-on to inpatient children's treatment. It was hypothesized that app-assisted TF-CBT-based intervention would significantly reduce post-traumatic stress symptoms, post-traumatic cognitions, negative moods and feelings, and dissociation symptoms of hospitalized children.

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2. Materials and Methods

2.1. The Sample

The total sample consisted of 20 children hospitalized in the Child Psychiatry Unit at Vilnius University Hospital Santaros Klinikos, Vilnius, Lithuania. The criteria for the inclusion of participants in biomedical research were the age of the study participants (10-17 years old, as most original research methodologies were developed for children aged 10 and older), and a high probability of PTSD based on a score of the Child and Adolescent Trauma Screen (CATS) results.

The sociodemographic and other characteristics of participants at baseline in TF-CBT and TAU samples are presented in Table 1.

Table 1. Characteristics of participants at baseline in clinical and non-clinical samples.

Baseline characteristic	**TF-CBT sample (*n* = 9)**		**TAU sample (*n* = 11)**	
	n	**%**	***n***	**%**
Gender				
Female	8	88.9	4	40
Male	1	11.1	6	60
Prefer not to answer	-	-	1	10
	M	***SD***	***M***	***SD***
Age	13.111	1.167	12.600	2.503
Female	13.250	1.165	14.000	3.162
Male	12.000	-	11.667	1.633
Prefer not to answer	**-**	-	***n = 1***	-

Note. M = Mean; SD = standard deviation.

The diagnoses of participants in the TF-CBT and TAU samples are presented in Table 2.

Table 2. Diagnoses of participants in the TF-CBT and TAU samples.

ID	**Code**	**Full Diagnosis based on the ICD-10**
	TF-CBT sample	
1	XTRAblosx	Childhood autism (F84.0) and Mixed disorder of scholastic skills (F81.3).
2	XTRAczicj	Moderate depressive episode without somatic symptoms (F32.10), Suicidal thoughts, Suicidal ideation (R45.81), Personal history of self-harm (Z91.5).
3	XTRAdfams	Other childhood emotional disorders (F93.8), Other specified problems related to primary support group (Z63.8), Other negative life events in childhood (Z61.8).
4	XTRAglnam	Moderate depressive episode without somatic symptoms (F32.10), Suicidal ideation (R45.81), Personal history of self-harm (Z91.5), Other negative life events in childhood (Z61.8).
5	XTRAjfqpg	Severe depressive episode with psychotic symptoms, unspecified as to whether postnatal (F32.30), Suicidal ideation (R45.81), Dietary counseling and supervision (Z71.3), Other negative life events in childhood (Z61.8).
6	XTRAjqhdd	Other childhood emotional disorders (F93.8), Other conduct disorders (F91.8), Mixed disorder of scholastic skills (F81.3), Dietary counseling and supervision (Z71.3), Personal history of self-harm (Z91.5).
7	XTRAnkdom	Other childhood emotional disorders (F93.8), Accentuation of personality traits (Z73.1), Suicidal ideation (R45.81), Personal history of self-harm (Z91.5), Other specified problems related to primary support group (Z63.8).
8	XTRAtfaqb	Depressive conduct disorder (F92.0), Mixed disorder of scholastic skills (F81.3), Other negative life events in childhood (Z61.8), Other specified problems related to upbringing (Z62.8), Feeding difficulties (R63.3).

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9	XTRAtnhfm	Other childhood emotional disorders (F93.8), Accentuation of personality traits (Z73.1), Suicidal ideation (R45.81), Personal history of self-harm (Z91.5), Problems related to alleged sexual abuse of a child by a person within the primary support group (Z61.4), Other negative life events in childhood (Z61.8).
	TAU sample	
10	XTRAapxdf	Other childhood emotional disorders (F93.8).
11	XTRAhewup	Other childhood emotional disorders (F93.8).
12	XTRAhfjrp	Other brief psychotic disorder without associated acute stress (F23.80), Suicidal ideation (R45.81).
13	XTRAjaqko	Childhood autism (F84.0), Other conduct disorders (F91.8), Transient tic disorder (F95.0), Inorganic sleep-wake rhythm disorder (F51.2).
14	XTRAmdqlq	Other childhood emotional disorders (F93.8), Other conduct disorders (F91.8), Mixed disorder of scholastic skills (F81.3), Other specified problems related to upbringing (Z62.8), Other negative life events in childhood (Z61.8).
15	XTRAqipcw	Atypical anorexia nervosa (F50.1), Moderate depressive episode without somatic symptoms (F32.10), Suicidal ideation (R45.81), Personal history of self-harm (Z91.5).
16	XTRAqxrur	Other childhood emotional disorders (F93.8), Mixed disorder of scholastic skills (F81.3), Other specified problems related to primary support group (Z63.8).
17	XTRAsyfmo	Moderate depressive episode without somatic symptoms (F32.10), Suicidal ideation (R45.81), Other negative life events in childhood (Z61.8).
18	XTRAwjrxf	Other childhood emotional disorders (F93.8), Asperger's Syndrome (F84.5).
19	XTRAzdixe	Moderate depressive episode without somatic symptoms (F32.10), Atypical anorexia nervosa (F50.1), Suicidal ideation (R45.81), Personal history of self-harm (Z91.5), Other negative life events in childhood (Z61.8).
20	XTRAzjxvw	Attention-deficit hyperactivity disorder, predominantly inattentive type (F90.0), Mixed disorder of scholastic skills (F81.3), Other negative life events in childhood (Z61.8).

2.2. Instruments

Child and Adolescent Trauma Screen (CATS) was applied to assess children's traumatic experiences [72–74]. *CATS* measures 1) potentially traumatic events, 2) posttraumatic stress symptoms, and 3) impairment in psychosocial functioning in children and adolescents aged from 7 to 17 years. The potentially traumatic events checklist includes 15 items assessing traumatic experiences. Posttraumatic stress symptoms in the last four weeks are assessed using 20 items rated on a 4-point Likert scale from 0 ("never") to 3 ("almost always"). Impairment in psychosocial functioning is assessed via five 'yes' or 'no' items that ask whether the previously rated symptoms interfere with key areas of functioning (getting along with others, school/, hobbies, relationships, and general happiness). Previous studies reported a reliability range between 0.88 and 0.94; the convergent-discriminant validity pattern showed medium to strong correlations with measures of depression and anxiety [73–77].

The Adolescent Dissociative Experience Scale - II (A-DES) assessed dissociative symptoms [63,78]. The 30 items in the A-DES are rated on a scale from 0 ("never") to 10 ("always") based on children's self-report symptoms. The total A-DES score is the mean of the 30-item scores. A-DES has been validated in previous studies and demonstrated high reliability [63,78,79].

Short Moods and Feelings Questionnaire (SMFQ) was utilized to assess children's moods and feelings [70]. The SMFQ is a short measure of symptoms of depression in children and adolescents and is validated for use in children aged 6 years and up. The self-report version of the SMFQ, used for this study, consists of 13 items measured on a 3-point Likert scale ranging from 0 ("not true") to 2 ("true"). The SMFQ has been validated with several samples and demonstrated a high reliability of up to 0.91 [69,70,80,81].

PTSD Checklist for DSM-5 (PCL-5) was employed to evaluate children's post-traumatic stress symptoms [82–84]. PCL-5 is a 20-item self-report measure that assesses 20 symptoms of PTSD as

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outlined in the DSM-5, organized into four symptom clusters: 'Intrusion symptoms' (items 1–5), 'Avoidance' (items 6–7), 'Negative alterations in cognition and mood' (items 8–14), and 'Alterations in arousal and reactivity' (items 15–20). Respondents indicate how much they were bothered by a symptom on a 5-point Likert scale ranging from 0 ("not at all") to 4 ("extremely"). The probability of PTSD is verified by endorsing symptoms at 'Moderately' (2) or above for at least one 'Intrusion' and 'Avoidance' symptom, and two 'Negative alterations in cognition and mood' and 'Alterations in arousal and reactivity' symptoms. The validity of the PCL-5 was supported by prior studies which revealed the high reliability of 0.93 of the instruments [82,85,86].

Children's Post-Traumatic Cognitions Inventory (CPTCI) was used to assess children's cognitions [45]. The CPTCI is a self-report scale with 25 items, which aims at assessing negative posttraumatic appraisals in children and adolescents aged 6 to 17 years old on a Likert scale ranging from 1 ("don't agree at all") to 4 ("agree a lot"). The CPTCI includes a belief in "permanent and disturbing change" and a belief in being a "fragile person in a scary world." Previous studies reported good internal consistency (Cronbach's α values between .86 and .96) and moderate correlations with measures of depression and post-traumatic symptoms [31,44,45,87–89].

Table 3 presents Cronbach's α and McDonald's ω values that show the internal consistency regarding the scales used in this study.

Table 3. Cronbach's α and McDonald's ω values of the scales used in the study.

Scales	Variables	Pre-treatment		Post-treatment	
		Cronbach's α	McDonald's ω	Cronbach's α	McDonald's ω
CATS	Posttraumatic stress symptoms	.909	.901	.957	.956
A-DES	Dissociation symptoms, overall	.933	.926	.977	.978
SMFQ	Moods and feelings, overall	.930	.929	.926	.928
PCL-5	PTSD Checklist, overall	.927	.922	.960	.959
	Intrusion symptoms	.827	.824	.878	.895
	Avoidance	.700	.699	.910	.910
	Negative alterations in cognition and mood	.779	.811	.898	.907
	Alterations in arousal and reactivity	.834	.834	.912	.915
CPTCI	Post-Traumatic Cognitions, overall	.958	.957	.967	.966
	Permanent and disturbing change	.932	.930	.960	.960
	Fragile person in a scary world	.900	.894	.910	.906

2.3. Procedure

The procedure followed the guidelines in the Declaration of Helsinki and was approved by the Lithuanian Vilnius region Biomedical Research Ethics Committee, permission No. 2023/4-1499-963, issued 04/04/2023.

The Children's Psychiatry Department at Santaros Clinics hospitalizes about 100 children annually. To collect the data, hospitalized children, and their parents on the day of hospitalization were asked if they agreed to participate in biomedical research. After providing and signing informed consent, children were interviewed with the help of a mobile application created specifically for research purposes and filled out the questionnaires which took approximately 60 minutes to complete. Out of 41 children assessed, 20 children met the criteria for a high probability of PTSD.

A randomized controlled trial was conducted to evaluate the efficacy of app-assisted TF-CBT-based intervention. Twenty trauma-exposed children were randomly assigned to either the group which, in addition to TAU treatment, received app-assisted TF-CBT based interventions (TF-CBT group), or the TAU group. Participants completed CATS, A-DES, SMFQ, PCL-5, and CPTCI at baseline and post-treatment. The data was collected from 3rd July 2023 to 28th February 2024.

Each participant in the TAU group during a 21-day treatment period received treatment based on a diagnosis and registered in the clinics with no CBT or mindfulness exercises included. Each

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participant in app-assisted TF-CBT-based intervention during a 21-day treatment period, in addition to TAU, received 12 sessions including mindfulness exercises facilitated by psychiatrists, with no sessions with caregivers. Overall, 108 sessions (9 participants, 12 sessions) were completed.

2.4. Statistical Analyses

The SPSS (version 29) software and JASP (version 0.16.04.0) software were applied for the statistical analyses. To test the reliability of the instruments, Cronbach's α and McDonald's ω were assessed. Next, the normality of data distribution was evaluated (Shapiro-Wilk test, skewness, and kurtosis). Independent samples' T-test was applied to identify the response in post-traumatic stress symptoms, post-traumatic cognitions, dissociative symptoms, and moods and feelings in the TF-CBT and TAU samples.

3. Results

As demonstrated in Table 4, the Shapiro-Wilk test results were partly significant, but the skewness and kurtosis suggested that the data may be considered normally distributed [90], so the parametric statistics were applied.

Table 4. Data distribution in the samples.

Scales	Variables	Pre-treatment						Post-treatment					
		TF-CBT Sample			TAU Sample			TF-CBT Sample			TAU Sample		
		W	S	K	W	S	K	W	S	K	W	S	K
CATS	Posttraumatic stress symptoms	.945	.450	-1.023	.934	-.533	-.660	.944	-.406	-1.583	.919	.538	-.494
	Impairment in psychosocial functioning	.853	-.362	-1.826	.852*	.249	-1.220	.868	.214	-1.954	.882	-.532	-1.241
A-DES	Dissociation symptoms, overall	.952	.808	.591	.957	.238	-.662	.935	.524	-.285	.753**	1.603	1.459
SMFQ	Moods and feelings, overall	.928	-.763	-.455	.910	-.085	-1.545	.888	-.192	-1.783	.977	-.156	.225
PCL-5	PTSD Checklist	.972	-.556	-.091	.920	.218	-1.475	.984	-.382	.621	.830*	.111	-2.214
	Intrusion symptoms	.920	-.049	-1.591	.883	.338	-1.463	.907	-.322	-.960	.818*	.220	-2.124
	Avoidance	.896	.824	-.216	.886	.302	-1.593	.898	-.104	-1.828	.826*	.578	-1.493
	Negative alterations	.959	-.493	.461	.915	.327	-.904	.960	-.625	.234	.854*	.265	-1.923
	Alterations in arousal and reactivity	.916	.518	-1.041	.904	-.106	-1.663	.957	-.218	-.363	.892	.212	-1.698
CPTCI	Post-Traumatic Cognitions, overall	.931	-.526	-.924	.923	.396	-1.316	.928	-.377	-1.402	.938	.529	-0.829
	Permanent and disturbing change	.913	-.314	-1.151	.877	.635	-1.089	.877	-.168	-2.041	.873	.662	-0.977
	Fragile person in a scary world	.945	-.182	-.952	.954	-.051	-1.292	.931	-.967	.620	.972	.459	-.309

Note. W = Shapiro-Wilk test; *S* = skewness; *K* = kurtosis; * $p < .05$, ** $p < .01$.

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The frequencies of experiences of potentially traumatic events in samples are presented in Table 5. In the TF-CBT group, more than 66.6 percent of participants revealed that they were slapped, punched, or beaten up not in their family, 55.5 percent were slapped, punched, or beaten up in their family, and 55.5 percent saw someone being slapped or punched in the community. In the TAU group, 63.6 percent saw someone being slapped or punched in the community, and 55.5 percent were slapped, punched, or beaten up in their family.

Table 5. The frequencies of experiences of potentially traumatic events in TF-CBT and TAU samples.

Potentially traumatic events	TF-CBT sample (*n* = 9)		TAU sample (*n* = 11)	
	n (yes)	%	*n (yes)*	%
1. Serious natural disasters like a flood, hurricanes, earthquakes, or fires.	4	44.4	3	27.3
2. Serious accident or injury like a car/bike crash, dog bite, sports injury.	2	22.2	5	45.5
3. Robbed by threat, force, or weapon.	1	11.1	1	9.1
4. Slapped, punched, or beat up in your family.	5	55.5	6	55.5
5. Slapped, punched, or beaten up by someone not in your family.	6	66.6	4	36.4
6. Seeing someone in your family get slapped, punched, or beat up.	4	44.4	5	45.5
7. Seeing someone in the community get slapped or punched.	5	55.5	7	63.6
8. Someone older touching your private parts when they shouldn't.	3	33.3	2	18.2
9. Someone forcing or pressuring sex, or when you couldn't say no.	0	0	0	0
10. Someone close to you dies suddenly or violently.	4	44.4	3	27.3
11. Attacked, stabbed, shot at, or hurt badly.	1	11.1	1	9.1
12. Seeing someone attacked, stabbed, shot at, hurt badly, or killed	1	11.1	1	9.1
13. Stressful or scary medical procedure.	3	33.3	3	27.3
14. Being around war.	0	0	0	0
15. Other stressful or scary events.	4	44.4	4	36.4

The means, standard deviations, and the results of the Independent samples' T-test in TF-CBT and TAU samples at baseline (pre-treatment) are presented in Table 6.

Table 6. Means, standard deviations, and the results of the T-test comparing TF-CBT and TAU samples at baseline (pre-treatment).

Variables	TF-CBT Sample		TAU sample		Mean differ.	t (df)	*p*	Cohen's d
	M	*SD*	*M*	*SD*				
Potentially traumatic events	4.778	3.701	4.091	2.844	0.687	0.457(14.831)	.654	0.208
Impairment in psychosocial functioning	3.000	2.000	2.364	1.963	0.636	0.714(17.089)	.485	0.321
Posttraumatic stress symptoms	33.333	10.794	27.500	15.407	5.833	0.963(16.104)	.350	0.439
Dissociation symptoms	3.734	2.290	4.228	2.030	-0.494	-0.505(16.225)	.621	-0.228
Moods and feelings, overall	17.556	6.327	12.455	8.454	5.101	1.542(17.895)	.141	0.683
PTSD, overall	45.444	11.770	32.100	22.786	13.344	1.626(13.766)	.127	0.736
Intrusion symptoms	9.889	3.790	7.727	6.987	2.162	0.880(15.912)	.392	0.385
Avoidance	3.667	2.449	3.273	3.003	0.394	0.323(17.999)	.750	0.144
Negative alterations in cognition and mood	18.889	5.207	11.545	7.647	7.343	2.545(17.514)	.021	1.123
Alterations in arousal and reactivity	13.000	4.062	8.200	6.215	4.800	2.011(15.614)	.062	0.914
Post-Traumatic Cognitions, overall	70.222	15.802	54.000	23.367	16.222	1.788(15.863)	.093	0.813

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Permanent and disturbing change	34.556	9.289	26.700	12.910	7.856	1.533(16.274)	.144	0.699
Fragile person in a scary world	35.667	7.297	27.545	10.425	8.121	2.043(17.651)	.056	0.903

Note. M = Mean; SD = standard deviation; Welch's T-test has been used.

The Independent samples' T-test revealed just one significant difference between TF-CBT and TAU samples at baseline (pre-treatment): the TF-CBT sample demonstrated significantly (p=.021) higher scores in negative alterations in cognition and mood (M=18.889, SD=5.207) compared to TAU group (M=11.545, SD=7.647). However, there were no significant differences between the groups in experiencing potentially traumatic events, impairment in psychosocial functioning, posttraumatic stress symptoms, dissociation symptoms, moods and feelings, PTSD checklist, intrusion symptoms, avoidance, alterations in arousal and reactivity, post-traumatic cognitions, belief in "permanent and disturbing change" and "fragile person in a scary world".

The Independent samples' T-test in the TF-CBT and TAU samples post-treatment are presented in Table 7.

Table 7. Means, standard deviations, and the results of the T-test comparing TF-CBT and TAU samples post-treatment.

Variables	TF-CBT Sample		TAU sample		Mean differ.	t (df)	*p*	Cohen's d
	M	*SD*	*M*	*SD*				
Potentially traumatic events	4.000	4.301	5.727	4.407	-1.727	-0.884(17.384)	.389	-0.397
Impairment in psychosocial functioning	2.500	2.000	3.091	1.814	-0.591	-0.661(14.299)	.519	-0.309
Posttraumatic stress symptoms	24.714	13.475	23.091	17.975	1.623	0.218(15.419)	.830	0.102
Dissociation symptoms, overall	3.683	2.986	2.885	2.192	0.798	0.632(12.525)	.539	0.305
Moods and feelings, overall	16.444	8.141	10.700	5.982	5.744	1.737(14.600)	.104	0.804
PTSD, overall	36.125	19.090	27.600	24.126	8.525	0.837(16.000)	.415	0.392
Intrusion symptoms	7.000	4.840	6.20	6.477	0.800	0.300(15.955)	.768	0.140
Avoidance	4.000	3.207	3.091	3.300	0.909	0.600(15.578)	.557	0.278
Negative alterations in cognition and mood	15.750	8.102	8.909	8.264	6.841	1.802(15.420)	.091	0.836
Alterations in arousal and reactivity	9.375	5.655	8.091	6.891	1.284	0.445(16.672)	.662	0.204
Post-Traumatic Cognitions, overall	58.750	21.097	50.800	21.478	7.950	0.788(15.261)	.443	0.373
Permanent and disturbing change	29.250	13.392	23.700	10.552	5.550	0.958(13.156)	.355	0.460
Fragile person in a scary world	29.500	8.767	26.727	10.669	2.773	0.621(16.666)	.543	0.284

Note. M = Mean; SD = standard deviation; Welch's T-test has been used.

The Independent samples' T-test revealed no significant differences between TF-CBT and TAU groups at post-treatment: there were no significant differences in experiencing potentially traumatic events, impairment in psychosocial functioning, posttraumatic stress symptoms, dissociation symptoms, moods and feelings, PTSD checklist, intrusion symptoms, avoidance, negative alterations in cognition and mood alterations in arousal and reactivity, post-traumatic cognitions, belief in "permanent and disturbing change" and "fragile person in a scary world".

Means, standard deviations, and the results of the T-test comparing TF-CBT at baseline and post-treatment are presented in Table 8.

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Table 8. Means, standard deviations, and the results of T-test comparing TF-CBT at baseline and post-treatment.

Variable	TF-CBT Pre-treatment		TF-CBT Post-treatment		Mean differ.	t(df)	*p*	Cohen's d
	M	*SD*	*M*	*SD*				
Impairment in psychosocial functioning	2.875	2.100	2.500	2.000	0.375	1.158(7)	.285	0.409
Posttraumatic stress symptoms	35.714	10.828	24.714	13.475	11.000	2.034(6)	.088	0.769
Dissociation symptoms, overall	3.884	2.401	3.683	2.986	0.201	0.343(7)	.742	0.121
Moods and feelings, overall	17.556	6.327	16.444	8.141	1.111	0.445(8)	.668	0.148
PTSD, overall	45.250	12.567	36.125	19.090	9.125	2.819(7)	.026	0.997
Intrusion symptoms	9.250	3.495	7.000	4.840	2.250	2.679(7)	.032	0.947
Avoidance	4.000	2.390	4.000	3.207	0.000	0.000(7)	1.000	0.000
Negative alterations in cogn. and mood	18.625	5.502	15.750	8.102	2.875	1.910(7)	.098	0.675
Alterations in arousal and reactivity	13.375	4.173	9.375	5.655	4.000	2.779(7)	.027	0.983
Post-Traumatic Cognitions, overall	68.750	16.219	58.750	21.097	10.000	3.179(7)	.016	1.124
Permanent and disturbing change	33.375	9.180	29.250	13.392	4.125	1.477(7)	.183	0.522
Fragile person in a scary world	35.375	7.745	29.500	8.767	5.875	3.678(7)	.008	1.300

Note. M = Mean; SD = standard deviation; Welch's T-test has been used.

The Independent samples' T-test revealed several significant differences in the TF-CBT group's pre-treatment and post-treatment scores. The post-treatment scores were significantly lower in post-traumatic stress symptoms (p=.026), intrusion symptoms (p=.032), alterations in arousal and reactivity (p=.027), overall post-traumatic cognitions (p=.016), and belief in being "a fragile person in a scary world" (p=.008). However, there were no significant differences in the pre-treatment and post-treatment scores in impairment in psychosocial functioning, dissociation symptoms, moods and feelings, avoidance, negative alterations in cognition and mood, and belief in "permanent and disturbing change".

Means, standard deviations, and the results of the T-test comparing TAU at baseline and post-treatment are presented in Table 9.

Table 9. Means, standard deviations, and the results of the T-test comparing TAU at baseline and post-treatment.

Variable	TAU Pre-treatment		TAU Post-treatment		Mean differ.	t(df)	*p*	Cohen's d
	M	*SD*	*M*	*SD*				
Impairment in psychosocial functioning	2.364	1.963	3.091	1.814	-0.727	-1.056(10)	.316	-0.318
Posttraumatic stress symptoms	27.500	15.407	22.500	18.834	5.000	1.285(9)	.231	0.406
Dissociation symptoms, overall	4.011	2.000	2.885	2.192	1.126	3.370(9)	.008	1.066
Moods and feelings, overall	12.400	8.909	10.700	5.982	1.700	1.004(9)	.342	0.317
PTSD, overall	33.444	23.744	30.000	24.290	3.444	1.348(8)	.215	0.449
Intrusion symptoms	8.000	7.303	6.200	6.477	1.800	2.586(9)	.029	0.818
Avoidance	3.273	3.003	3.091	3.330	0.182	0.482(10)	.640	0.145
Negative alterations in cognition and mood	11.545	7.647	8.909	8.264	2.636	1.943(10)	.081	0.586
Alterations in arousal and reactivity	8.200	6.215	8.500	7.122	-0.300	-0.226(9)	.826	-0.072

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Post-Traumatic Cognitions, overall	54.000	23.367	50.800	21.478	3.200	1.530(9)	.160	0.484
Permanent and disturbing change	26.700	12.910	23.700	10.552	3.000	2.076(9)	.068	0.656
Fragile person in a scary world	27.545	10.425	26.727	10.669	0.818	0.697(10)	.502	0.210

Note. M = Mean; SD = standard deviation; Welch's T-test has been used.

The Independent samples' T-test revealed two significant differences in the TAU group's pre-treatment and post-treatment scores. The post-treatment scores were significantly lower in dissociation symptoms (p=.008), and intrusion symptoms (p=.029). However, there were no significant differences in the pre-treatment and post-treatment scores in post-traumatic stress symptoms, impairment in psychosocial functioning, dissociation symptoms, moods and feelings, avoidance, alterations in cognition and mood, alterations in arousal and reactivity, overall post-traumatic cognitions, belief in being "a fragile person in a scary world", and belief in "permanent and disturbing change".

Individual differences in response to treatment in the TF-CBT and TAU groups are presented in Table 10.

Table 10. Individual differences in response to treatment (dissociation, intrusion, alterations in arousal and reactivity, moods and feelings, post-traumatic cognitions, "fragile person in a scary world") in the TF-CBT and TAU groups at baseline (Pre) and post-treatment (Post).

ID	Gender	Age	Alterations in arousal and reactivity		Intrusion		Dissociation		Moods and feelings		Post-traumatic cognitions		"Fragile person in a scary world"	
TF-CBT sample			**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
1	F	13.00	4.00	1.00	2.00	.00	4.30	5.03	6.00	6.00	62.00	58.00	32.00	32.00
2	F	12.00	3.00	1.00	1.00	.00	2.20	.50	25.00	6.00	66.00	42.00	33.00	29.00
3	F	12.00	5.00	5.00	2.00	3.00	8.21	5.73	21.00	19.00	77.00	73.00	44.00	34.00
4	F	14.00	4.00	.00	5.00	.00	2.53	-	20.00	20.00	82.00	-	38.00	-
5	F	15.00	3.00	5.00	5.00	4.00	5.93	8.97	22.00	23.00	83.00	83.00	38.00	37.00
6	F	12.00	5.00	4.00	3.00	4.00	3.53	3.20	11.00	9.00	45.00	39.00	25.00	21.00
7	F	14.00	5.00	3.00	3.00	3.00	4.30	4.50	23.00	26.00	91.00	81.00	46.00	40.00
8	M	12.00	4.00	.00	1.00	.00	.67	.30	17.00	26.00	49.00	26.00	26.00	13.00
9	F	14.00	5.00	5.00	4.00	4.00	1.93	1.23	13.00	13.00	77.00	68.00	39.00	30.00
TAU sample														
10			2.00	5.00	3.00	1.00	3.93	2.60	22.00	13.00	55.00	53.00	29.00	28.00
11	F	10.00	4.00	5.00	5.00	5.00	6.40	-	20.00	21.00	87.00	89.00	40.00	47.00
12	M	14.00	3.00	4.00	4.00	4.00	6.47	6.17	11.00	11.00	62.00	65.00	35.00	36.00
13	M	13.00	.00	.00	.00	.00	1.60	1.80	.00	.00	25.00	26.00	12.00	12.00
14	M	10.00	3.00	2.00	.00	.00	3.97	1.17	5.00	6.00	45.00	37.00	21.00	22.00
15	F	13.00	1.00	1.00	.00	.00	1.23	1.37	6.00	13.00	30.00	33.00	16.00	18.00
16	M	11.00	.00	.00	2.00	.00	3.31	2.17	13.00	9.00	33.00	27.00	16.00	14.00
17	F	16.00	3.00	4.00	3.00	3.00	3.77	1.77	23.00	16.00	74.00	60.00	36.00	31.00
18	M	12.00	4.00	2.00	.00	.00	3.00	1.33	2.00	5.00	40.00	42.00	25.00	25.00
19	F	17.00	5.00	5.00	5.00	5.00	5.13	2.93	22.00	13.00	89.00	76.00	43.00	38.00
20	M	10.00	1.00	.00	2.00	1.00	7.70	7.55	13.00	-	62.00	-	30.00	23.00

The analysis of the individual response to TF-CBT and TAU showed that in the TF-CBT group, there were no improvements in symptoms, moods, and cognitions for patient Nr. 5 (prior diagnoses: severe depressive episode with psychotic symptoms, unspecified as to whether postnatal, F32.30; suicidal ideation, R45.81; dietary counseling and supervision, Z71.3; other negative life events in childhood, Z61.8) and in the TAU group, however, no improvement was observed in symptoms,

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moods, and cognitions for patient Nr. 11 (other childhood emotional disorders, F93.8) and patient Nr. 12. (other brief psychotic disorder without associated acute stress, F23.80; suicidal ideation, R45.81).

4. Discussion

Numerous studies provided evidence on the efficacy of TF-CBT for children and adolescents [17,91–103]. Some studies supported the effectiveness of digital solutions for CBT [104–107]. This study adds to the research targeting the efficacy of digital solutions for TF-CBT and comparisons between TF-CBT and other interventions [8,108–111]. The results of this study provide some insights into the effectiveness of TF-CBT compared to Treatment as Usual (TAU) in addressing the mental health of hospitalized children who experienced traumatic events.

In this study, children hospitalized in a psychiatric unit revealed a high prevalence of exposure to traumatic events. In the TF-CBT group, a significant percentage of participants reported experiencing physical violence outside their family (66.6%), within their family (55.5%), and witnessing community violence (55.5%). In the TAU group, a slightly lower percentage observed community violence (63.6%), and a similar percentage experienced violence within their family (55.5%). These statistics underscore the possible impact of traumatic experiences on children's mental health and the importance of addressing such traumatic experiences in therapeutic interventions. These results relate to previous studies reporting links between exposure to traumatic events and harmful consequences for mental health [112,113].

At the pre-treatment stage, the independent samples' T-test indicated a significant difference between the TF-CBT and TAU groups: the TF-CBT group exhibited significantly higher scores in negative alterations in cognition and mood than the TAU group. However, no significant differences were found between the groups in terms of potentially traumatic events, psychosocial functioning impairment, posttraumatic stress symptoms, dissociation symptoms, moods and feelings, PTSD checklist, intrusion symptoms, avoidance, alterations in arousal and reactivity, post-traumatic cognitions, belief in "permanent and disturbing change," and "fragile person in a scary world". Negative alterations in cognition and mood represent one of the PTSD clusters [114], so it could be presumed that the TF-CBT group participants started with higher levels of PTSD symptoms.

At post-treatment, the independent samples' T-test revealed no significant differences between the TF-CBT and TAU groups. Scores for experiencing potentially traumatic events, impairment in psychosocial functioning, posttraumatic stress symptoms, dissociation symptoms, moods and feelings, PTSD checklist, intrusion symptoms, avoidance, negative alterations in cognition and mood, alterations in arousal and reactivity, post-traumatic cognitions, belief in "permanent and disturbing change," and "fragile person in a scary world" showed no statistically significant variations. Therefore, the findings indicate that app-assisted TF-CBT-based intervention could be effective as suggested by previous research [15,105,115–126].

Within the TF-CBT group, there were several significant differences between pre-treatment and post-treatment scores. Post-treatment scores were significantly lower in post-traumatic stress symptoms, intrusion symptoms, alterations in arousal and reactivity, overall post-traumatic cognitions, and belief in being "a fragile person in a scary world". Yet, there were no significant changes in scores for dissociation symptoms, moods and feelings, avoidance, negative alterations in cognition and mood, and belief in "permanent and disturbing change". The findings suggest that employing app-supported TF-CBT intervention, consistent with prior research findings, could reduce post-traumatic stress symptoms [19], intrusion symptoms, alterations in arousal and reactivity, or overall post-traumatic cognitions [127,128].

For the TAU group, the independent samples' T-test revealed two significant differences between pre-treatment and post-treatment scores. Post-treatment scores were notably lower in dissociation symptoms and intrusion symptoms. However, no significant differences were found in post-traumatic stress symptoms, impairment in psychosocial functioning, moods, and feelings, avoidance, alterations in cognition and mood, alterations in arousal and reactivity, overall post-traumatic cognitions, belief in "a fragile person in a scary world," belief in "permanent and disturbing

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change". The results suggest the added value of the TF-CBT intervention as compared to other treatments in targeting specific symptoms related to traumatic experiences [8,108–110].

Therefore, the findings revealed that within the TF-CBT group, significant improvements were observed in post-traumatic stress symptoms, intrusion symptoms, arousal and reactivity, overall post-traumatic cognitions, and belief in being a "fragile person in a scary world." In the TAU group, significant improvements were noted in dissociation and intrusion symptoms post-treatment. While both groups demonstrated improvements, TF-CBT showed specific enhancements in targeted areas, suggesting the efficacy of the intervention in addressing trauma-related symptoms, as suggested by earlier research [129,130].

Upon analyzing individual responses to TF-CBT and TAU, it was observed that for patient Nr. 5 in the TF-CBT group and patients Nr. 11 and Nr. 12 in the TAU group, there were no improvements in symptoms, moods, and cognitions. Patient Nr. 5 had prior diagnoses of severe depressive episodes with psychotic symptoms, unspecified as to whether postnatal (F32.30), suicidal ideation (R45.81), and dietary counseling and supervision (Z71.3), along with other negative life events in childhood (Z61.8). In the TAU group, patient Nr. 11 had other childhood emotional disorders (F93.8), and patient Nr. 12 had other brief psychotic disorder without associated acute stress (F23.80) and suicidal ideation (R45.81). Thus, patient Nr. 5 in the TF-CBT group and patients Nr. 11 and Nr. 12 in the TAU group showed no improvements in symptoms, moods, and cognitions. These results to some extent relate to previous studies on applications of TF-CBT for patients with psychotic symptoms [62,136], suggesting the necessity for future research in this area. Individual differences in response to treatment highlight the complexity of trauma effects and the need for personalized approaches.

In summary, the study suggests that app-assisted TF-CBT-based intervention can be effective in addressing specific trauma-related symptoms, but individual differences in response to treatment should be considered.

Limitations and Future Directions

The main limitation of this study was the sample size. So, it is recommended to replicate the study with much bigger samples. Next, there were no sessions with caregivers, and it is strongly recommended to involve the sessions with them in future research. In addition, controlling other variables that might contribute to the efficacy of the interventions could provide more insights into the applications of interventions. In addition, the findings are specific to the Lithuanian sample and should be regarded cautiously when generalizing the results to other cultural contexts. In conclusion, though this study contributes some insights into the efficacy of app-assisted TF-CBT-based intervention, it highlights the importance of future research.

Based on the findings of this study, it is vital to implement systematic screening procedures for exposure to traumatic events in children admitted to psychiatric units. Early identification of such experiences can facilitate timely interventions and prevent long-term mental health repercussions. Next, healthcare providers should adopt trauma-informed care approaches in therapeutic interventions for children with psychiatric hospitalizations to develop personalized treatment plans.

While TF-CBT showed efficacy in addressing certain post-traumatic symptoms and cognitions, it's essential to recognize that individual differences exist in treatment responses, and treatment plans should be tailored to the specific needs of each child, considering factors such as the severity of trauma exposure and pre-existing cognitive and emotional vulnerabilities.

Next, this study suggests that Trauma-Focused Cognitive Behavioral Therapy (TF-CBT) can be effective in reducing specific symptoms related to post-traumatic stress, such as intrusion symptoms and alterations in arousal and reactivity, so healthcare facilities should consider integrating TF-CBT into their treatment protocols for children with a history of trauma.

Besides, incorporating technology-assisted interventions, such as app-based support for TF-CBT, can enhance accessibility and engagement in therapeutic interventions, and healthcare providers should explore and utilize technological resources to optimize treatment outcomes for children with trauma-related symptoms.

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Moreover, the findings suggest that regular assessment and monitoring of treatment progress are crucial, and healthcare providers should enable timely adjustments to treatment approaches based on individual responses. Collaboration with other support services, such as family therapy, social work, and school-based interventions, and coordinated efforts among multidisciplinary teams can address the complex needs of children with trauma histories more effectively.

5. Conclusions

Firstly, in this study, children hospitalized in a psychiatric unit revealed a high prevalence of exposure to traumatic events. The findings highlight the high prevalence of physical violence, underscoring the possible impact of traumatic interpersonal experiences on children's mental health and the importance of addressing such experiences by health care providers.

The TF-CBT participants started with higher levels of negative alterations in cognition and mood. At post-treatment, no significant differences were observed between the TF-CBT and TAU groups in impairment in psychosocial functioning, posttraumatic stress symptoms, dissociation symptoms, moods and feelings, PTSD checklist, intrusion symptoms, avoidance, negative alterations in cognition and mood, alterations in arousal and reactivity, post-traumatic cognitions, belief in "permanent and disturbing change," and belief in "fragile person in a scary world".

Within the TF-CBT group, post-treatment scores were significantly lower in post-traumatic stress symptoms, intrusion symptoms, alterations in arousal and reactivity, overall post-traumatic cognitions, and belief in being "a fragile person in a scary world". Yet, there were no significant changes in scores for impairment in psychosocial functioning, dissociation symptoms, moods and feelings, avoidance, negative alterations in cognition and mood, and belief in "permanent and disturbing change".

Within the TAU group, post-treatment scores were notably lower in dissociation symptoms and intrusion symptoms. However, no significant differences were found in post-traumatic stress symptoms, impairment in psychosocial functioning, moods, and feelings, avoidance, alterations in cognition and mood, alterations in arousal and reactivity, overall post-traumatic cognitions, belief in "a fragile person in a scary world," and belief in "permanent and disturbing change".

In summary, the study suggests that app-assisted TF-CBT-based intervention can be effective in reducing post-traumatic stress symptoms (intrusion symptoms, alterations in arousal and reactivity) and post-traumatic cognitions (namely, belief in being "a fragile person in a scary world"); however, individual differences should be considered.

The findings imply the necessity for screening for traumatic experiences, incorporating trauma-informed care, implementation of TF-CBT into treatment protocols, utilization of app-assisted interventions, tailoring interventions to individual needs, and comprehensive assessment and monitoring of treatment progress.

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