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Ph.D. THESIS

THE MENTAL HEALTH OF YOUNG PEOPLE WITH CHRONIC ILLNESS: EMOTION REGULATION AND TECHNOLOGY-BASED INTERVENTIONS

Summary

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I. THEORETICAL BACKGROUND

1.1. General Context

Chronic physical illnesses affect an estimated 10–15% of children globally, with wide variation across Europe (as low as 4% in Romania, Bulgaria, Italy, and Greece; up to 39% in Finland). Rates have risen over recent decades due to increases in asthma, obesity-related disorders, autoimmune diseases, and neurodevelopmental conditions, alongside improved pediatric survival rates (Mastorci et al., 2025; Schnick-Vollmer et al., 2024; Sweetey et al., 2023). Illness unpredictability constitutes a chronic psychological stressor, making it harder for children to form stable illness representations and coping strategies. Chronically ill children are more than twice as likely to develop mental health difficulties than healthy peers, with anxiety and depression present in 31.7% of medically affected adolescents versus 16.3% of healthy peers, and meta-analyses showing a fourfold increase in psychopathology risk. This vulnerability is mechanistically linked to illness-related uncertainty, treatment burden, and cumulative allostatic load (Mastorci et al., 2025; Nibras et al., 2022).

HRQoL is a multidimensional construct spanning physical, emotional, social, and school functioning. Illness symptoms and unpredictable disease activity disrupt routines and participation in normative childhood experiences, creating a cumulative sense of exclusion from ordinary childhood life (Varni et al., 2011).

A biopsychosocial lens integrates biological, psychological, and social pathways. Chronic illness activates neuroendocrine stress systems (HPA axis, sympathetic-adrenal-medullary system), with downstream effects on immune function and neural circuitry involved in emotion processing, potentially lowering thresholds for anxiety and depression (Dantzer et al., 2008; Miller & Raison, 2016).

1.2. Definition and Prevalence of Chronic Illness in Childhood

Pediatric chronic illness is broadly defined as a non-acute condition lasting at least three months requiring ongoing medical care and capable of affecting development, though definitions vary considerably across the literature. For this thesis, the term includes conditions such as asthma, diabetes, epilepsy, and chronic pain (Chambers et al., 2024).

1.3. Psychological Burden: Anxiety, Depression, and Behavioral Difficulties

Chronic illness in youth is strongly associated with elevated anxiety, depression, and behavioral difficulties, with roughly double the rates of anxiety/depression compared to healthy peers, a fourfold increase in new-onset psychopathology, and psychological burden actively shaped by emotion regulation and cognitive appraisal processes rather than being a simple reactive consequence of illness (Shakeshaft et al., 2025).

Anxiety is the most prevalent psychological complication, often overlapping symptomatically with physical illness, leading to both under- and overdiagnosis, with unrecognized anxiety linked to poorer treatment adherence and greater impairment (Pinquart & Thorwarth, 2025).

Pediatric depression in chronic illness often presents with prominent somatic features; younger children show irritability and withdrawal, while adolescents show hopelessness and illness-related rumination. Deficits in adaptive emotion regulation (low reappraisal, high rumination) are linked to higher depression rates independent of illness severity (Hards et al., 2023).

Both internalising (withdrawal, somatic complaints) and externalising (oppositional behavior, aggression) difficulties are elevated, particularly in illnesses involving neurological involvement or high treatment burden, with frequent co-occurrence of both types (Pinquart, 2026).

Persistent psychological burden disrupts acquisition of key developmental competencies, leading to poorer long-term outcomes in psychiatric health, education, and social integration, underscoring the need for early intervention.

Psychological burden is sustained by specific processes (maladaptive appraisals, cognitive distortions, emotion regulation deficits, rumination) relatively independent of illness severity, meaning interventions must target these underlying mechanisms rather than only medical or generic emotional support.

1.4. Functional and Developmental Consequences

Chronic illness disproportionately affects schooling, with higher absenteeism (~26% vs. 15%) and cumulative instructional and self-confidence deficits, amplified by socioeconomic disadvantage (Jay et al., 2024).

1.5. Comorbidity Patterns and Developmental Risk

Psychiatric comorbidity is substantially elevated in chronically ill youth, roughly double the risk of internalizing disorders compared to healthy peers. Anxiety-depression overlap and combined internalizing-externalizing profiles are common comorbidity patterns (Gross, 2015).

1.6. Emotion Regulation as a Transdiagnostic Mechanism

Emotion regulation refers to processes influencing which emotions are experienced and how they are expressed; emotions themselves are adaptive, but regulatory capacity determines clinical outcomes. Chronic illness imposes a sustained regulatory burden (pain, treatment demands, uncertainty) that taxes children's regulatory capacities beyond typical developmental challenges (Gross, 1998).

1.7. Cognitive Mechanisms: Irrational Beliefs and Appraisal Systems

Cognitive appraisal processes, rooted in the foundational work of Beck (1967) and Ellis (1962), are central to how emotional and behavioral disorders develop, as subjective meaning-making shapes psychological responses to circumstances .

1.8. Digital Mental Health Interventions in Youth

Digital mental health interventions include apps, internet-based CBT, serious games, VR, and chatbots, offering scalability, accessibility, and reduced cost compared to conventional clinical services, while avoiding stigma associated with help-seeking (Hicks et al., 2025).

1.9. The RETHink Game as Intervention

The RETHink Game is grounded in Rational-Emotive Behavior Therapy (REBT), targeting irrational beliefs as the primary driver of emotional distress. It functions as a process-focused intervention addressing both cognitive and regulatory mechanisms, reflecting broader efforts to create scalable psychological tools (David et al., 2021).

1.10. Research Gap

Despite evidence linking chronic illness to emotional difficulties, existing research is largely descriptive, with limited attention to underlying mechanisms. The role of emotion

regulation as a central linking process remains theoretically acknowledged but empirically underexamined in integrated frameworks.

II. RESEARCH OBJECTIVES AND GENERAL METHODOLOGY

The general aim of this thesis is to explore how chronic illnesses in childhood and youth shape vulnerability to emotional difficulties, with a specific focus on the role of emotion regulation. Although high rates of anxiety, depression, and related symptoms among young people diagnosed with a chronic illness are well documented, the mechanisms that sustain these difficulties are not yet fully understood.

To address these gaps, this thesis employs a multi-method research programme combining a meta-analytic synthesis, a psychometric validation, a network analysis and an experimental evaluation on a digital intervention. By integrating evidence across these distinct methodological approaches, the thesis aims to (a) clarify the state of the science regarding digital psychological interventions for medically vulnerable youth, (b) adapt a psychometrically strong tool for assessing emotion regulation in children and adolescents, (c) investigate the interrelations among emotion-regulation strategies and emotional symptoms in children and young people with chronic illness, and (d) test the efficacy of an evidence-based digital intervention in children and adolescents with mental health problems. Through this comprehensive strategy, the thesis seeks to highlight how emotion regulation contributes to mental health outcomes across contexts of physical illness and psychiatric vulnerability and to inform the development of scalable, evidence-based future interventions targeting regulatory mechanisms.

When developing a research programme, the first step is to consult the current state of the literature regarding the specific topic that you base the research on. The **first objective** is to conduct a meta-analysis on the effectiveness of digital psychological interventions in

reducing anxiety among children, adolescents, and adults with oncological conditions. This review contextualizes the thesis within current efforts to use technology for mental health support in medically vulnerable populations, addressing the limited evidence on whether such tools reduce distress in people with severe chronic illness. It provides the empirical basis for developing emotion regulation-focused digital interventions for young people.

The **second objective** focuses on the psychometric validation and translation of the Emotion Regulation Index for Children and Adolescents (ERICA) within a large Romanian youth sample (Biesecker & Easterbrooks, 2001), examining its factor structure, internal consistency, and construct validity (convergent and divergent), as well as age-related measurement properties. This provides a culturally appropriate, psychometrically reliable measure, establishing the methodological foundation for future studies and contributing to the broader literature on emotion regulation assessment.

Chronic illness requires young people to adapt to ongoing medical demands and reorganize their routines and expectations over time. The **third objective** clarifies how chronic illness shapes emotional vulnerability by examining the structural organization of emotion-regulation strategies and affective symptoms in this population. Using a network analytic framework, the study investigates patterns of interconnection among regulatory strategies and symptoms, identifying central elements and clustering. This offers a nuanced understanding of the emotional landscape in youth with chronic illness, highlighting regulatory patterns linked to psychological risk relative to healthy peers.

Children and adolescents with medical vulnerabilities face persistent symptom burden, treatment demands, and psychological distress that interfere with daily functioning

and development, making accessible psychological interventions a critical priority. The **final empirical objective** assesses whether the Rethink Game, a technology-supported intervention grounded in rational emotive and behavioral principles, enhances emotion regulation and reduces emotional symptoms in children and adolescents with psychiatric diagnoses. Through a randomized controlled trial comparing the intervention with treatment as usual, this study tests whether strengthening emotion-regulation skills leads to meaningful clinical improvement, addressing the translational question of whether digital interventions can modify core regulatory mechanisms in high-risk youth.

III. ORIGINAL RESEARCH

3.1. Study 1: Technology-Based Psychological Interventions Addressing Anxiety in Patients with Oncological Conditions: A Meta-Analysis

3.1.1. Introduction

Cancer is among the most psychologically demanding medical diagnoses, frequently accompanied by anxiety, depression, and sustained distress driven by concerns about prognosis, treatment side effects, and fear of recurrence (Pitman et al., 2018; Hinz et al., 2010). Persistent anxiety can reduce quality of life and interfere with treatment adherence (Fallowfield et al., 2001), prompting international guidelines to recommend routine psychological screening across the cancer continuum.

Digital health interventions, including web-based programs, mobile applications, and virtual-reality tools, have emerged as promising means of delivering psychoeducation, symptom monitoring, and evidence-based therapeutic components such as CBT and mindfulness training (McCann et al., 2019; WHO, 2021). However, few digital interventions target anxiety as a primary outcome, and existing evidence remains limited to small feasibility trials (Schaffer et al., 2023). Prior meta-analyses in oncology have largely focused on physical outcomes rather than psychological endpoints (Zhang et al., 2023; Elkefi et al., 2023), leaving anxiety-specific effects unclear.

This study addresses this gap through a meta-analysis examining the effectiveness of digital psychological interventions in reducing anxiety among children, adolescents, and adults with cancer, while identifying moderators related to intervention format and population characteristics.

The primary objective was to evaluate the effectiveness of technology-based psychological interventions (web-based, mHealth, telehealth, virtual-reality) in reducing anxiety among children, adolescents, and adults with cancer, given fragmented evidence despite their potential advantages in accessibility and scalability (McCann et al., 2019).

A secondary objective examined whether efficacy was moderated by demographic (age, gender) and clinical/methodological factors (cancer type, disease stage, duration, delivery modality, therapeutic orientation), to clarify variability in prior findings (Schaffer et al., 2017) and inform which patient groups and intervention designs yield the strongest anxiety reduction.

3.1.2. Method

3.1.2.1. Study design

This systematic review and meta-analysis was conducted in line with the Cochrane Handbook for Systematic Reviews of Interventions and followed the PRISMA 2020 reporting guidelines (Higgins & Cochrane Collaboration, 2020). The protocol, which set out the eligibility criteria, analytic plan, and all procedural steps, was preregistered in PROSPERO (CRD42023425161) to ensure transparency and reduce the risk of selective reporting.

3.1.2.2. Search strategy

A systematic search was carried out across PubMed, Elsevier, Scopus, Web of Science, and Google Scholar. The initial search took place between May and June 2024, with updates in December 2024 and September 2025 to capture newly published studies, particularly given the rapid expansion of digital health tools in oncology.

3.1.2.3. Eligibility criteria

Eligibility followed predefined PICO criteria. The population included children, adolescents, and adults diagnosed with cancer; studies focused on caregivers or mixed samples were excluded unless patient data were reported separately. Interventions had to be technology-based psychological programs targeting anxiety reduction (e.g., mobile apps, web-based interventions, virtual reality, wearables, serious games); purely educational or pharmacological interventions without a psychological component were excluded. Eligible comparators included treatment-as-usual, standard care, waitlist, or minimal-contact controls. Studies had to report quantitative anxiety outcomes via validated measures (e.g., HADS, STAI, PROMIS Anxiety) and be randomized controlled trials; quasi-experimental designs, observational studies, protocols, and reviews were excluded.

3.1.2.4. Screening process

Records were imported into Zotero, with duplicates removed via automated and manual checks. Two reviewers independently screened titles/abstracts, then full texts of eligible articles; disagreements were resolved through discussion, with a third reviewer available if needed (consensus was reached in all cases). The initial search yielded 1,420 records, supplemented by 22 additional studies from reference screening and updated searches. After full screening, 30 studies met eligibility criteria.

3.1.2.5. Data extraction

Data extraction followed a standardized protocol. Two reviewers independently coded each study, recording publication details, design, participant characteristics, intervention features, comparators, and anxiety outcomes, along with sample sizes, means, and standard deviations needed for effect size computation. Secondary outcomes were noted when

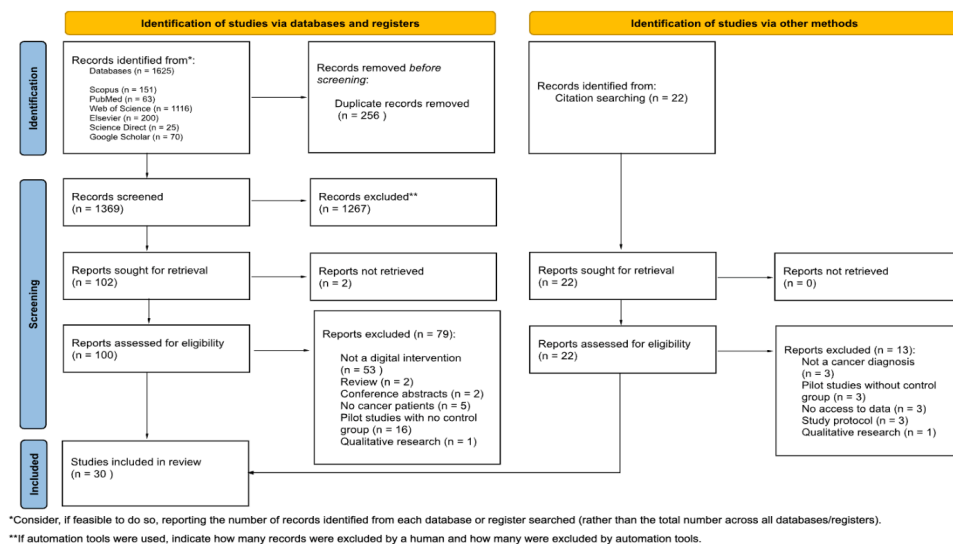
available. Corresponding authors were contacted when information was missing or unclear. Inter-rater agreement reached 95%, with discrepancies resolved through discussion.

3.1.2.6. Quality assessment

Methodological quality was assessed using the Cochrane Risk of Bias framework, evaluating domains such as random sequence generation, allocation concealment, blinding, outcome completeness, and selective reporting. Two reviewers independently rated each study, with particular attention to challenges specific to digital interventions (e.g., technological attrition, limited blinding, variable engagement). Disagreements were resolved through discussion, and risk-of-bias ratings informed subsequent sensitivity analyses.

Figure 1

PRISMA Flow Diagram of the Study Selection Process



3.1.2.7. Ethical considerations

As this meta-analysis synthesized previously published, aggregated data, no new data collection was required and individual participants could not be identified. All included trials were presumed to have obtained ethics approval from their respective review boards.

3.1.2.8. Statistical analysis

Analyses were conducted using Comprehensive Meta-Analysis (Version 4; Borenstein, 2022). Standardized mean differences (Hedges' g) were calculated from post-intervention means, standard deviations, and sample sizes, using a random-effects model to accommodate variability across studies. Heterogeneity was assessed via Q , I^2 , and τ^2 . Subgroup analyses (mixed-effects models) and meta-regression (for continuous moderators such as age, baseline anxiety, and intervention duration) explored moderators of effectiveness. Publication bias was assessed through funnel plot inspection and formal tests, and sensitivity analyses evaluated the robustness of effect estimates to study quality and design.

3.1.3. Results

3.1.3.1. Study characteristics

The 30 eligible RCTs were published between 2003 and 2024, with sample sizes ranging from 11 to 449 (pooled $N = 3,575$). Interventions included mobile applications (56.7%), virtual reality (13.3%), chat-based platforms (10%), web-based programs (6.7%), and single instances of robot-assisted, video-based, text-message, and serious game formats. The most common anxiety measures were HADS, STAI, and GAD-7. At post-intervention, digital interventions produced a moderate, statistically significant reduction in anxiety compared to controls (Hedges' $g = -0.355$, 95% CI: -0.560 to -0.149).

3.1.3.2. Participant characteristics

Of 3,553 participants, 1,749 received the intervention and 1,804 were controls. Most studies involved adults of both genders (73%), with 26.7% women-only samples, 13.3% children, and a small number of young adult samples. Mixed cancer diagnoses were most common (63%), followed by breast cancer (26.7%). Studies were conducted primarily in China (26.7%), the United States (23.3%), and Germany (10%), among other countries.

3.1.3.3. Mean effect size

Digital psychological interventions were associated with a moderate, significant reduction in anxiety (Hedges' $g = -0.355$, 95% CI: -0.560 to -0.149 ; $Z = -3.38$, $p = .00072$), indicating a meaningful beneficial effect on anxiety in cancer populations.

Table 1

Mean Effect Size

Model	Number Studies	Point estimate	Standard error	Variance	Lower limit	Upper limit	Z-value	P-value
Fixed	30	-0.299	0.001	0.001	-0.370	-0.229	-8.298	0.000
Random	30	-0.355	0.105	0.001	-0.560	-0.149	-3.382	0.000

3.1.3.4. Types and functions of digital health interventions

Across trials, technology-based interventions showed consistent short-term benefits in reducing cancer-related anxiety, with favorable effects across mobile applications, virtual reality, web-based platforms, and other formats, though the magnitude varied by modality. Post-intervention effects were generally moderate, while longer-term follow-up findings were

more heterogeneous, suggesting that maintaining treatment gains may require continued engagement or supplemental support. These patterns highlight the potential of digital health interventions as accessible, scalable adjuncts to conventional psychological care in oncology.

Sensitivity analyses confirmed stable, outlier-independent results. Most interventions reduced anxiety significantly post-treatment, but follow-up effects were less consistent, virtual reality interventions showed more sustained improvements than other formats, highlighting the need to identify features driving longer-term benefits.

3.1.3.5. Moderators of intervention effectiveness

Given substantial heterogeneity across studies, subgroup analyses and meta-regression examined whether study characteristics, intervention type, cancer type, control condition, age, gender distribution, and intervention duration, moderated treatment effects. None of the tested moderators reached statistical significance; effects did not vary meaningfully by gender, age, diagnosis, format, or control type, with all confidence intervals including zero. This suggests that variability in outcomes cannot be explained by study-level characteristics, and that factors such as engagement, adherence, or specific content features may play a more substantial role, warranting further investigation.

3.1.4. Discussion and Conclusions

This study synthesized evidence on the effectiveness of digital psychological interventions in reducing cancer-related anxiety. Drawing on 30 RCTs (N = 3,553), the meta-analysis found a moderate, statistically significant reduction in anxiety post-treatment, though sustainability of effects was inconsistent at follow-up. These findings align with prior narrative and scoping reviews reporting encouraging but heterogeneous effects of digital interventions on psychological distress in oncology (Schaffer et al., 2017; Elkefi et al., 2023).

3.1.4.1. Summary of main findings

Technology-based psychological interventions produced a moderate, statistically significant reduction in anxiety post-treatment, though considerable heterogeneity suggested outcomes varied by population, design, and modality. The included interventions spanned mobile applications, serious games, web-based programs, telehealth, and virtual reality, reflecting the flexibility of digital platforms for delivering psychosocial oncology care (McCann et al., 2019).

While most interventions showed meaningful post-treatment reductions, longer-term effects were less uniform. Virtual reality programs tended to show stronger, more sustained improvement, possibly due to their immersive and distraction-based qualities, whereas self-guided mobile or web-based applications showed smaller, often short-lived effects, differences potentially reflecting adherence, therapist guidance, and interactivity (Schaffer et al., 2017).

Unlike broader meta-analyses assessing composite psychological outcomes (Zhang et al., 2023), this review focused specifically on anxiety, offering clearer insight into how digital interventions address this prevalent emotional response (Pitman et al., 2018). Subgroup analyses found no significant moderating effects of gender, age, cancer type, duration, or control condition, suggesting that process-level factors, user engagement, therapeutic alliance, and adherence, may better explain variability in outcomes (McCann et al., 2019).

Overall, findings support the short-term effectiveness of digital interventions in reducing anxiety among cancer patients, though long-term maintenance remains inconsistent. Larger, rigorous trials with extended follow-up are needed to clarify durability and underlying mechanisms.

3.1.4.2. Limitations

Few studies assessed follow-up outcomes, limiting conclusions about long-term effectiveness. Substantial variability in intervention formats, cancer types, and participant characteristics contributed to heterogeneity, and most studies relied on self-report anxiety measures, which are more susceptible to measurement error than clinician-administered assessments.

3.1.4.3. Implications for practice and future research

Digital interventions represent a promising, accessible adjunct to standard oncology care, particularly where in-person support is limited. Clinicians may consider integrating them into routine care based on patient preferences and technological literacy, with ongoing monitoring given variable long-term outcomes. More immersive, interactive interventions appear to produce more durable effects, underscoring the importance of engagement and adherence. Future research should explore mechanisms of action, personalization strategies, and tools such as adaptive feedback and gamification to enhance long-term impact.

3.1.4.4. Conclusions

This meta-analysis demonstrates that digital psychological interventions, particularly mobile applications and virtual reality programs, effectively reduce anxiety among cancer patients, especially short-term (McCann et al., 2019; Schaffer et al., 2017). While some interventions show sustained benefits, long-term outcomes vary, highlighting the need to identify factors, intervention intensity, personalization, motivation, and clinician guidance, that support durable improvement (Elkefi et al., 2023).

3.2. Study 2: Psychometric Properties and Validation of the Emotion Regulation Index for Children and Adolescents (ERICA) in Romanian Children

3.2.1. Introduction

Emotion regulation refers to the processes through which individuals manage, modify, and express their emotional experiences to support adaptive functioning (Zarolia et al., 2015). It encompasses the capacity to influence which emotions occur, when, and how they are expressed behaviorally or physiologically, and has evolved alongside related constructs such as affect regulation and emotion control (Cole et al., 2004), shaped by shifting theoretical orientations from psychodynamic to neurobiological models (Mihic & Novak, 2018).

Thompson's (1994) influential definition frames emotion regulation as the intrinsic and extrinsic processes involved in monitoring, evaluating, and modifying emotional reactions to accomplish goals, acknowledging that regulation develops through interpersonal interaction as well as self-initiated processes. Later work (Thompson, 2007) emphasizes its dynamic, goal-oriented nature, involving attention shifting, cognitive reappraisal or suppression, and calibration of expressive behavior to context.

Emotion regulation abilities are consistently linked to mental health outcomes across development. Difficulties in emotional awareness and reliance on maladaptive strategies such as avoidance or rumination are associated with heightened risk for anxiety, depression, and externalizing problems (Zeman et al., 2002, 2006; Carthy et al., 2010), while adaptive strategies such as cognitive reappraisal and problem solving are linked to lower physiological arousal and better coping (Silk et al., 2006). Early regulatory competence appears to promote resilience over time (Feng et al., 2008), a relevance that extends to populations facing chronic stressors such as physical illness, where regulatory demands are heightened.

3.2.1.1. Objectives

This study assesses the psychometric properties, including reliability, factorial validity, and construct validity, of the Romanian version of the Emotion Regulation Index for Children and Adolescents (ERICA) in a school-based sample, to determine whether it represents a culturally appropriate instrument for this population and to support cross-cultural developmental and clinical research.

The ERICA is a 17-item revised adaptation of the 27-item Emotion Regulation Checklist for Adolescents (ERCA; Biesecker & Easterbrooks, 2001), suitable for children as young as nine. Previous research reports adequate internal consistency (Cronbach's alpha 0.60 to 0.73 for subscales, 0.75 total) and satisfactory test retest reliability (0.64 to 0.76 for subscales, 0.77 total) (MacDermott et al., 2010).

MacDermott et al. (2010) found that both PCA and CFA supported a three factor solution, Emotional Control, Emotional Self Awareness, and Situational Responsiveness, accounting for 43.18% of total variance, with excellent model fit (CFI = .96, RMSEA = .03) and stability across gender and school level groups.

Mazefsky et al. (2021) noted that the ERICA improved on its parent measure, the Emotion Regulation Checklist (ERC; Shields & Cicchetti, 1997), by removing ambiguous or cross loading items, strengthening construct clarity. The three factor structure has been consistently replicated, supporting interpretation of both subscale and total scores.

Overall, the ERICA appears to be a concise, psychometrically sound instrument for assessing self reported emotion regulation in youth. Validating it for Romania would support culturally relevant developmental research and expand the availability of reliable assessment tools,

consistent with the growing recognition of emotion regulation as a key determinant of mental health (Compas et al., 2017).

3.2.2. Method

3.2.2.1. Translation

The Emotion Regulation Index for Children and Adolescents (ERICA) was translated from English into Romanian using a multi step procedure. Two independent translators produced initial versions, one emphasizing psychological terminology and the other prioritizing natural language, which a third translator synthesized into a single consensual version. This Romanian version was then back translated into English and compared with the original to ensure meaning was preserved.

3.2.2.2. Participants

Data were collected as part of a larger study conducted in 15 schools across four Romanian counties (10 high schools, 5 secondary schools), examining emotion regulation, anxiety, attachment, and well being. Only students with parental consent and school approval participated. Schools were selected to reflect diverse socio economic backgrounds and urban and rural communities. A total of 705 children and adolescents participated (mean age = 10.81, SD = 2.92; 46.66% male), ranging from 8 to 17 years and grades 2 to 11. Parental occupation, income, and education were also recorded; age and gender distribution matched national demographic patterns.

3.2.2.3. Measures

The ERICA (Biesecker & Easterbrooks, 2001) assesses emotion regulation using a 16 item Romanian version rated on a five point Likert scale, grouped into three factors:

Emotional Control, Emotional Self Awareness, and Situational Responsiveness. The CERQ (Garnefski & Kraaij, 2006) is a 36 item self report measure of cognitive coping strategies following negative events, covering nine strategies, with versions for adults, adolescents, and children. The SDQ (Goodman, 1997) is a 25 item screening tool for behavioral and emotional difficulties in children aged 2 to 17, covering five subscales. The CASI (Bernard & Cronan, 1999) includes 28 items assessing irrational beliefs across four domains, rated on a five point Likert scale.

3.2.2.4. Procedure

After school principals granted permission and parents provided written consent, students completed the questionnaires during school hours, with research team members present to introduce the study and answer questions.

3.2.3. Results

3.2.3.1. Analysis plan and data screening

The dataset was screened for missing values, outliers, and quality issues; descriptive statistics and assumption checks were conducted to ensure valid, interpretable results, along with sensitivity analyses to assess robustness.

The mean ERICA total score was 57.11 (SD = 10.46, median 57, range 0 to 62). Subscale means were 16.99 (SD = 4.07) for Emotional Self Awareness, 16.52 (SD = 2.58) for Situational Responsiveness, and 23.59 (SD = 7.01) for Emotional Control. Item level means ranged from 2.70 (item 7) to 4.32 (item 11), with varying response variability across items.

3.2.3.2. Independent samples t tests

Independent samples t tests examined whether ERICA scores differed between boys and girls (Table 2). No significant gender differences emerged for any item or subscale (all $p > .05$), for example, item 1: $t(703) = 1.303$, $p = .193$; item 2: $t(702) = 1.104$, $p = .270$; item 3: $t(702) = 0.498$, $p = .619$. These findings suggest that emotion regulation, as measured by the ERICA, does not differ systematically between boys and girls in this sample.

3.2.3.3. Principal Component Analysis

The Principal Component Analysis supported the expected factorial structure of the ERICA. Component 1 accounted for 23.9% of the variance, Component 2 for 14.6%, and Component 3 for 11.0%, together reflecting the theorized dimensions of emotion regulation and supporting construct validity.

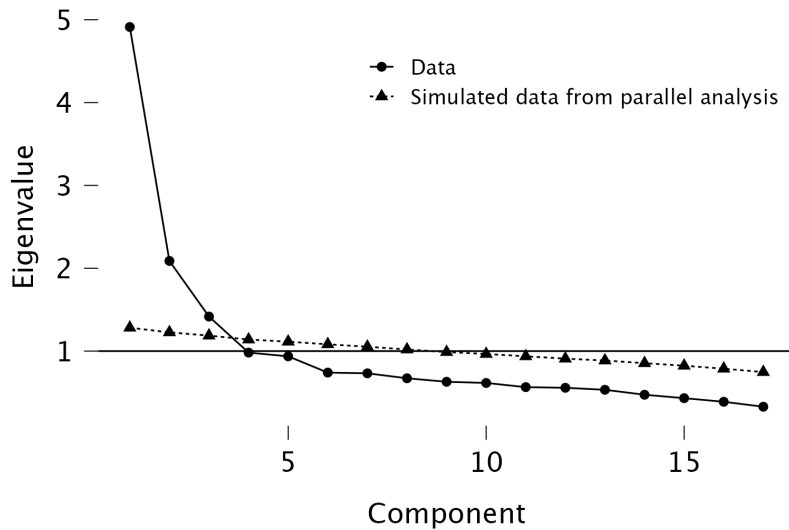
The rotated component matrix (Promax rotation) showed a clear pattern of factor loadings. Component 1 included strong loadings for items 6, 9, 15, and 5 (0.690 to 0.704); Component 2 for items 1, 11, 14, and 4 (0.616 to 0.760); and Component 3 for items 8, 3, and 17 (0.574 to 0.759), supporting three distinct but related components.

3.2.3.4. Confirmatory Factor Analysis

A Confirmatory Factor Analysis tested the three factor model (Emotional Control, Emotional Self Awareness, Situational Responsiveness) proposed in previous validation studies. The model showed acceptable fit, supporting the applicability of the ERICA's three factor structure in this population.

Figure 1

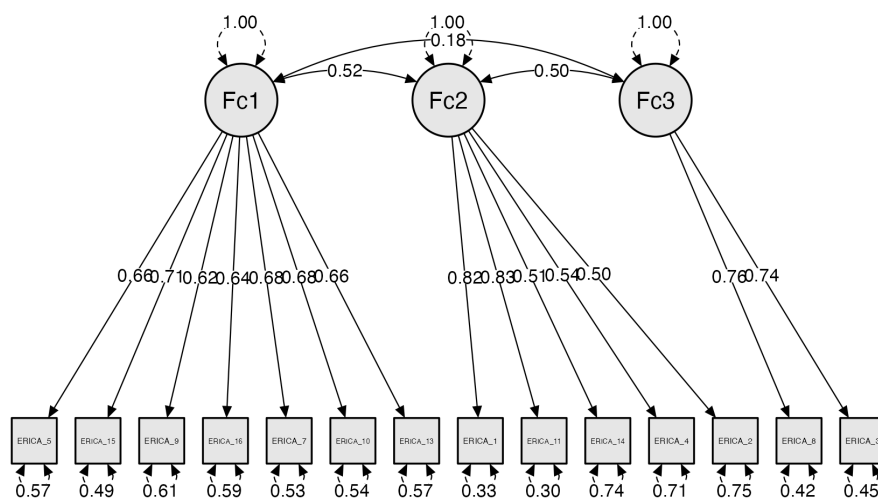
Scree Plot



Standardized factor loadings supported the three factor model. Within Emotional Control, items 5, 15, and 7 showed substantial loadings (0.62 to 0.71), reinforcing this factor's reliability. Within Emotional Self Awareness, items 1 and 11 showed particularly strong loadings (above 0.80), while items 14 and 2 showed moderately lower but acceptable loadings (0.50 to 0.54), suggesting possible targets for future refinement. Within Situational Responsiveness, items 8 and 3 showed strong loadings (0.74 and 0.76), substantiating this factor as a distinct dimension.

Figure 2

Model Plot



Factor covariances showed moderate correlations between Emotional Control and Emotional Self Awareness ($r = 0.521$) and between Emotional Self Awareness and Situational Responsiveness ($r = 0.497$), while Emotional Control and Situational Responsiveness showed a lower correlation ($r = 0.182$), indicating relative independence. Together, these findings confirm the validity of the ERICA's three factor structure, consistent with theoretical expectations and prior research, supporting the Romanian version as psychometrically robust.

3.2.3.5. Reliability analysis, internal consistency

Cronbach's alpha indicated excellent total scale reliability ($\alpha = .83$) and good subscale reliability (Emotional Control $\alpha = .75$, Emotional Self Awareness $\alpha = .79$, Situational Responsiveness $\alpha = .83$). Average inter item correlation (.21) fell within the recommended range, supporting the ERICA's reliability as an emotion regulation measure.

3.2.3.6. Construct validity

Confirmatory Factor Analysis confirmed acceptable fit for the three factor structure, with all items loading significantly, from moderate to high, onto their respective factors. Moderate to low inter factor correlations suggested conceptual relatedness without redundancy, providing strong evidence for construct validity.

3.2.3.7. Normative data for the Romanian population

Norms were established using the full sample ($N = 705$), calculated separately by gender for the total score and three subscales (Table 6). Total ERICA scores were highly similar for boys ($M = 57.24$, $SD = 10.98$) and girls ($M = 56.99$, $SD = 9.99$), with comparable medians and interquartile ranges across subscales, though Emotional Control showed slightly greater variability by gender. These norms support the ERICA's consistency across genders and its cultural appropriateness for Romanian children and adolescents.

3.2.3.8. Gender and age differences

No significant gender differences emerged for the ERICA total score or subscales. Age related patterns were similarly minimal, and linear regression confirmed age was not a significant predictor of total score. Overall, neither age nor gender significantly influenced ERICA scores, pointing to relative stability of emotion regulation abilities across this sample.

3.2.4. Discussion and Conclusions

This study examined the psychometric properties of the ERICA in a large, school based sample of Romanian children and adolescents. Findings confirmed three distinct yet interrelated dimensions, Emotional Control, Emotional Self Awareness, and Situational Responsiveness, mirroring previous research (MacDermott et al., 2010; Mazefsky et al., 2021). The absence of significant gender or age differences supports the ERICA's structural stability and measurement invariance. Although the three factor model explained a modest 39.2% of variance, this is consistent with earlier validations and reflects the complexity of emotion regulation as a construct. Future research could refine lower loading items and examine additional components such as cognitive reappraisal.

CFA results strongly supported the three factor structure, closely aligning with the original Australian validation (MacDermott et al., 2010), with satisfactory fit indices and moderate to strong loadings, affirming cross cultural validity and theoretical coherence (Thompson, 1994; Gross & Jazaieri, 2014). Internal consistency was acceptable to excellent for the total scale and subscales, comparable to or exceeding previous studies.

No significant age or gender effects emerged on total or subscale scores, suggesting the instrument assesses emotion regulation consistently across the developmental range. Further research should examine ERICA's functioning across different cultural,

socioeconomic, and clinical populations, and longitudinal studies would clarify developmental stability and predictive value for mental health outcomes.

Overall, the Romanian ERICA shows strong psychometric performance, offering a theoretically grounded, empirically robust, and concise measure suited for research and applied practice, contributing to international efforts to assess emotion regulation in youth mental health.

3.2.4.1. Clinical implications

A reliable emotion regulation measure is essential for identifying youth at risk for anxiety, depression, and social or academic difficulties. The ERICA offers clinicians and school psychologists a practical screening tool for emotional vulnerability and regulatory capacity over time, supporting early identification, referral, and intervention planning in pediatric mental health services and school based wellbeing programs. Its brief format suits large scale screening and outcome evaluation.

Given the growing focus of emotion focused therapies on strengthening regulatory skills, the ERICA offers a framework for tailoring and evaluating interventions targeting specific regulatory deficits, particularly relevant for youth facing chronic illness or psychosocial adversity. Overall, the validated Romanian ERICA supports evidence based clinical decision making, early detection, and personalized intervention.

3.2.4.2. Limitations and future directions

Despite its large, geographically diverse sample, the demographic composition was relatively homogeneous, limiting generalizability. Future studies should examine ERICA's performance across diverse cultural, socioeconomic, and clinical populations. The cross sectional design also limits conclusions about developmental sensitivity; longitudinal

research would clarify stability and responsiveness to intervention. Refining lower loading items may further improve precision.

3.2.4.3. Conclusions

This study provides strong preliminary evidence for the psychometric soundness of the Romanian ERICA, showing solid internal consistency, an interpretable three factor structure, and stability across gender and age, consistent with prior international validations (MacDermott et al., 2010; Mazefsky et al., 2021).

This culturally validated, psychometrically robust version supports the ERICA's use in school, community, and clinical settings across Romania, contributing to international efforts to strengthen emotion regulation measurement in youth and facilitating research on regulatory abilities, psychological adjustment, and mental health outcomes, as well as the design of prevention and intervention programs.

3.3. Study 3: Mapping Emotion Regulation Networks in Children and Young Adults with Chronic Illnesses: A Network Analysis

3.3.1. Introduction

Children and young adults with long term medical conditions often face persistent disease related limitations, recurrent hospitalizations, and treatment side effects affecting growth, mobility, and daily functioning (Chaplin et al., 2021). Chronic pain independently predicts lower health scores and elevated depressive symptoms (Schuchard et al., 2023), while medical challenges disrupt schooling and peer networks, straining families and

reducing quality of life across physical, emotional, and social domains (Joselyn Sweet et al., 2023; Pinquart, 2020).

Young people with chronic illness show markedly higher rates of anxiety, depression, and emotion regulation difficulties than healthy peers, with meta analytic data indicating chronic illness roughly doubles mental health disorder risk in early adolescence (Mastorci et al., 2025; Marti et al., 2025). Cumulative physical and family stress may erode adaptive regulatory learning and, over time, alter neurobiological systems supporting emotional control (Chaplin et al., 2021; Schuchard et al., 2023).

Network based perspectives offer insight into how chronic illness may affect the organization of neural systems underlying affective regulation, with prefrontal limbic circuitry central to these processes (Ochsner & Gross, 2005; Banks et al., 2007; Silvers, 2022). Longitudinal and meta analytic evidence links early regulation deficits to altered corticolimbic coupling and later depression (Pagliaccio et al., 2015; Pozzi et al., 2021; Gyurak et al., 2011). However, it remains unclear whether chronic illness produces systematic changes in the topological organization of emotion regulation networks, motivating integration of network level findings with symptom measures to clarify internalizing risk in chronically ill youth (Ruan et al., 2023).

This study examines how emotion regulation strategies and affective symptoms are structurally interconnected in children and adolescents with chronic physical illness compared to healthy peers, using a network analytic framework. The primary objective is to compare the overall structure (density) of emotion regulation networks between groups. A second objective is to examine the strength of associations between maladaptive strategies and anxiety/depression symptoms. A third objective is to examine the centrality of adaptive

strategies within the network, testing whether they occupy a less influential position in chronically ill youth.

It is hypothesized that the chronic illness group will show a denser emotion regulation network, reflecting more rigid emotional functioning; that associations between maladaptive strategies and anxiety/depression will be stronger in this group; and that adaptive strategies will show lower centrality in the chronic illness network, suggesting reduced integration and buffering capacity.

3.3.2. Method

3.3.2.1. Participants

The study included 460 participants aged 8 to 25 (160 with a chronic condition such as diabetes, asthma, or autoimmune disorders; 300 healthy peers), recruited through schools and online platforms. Chronic illness participants required a diagnosis of at least one year; consent was obtained from participants 18 and older or from parents/guardians for younger participants. Network analyses were based on 13 nodes representing subscales assessing cognitive emotional strategies and affective symptoms.

3.3.2.2. Procedure

Participants completed assessments online or in person after providing informed consent (or parental consent for minors). Responses were recorded anonymously with confidentiality safeguards.

3.3.2.3. Measures

The CERQ (Garnefski et al., 2001) is a 36 item measure of cognitive coping strategies. The CASI (Bernard & Cronan, 1999) assesses emotional and behavioral symptoms

aligned with DSM criteria for ages 5 to 18. The DASS Y (Szabó & Lovibond, 2022) is a 42 item youth measure of depression, anxiety, and stress.

Analyses were conducted in R. Networks were estimated using qgraph, with structural differences tested via NetworkComparisonTest. Centrality indices (strength, proximity, betweenness) assessed node influence, and bootstrap procedures (bootnet package) evaluated network stability and edge reliability. Together, these methods examined the organization, connectivity, and stability of emotion regulation networks in youth with and without chronic illness, aiming to identify intervention targets.

3.3.3. Results

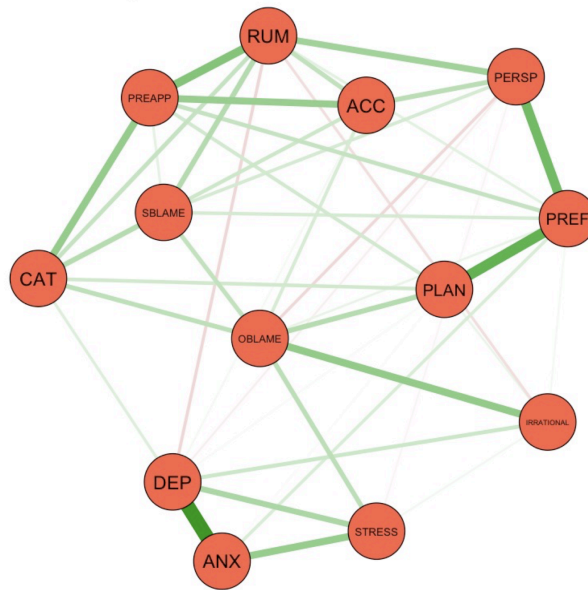
3.3.3.1. Network analyses

The chronic illness network showed a distinct configuration (Figure 1), with a notably strong association between depression and anxiety, consistent with known comorbidity in pediatric chronic illness and suggesting the two symptom clusters may reinforce one another. Rumination, positive refocusing, and planning emerged as influential, highly connected strategies, acting as organizing points within the network structure of the chronic illness group.

Figure 1

The Chronic Group Network

Chronic Group



Catastrophizing and blaming others also showed relatively strong links with affective variables, suggesting that these maladaptive cognitive styles are closely intertwined with negative emotional states and may feed into, and sustain, heightened distress. This pattern helps explain why young people with chronic illness often struggle with emotion regulation: the cognitive patterns accompanying their condition appear to reinforce rather than alleviate negative affect.

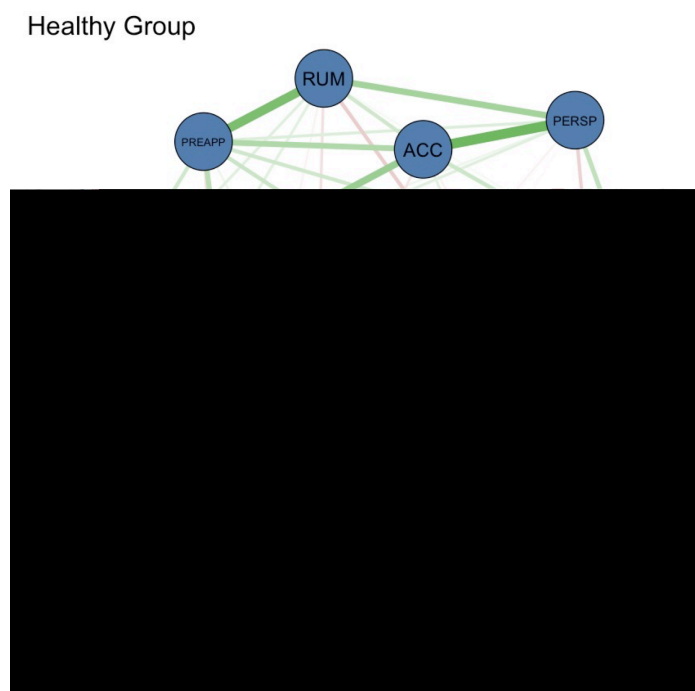
Overall, the chronic illness network reflects a more vulnerable emotional cognitive profile, with rumination, catastrophizing, and self blame forming a tightly knit cluster with anxiety and depression symptoms. While adaptive strategies such as positive reappraisal and planning are present, they do not appear influential enough to offset the pull of maladaptive nodes, potentially explaining heightened emotional reactivity in this population.

The healthy group's network (Figure 2) showed a somewhat different pattern. The depression anxiety link remained the strongest edge in both groups, but the overall structure

was noticeably less dense than in the chronic illness group, with cognitive strategies and affective symptoms forming more distinct clusters, suggesting a more efficient regulatory system less shaped by maladaptive cognition.

Figure 2

The Healthy Group Network



Adaptive emotion regulation nodes remained relatively central in the healthy group's network, and rumination also stayed influential, but surrounding connections were noticeably thinner than in the chronic illness group, suggesting weaker links between unhelpful cognition and negative affect, consistent with a more efficient regulatory system.

Overall, the healthy group's network portrayed a more balanced profile, with adaptive strategies and affective symptoms present but not tightly bound, potentially explaining lower emotional vulnerability in this group.

3.3.3.2. Centrality analyses

Strength, closeness, and betweenness centrality were computed using qgraph in R (Figures 3 and 4). Strength centrality showed marked group contrast: stress was the most strongly connected node in the chronic illness network, followed by self blame, rumination, positive refocusing, and irrationality, while in the healthy group stress also ranked highest but with a more even spread across nodes, indicating stress is more tightly embedded within maladaptive cognitive clusters in chronically ill youth.

Closeness centrality showed a similar pattern, with stress ranking highest in both groups but showing sharper distinctions in the chronic illness network. Betweenness centrality identified irrationality as a key bridging node in the chronic illness network, linking otherwise separate network components, whereas no variable showed comparable dominance in the healthy group.

Overall, centrality analyses indicate that stress is tightly integrated with maladaptive cognition in the chronic illness group, with irrational thinking functioning as a major connector, highlighting potential targets for emotion regulation interventions in this population.

Figure 3

Centrality Analyses for the Chronic Group

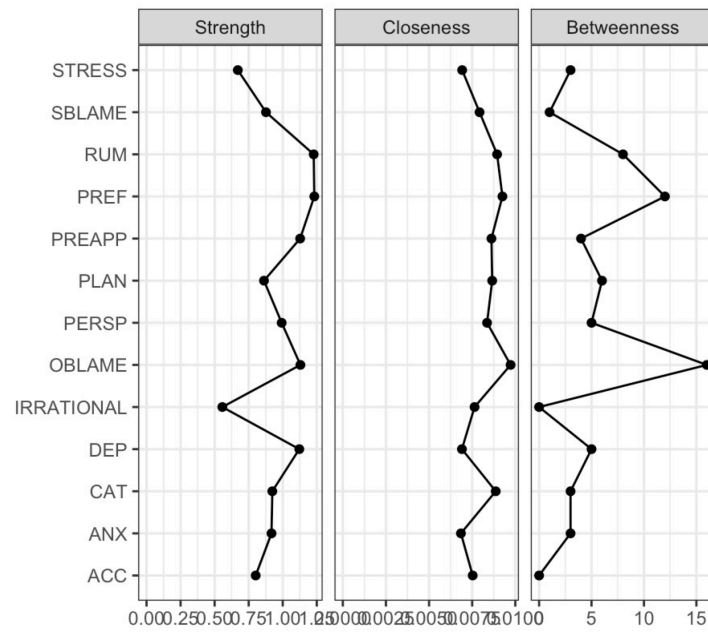


Figure 4

Centrality Analyses for the Healthy Group

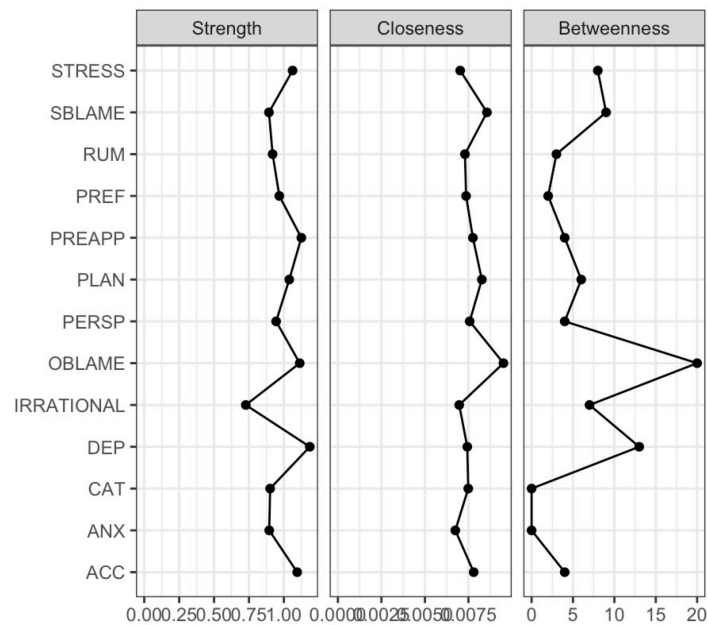
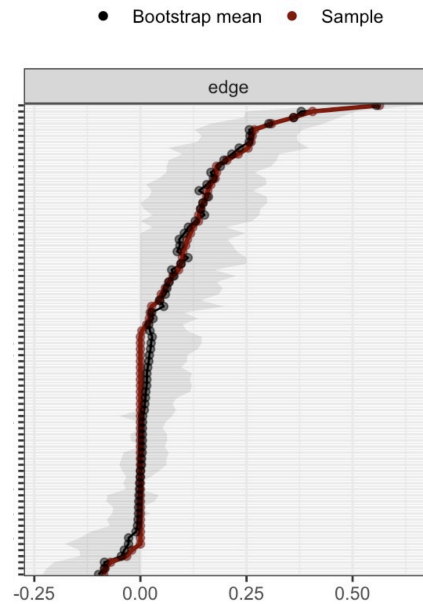


Figure 5

Bootstrap Analyses for the Chronic Group



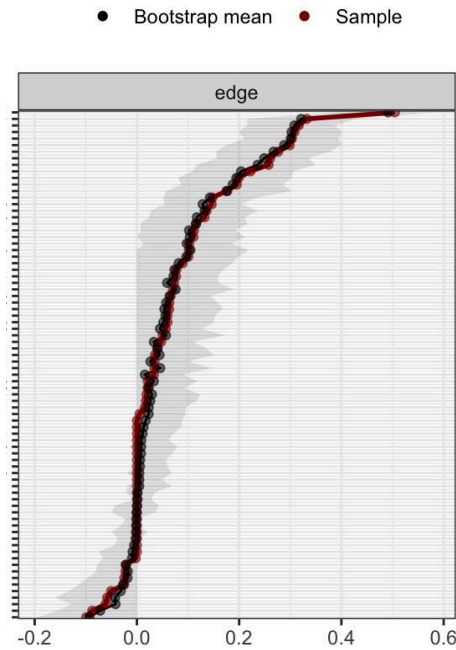
3.3.3.3. Bootstrap analyses

Network stability and accuracy were assessed via bootstrapping using the bootnet package in R, comparing original edge weights with variability across resampled datasets (red lines: original estimates; black lines: bootstrap averages; grey bands: confidence intervals).

In the chronic illness group (Figure 5), several edges reached comparatively high estimates, in some cases approaching 0.5, indicating strong associations between variables. The links between depression and anxiety, rumination and positive refocusing, and planning and positive refocusing showed especially narrow confidence intervals, with close alignment between original and bootstrap estimates, indicating these connections were stably estimated and unlikely to reflect sampling fluctuation.

Figure 6

Bootstrap Analyses for the Healthy Group



In the healthy group (Figure 6), a broadly similar pattern emerged, though most edges were weaker with wider confidence intervals than in the chronic illness group, suggesting a more modular, flexible network more commonly associated with psychological well being.

Together, the bootstrap results reinforce the contrast between groups: the chronic illness network shows stronger, more consistently estimated connections, possibly reflecting rigidity in emotional cognitive interaction, while the healthy group shows a looser, more adaptable configuration consistent with more effective emotion regulation.

3.3.4. Discussion and Conclusions

This study compared emotion regulation networks in chronically ill and healthy children and young adults, finding clear differences in organization and connection strength. In the chronic illness group, maladaptive strategies (rumination, self blame, catastrophizing, irrational thinking) were closely related to anxiety and depression, suggesting mutually reinforcing negative cognitions contributing to emotional distress. The healthy group's network showed a strong anxiety depression link but a less densely connected surrounding

structure, with weaker maladaptive symptom links and more central adaptive strategies (positive refocusing, planning), suggesting a more flexible, protective regulatory system.

Centrality analyses showed stress as the most influential node in both groups, but more embedded within maladaptive strategies in the chronic illness network, where irrational thinking also acted as a key connector, linking nodes that were more weakly related in healthy participants, marking these as potential intervention targets.

Bootstrap analyses supported the robustness of key associations in the chronic illness group (depression anxiety, rumination positive refocusing, planning positive refocusing), while the healthy group showed weaker, less stable edges, consistent with a more modular, flexible structure.

Overall, findings extend prior work on depression anxiety comorbidity in pediatric chronic illness and highlight maladaptive cognitive strategies as maintaining factors for emotional difficulty. This suggests interventions targeting central mechanisms such as rumination, stress sensitivity, or irrational thinking, potentially delivered through digital or personalized formats, may be particularly effective.

In summary, the chronic illness group showed a tightly interconnected network dominated by maladaptive cognition and negative affect, while the healthy group showed a more balanced, resilient configuration, supporting network approaches for identifying vulnerability and resilience and informing tailored interventions for medically vulnerable youth.

3.3.4.1. Limitations and future directions

The relatively small chronic illness group may have reduced edge estimate stability and power to detect group differences. The network included a limited variable set, excluding

constructs such as resilience, social support, or quality of life, which future research should incorporate. The cross sectional design also prevents conclusions about directionality; longitudinal or ecological momentary assessment approaches would better clarify how these processes interact over time.

3.3.4.2. Conclusions

This study identified clear differences in emotion regulation network organization between chronically ill and healthy youth. The chronic illness group showed a more densely interconnected network with strong maladaptive cognition symptom associations, while the healthy group showed a more balanced network with better integrated adaptive strategies and weaker maladaptive cognition links, suggesting chronic illness is associated with tighter coupling of negative cognitive emotional processes, reduced regulatory flexibility, and increased vulnerability to sustained distress.

3.4. Study 4: The Efficacy of the RETHinknGame on Emotional, Behavioral, and Cognitive Outcomes in Children and Adolescents: A Randomised Controlled Trial

3.4.1. Introduction

Emotional disorders, particularly anxiety and depression, are a significant and growing public health concern among children and adolescents, affecting 9–14% of school-aged youth, with rates increasing over time, especially among adolescent girls. These disorders are associated with impairments in academic, social, and family functioning, as well as long-term risks including low self-esteem, substance use, and later psychiatric disorders. Emotion regulation has been increasingly conceptualised as a central transdiagnostic mechanism underlying the emergence and maintenance of emotional

difficulties, with early regulatory deficits contributing to the continuity of internalising symptoms (de Lijster et al., 2019).

Given persistent barriers to accessibility and scalability in traditional treatments, digital interventions such as serious games have gained interest, though rigorous evidence in clinically diagnosed populations remains limited. The RETHink Game, a theory-driven intervention grounded in Rational-Emotive Behavior Therapy, was developed to address this gap, and the present study evaluates its efficacy as an adjunct to standard pharmacological treatment while examining whether changes in emotion regulation are associated with improved emotional and behavioral outcomes.

3.4.1.1. The RETHink Game

The RETHink Game is a therapeutic digital intervention grounded in Rational-Emotive Behavior Therapy (REBT), which posits that maladaptive emotional responses stem from irrational beliefs, such as rigid demands, catastrophising, low frustration tolerance, and global self-downing, rather than from activating events themselves. Through a narrative built around the character RETMAN and contrasting sets of rational and irrational characters, the game operationalises the REBT ABC model across seven progressively structured levels, guiding players to identify, challenge, and restructure maladaptive beliefs. The intervention is expected to influence outcomes through three interrelated pathways: modifying irrational beliefs, strengthening adaptive emotion-regulation strategies, and increasing engagement through its gamified format. It is situated within the broader field of digital mental health interventions, where rigorous randomized trials targeting clinically diagnosed pediatric populations remain scarce (David et al., 2021).

3.4.1.2. Objectives

The study's primary objective is to assess the efficacy of the RETHink Game as an adjunct to standard pharmacological treatment in reducing emotional symptomatology among children and adolescents with established psychiatric diagnoses. Secondary objectives include examining whether the intervention is associated with improvements in overall emotion regulation, evaluating its broader impact on internalising and externalising symptoms and prosocial behavior, and assessing whether it contributes to reductions in irrational beliefs.

3.4.1.3. Hypotheses

It was hypothesised that participants in the RETHink Game condition would show greater reductions in emotional symptoms, greater improvements in emotion regulation, greater reductions in internalising and externalising symptoms, and greater improvements in prosocial behavior compared to the control group. It was further hypothesised that the intervention would lead to greater reductions in irrational beliefs. A sixth, exploratory hypothesis, informed by prior network analysis identifying irrational thinking as a central bridging node, proposed that irrational beliefs would show direct and robust associations with both treatment assignment and symptom outcomes in the post-treatment network.

3.4.2. Method

3.4.2.1. Participants

Sixty-eight children and adolescents aged 8–18 with clinically established psychiatric diagnoses were recruited from the Pediatric Psychiatry Department of the Clinical Emergency Hospital for Children in Cluj-Napoca, Romania, and randomly allocated to an intervention group (REThink Game plus treatment as usual) or a control group (treatment as usual only). No dropouts occurred, as participants were inpatients under continuous psychiatric supervision. Informed consent and assent were obtained, and the study received

ethical approval. Power analyses confirmed the achieved sample was sufficient to detect the observed effect sizes.

3.4.2.2. Procedure

Participants completed a baseline assessment (T1) before random allocation, followed by a two-week intervention period during which the intervention group completed the seven-level RETHink Game alongside standard clinical care. Post-intervention assessment (T2) was conducted immediately after the intervention, and a follow-up assessment (T3) one month later, enabling examination of both immediate and short-term maintenance effects.

3.4.2.3. Measures

Emotional and behavioral difficulties were assessed using the Strengths and Difficulties Questionnaire (SDQ), irrational beliefs using the Child and Adolescent Scale of Irrationality (CASI), and cognitive emotion-regulation strategies using the Cognitive Emotion Regulation Questionnaire – Child Version (CERQ-K).

3.4.2.4. Data analysis

Analyses were conducted in JASP. Baseline equivalence between groups was tested using independent samples t-tests, with ANCOVA applied for variables showing baseline differences (maladaptive emotion regulation and SDQ total difficulties). For outcomes without baseline differences, mixed-design ANOVAs (Time $\times$ Group) were used, followed by Bonferroni-corrected post hoc comparisons where significant effects emerged, with effect sizes reported as partial eta squared and Cohen's d (significance threshold $p < .05$). An exploratory network analysis, drawing on Network Intervention Analysis logic, examined candidate mechanisms of change using residualized post-treatment scores for CASI, nine

CERQ subscales, and SDQ total difficulties, with treatment group entered as a binary node, estimated via mixed graphical models with bootstrap resampling in R.

3.4.3. Results

3.4.3.1. Preliminary analyses and baseline equivalence

Independent samples t-tests indicated no significant baseline differences between the intervention and control groups on irrational beliefs, $t(66) = 0.91$, $p = .366$, or adaptive emotion-regulation strategies, $t(66) = -1.37$, $p = .176$. However, significant baseline differences emerged for maladaptive emotion regulation, $t(66) = 5.10$, $p < .001$, and overall emotional and behavioral difficulties, $t(66) = 3.44$, $p = .001$, with the control group reporting higher initial levels on both. Given this partial baseline nonequivalence, ANCOVA was used for these two outcomes, with baseline score as covariate, group as fixed factor, and post-treatment and follow-up scores as dependent variables. Descriptive statistics for all outcomes across the three time points are presented in Tables 1-4.

Table 1

Descriptive Statistics for Irrational Beliefs (CASI)

Time	Control M (SD)	REThink M (SD)
Baseline	94.29 (15.75)	90.47 (18.73)
Post	74.32 (17.31)	93.68 (15.77)
Follow-up	74.74 (17.33)	95.97 (17.71)

Note. M = mean; SD = standard deviation.

Table 2

Descriptive Statistics for Emotion Regulation (CERQ) - Adaptive Strategies

Time	Control M (SD)	REThink M (SD)
Baseline	4.40 (1.35)	4.94 (1.87)
Post	7.24 (1.16)	5.27 (1.53)
Follow-up	7.16 (1.12)	5.32 (1.54)

Note. CERQ = Cognitive Emotion Regulation Questionnaire.

Table 3

Descriptive Statistics for Emotion Regulation (CERQ) - Maladaptive Strategies

Time	Control M (SD)	REThink M (SD)
Baseline	6.47 (1.26)	4.57 (1.77)
Post	4.00 (1.35)	5.35 (1.65)
Follow-up	4.04 (1.37)	5.68 (1.63)

Note. CERQ = Cognitive Emotion Regulation Questionnaire.

Table 4

Descriptive Statistics for Emotional and Behavioral Difficulties (SDQ Total)

Time	Control M (SD)	REThink M (SD)
Baseline	25.18 (4.56)	19.94 (7.61)
Post	17.18 (6.09)	21.71 (7.22)
Follow-up	16.85 (5.64)	24.35 (6.62)

Note. SDQ = Strengths and Difficulties Questionnaire.

Table 5

Baseline Group Differences

Variable	t(66)	p
CASI	0.91	.366
CERQ adaptive	-1.37	.176
CERQ maladaptive	5.10	< .001
SDQ total	3.44	.001

3.4.3.2. Effects on emotional symptoms

Given the significant baseline difference on SDQ total scores, ANCOVA was used to examine group differences at post-treatment, controlling for pre-treatment scores. Results showed a significant effect of Group, $F(1, 65) = 18.61$, $p < .001$, with the RETHink Game condition scoring significantly lower on overall emotional symptoms than the control group at post-treatment ($MD = -6.92$, $SE = 1.60$, $d = -1.14$, $p < .001$). A second ANCOVA at follow-up, controlling for post-treatment scores, again showed a significant effect of Group, $F(1, 65) = 22.34$, $p < .001$, with the intervention group continuing to report significantly fewer difficulties than controls ($MD = -3.96$, $SE = 0.84$, $d = -1.21$, $p < .001$). These findings support the primary hypothesis that the RETHink Game is associated with significant reductions in overall emotional symptoms, with effects maintained at follow-up.

Table 6

Analysis of Covariance for SDQ Total Score at Post-Test and Follow-Up

Source	SS	df	MS	F	p	η^2p
Post-Treatment						
Group	689.13	1	689.13	18.61	< .001	.222
SDQ Pre	538.75	1	538.75	14.55	< .001	.183
Residuals	2407.25	65	37.04			
Follow-Up						
Group	237.82	1	237.82	22.34	< .001	.256
SDQ Post	1804.12	1	1804.12	169.48	< .001	.723
Residuals	691.91	65	10.65			

Note. SDQ Pre = pre-treatment SDQ total score (covariate for post-treatment); SDQ Post = post-treatment SDQ total score (covariate for follow-up).

3.4.3.3. Effects on emotion regulation

For adaptive emotion-regulation strategies, a mixed-design ANOVA (Time $\times$ Group) showed a significant main effect of Time, $F(2, 132) = 55.34$, $p < .001$, $\eta^2p = .456$, a significant Time $\times$ Group interaction, $F(2, 132) = 33.27$, $p < .001$, $\eta^2p = .335$, and a significant main effect of Group, $F(1, 66) = 14.11$, $p < .001$, $\eta^2p = .176$, indicating that improvements in adaptive strategies were more pronounced in the intervention group.

For maladaptive strategies, given the baseline difference, ANCOVA was conducted separately for post-treatment and follow-up. At post-treatment, controlling for pre-treatment scores, the effect of Group was significant, $F(1, 65) = 31.95$, $p < .001$, with the intervention group reporting significantly lower maladaptive strategy use than controls ($MD = -2.19$, $SE = 0.39$, $d = -1.62$, $p < .001$). At follow-up, controlling for post-treatment scores, the effect of Group remained significant, $F(1, 65) = 12.35$, $p < .001$, with the intervention group

continuing to report lower maladaptive strategy use ($MD = -0.34$, $SE = 0.10$, $d = -0.94$, $p < .001$).

Together, these findings support the hypothesis that the RETHink Game is associated with improvements in emotion regulation, reflected in both increased use of adaptive strategies and decreased reliance on maladaptive strategies.

Table 7

Analysis of Covariance for CERQ Maladaptive Strategies at Post-Test and Follow-Up

Source	SS	df	MS	F	p	η^2p
Post-Treatment						
Group	58.74	1	58.74	31.95	< .001	.330
CERQ-M Pre	31.12	1	31.12	16.93	< .001	.207
Residuals	119.51	65	1.84			
Follow-Up						
Group	1.61	1	1.61	12.35	< .001	.160
CERQ-M Post	141.13	1	141.13	1085.36	< .001	.944
Residuals	8.45	65	0.13			

Note. CERQ-M Pre = pre-treatment maladaptive emotion regulation score (covariate for post-treatment); CERQ-M Post = post-treatment maladaptive emotion regulation score (covariate for follow-up).

3.4.3.4. Effects on internalising and externalising symptoms

For internalising symptoms, the mixed-design ANOVA showed a significant main effect of Time, $F(2, 132) = 4.74, p = .010, \eta^2p = .067$, and a significant Time $\times$ Group interaction, $F(2, 132) = 37.91, p < .001, \eta^2p = .365$. The intervention group showed significant reductions from pre- to post-treatment and pre- to follow-up (both $d = 1.11, p < .001$), with scores stable between post-treatment and follow-up. The control group instead showed significant increases at both timepoints. Between-group differences were significant at post-treatment ($d = -0.62, p = .012$) and follow-up ($d = -0.86, p < .001$).

For externalising symptoms, the main effect of Time was not significant, $F(2, 132) = 1.67, p = .192$, but the Time $\times$ Group interaction was, $F(2, 132) = 38.05, p < .001, \eta^2p = .366$. The intervention group showed significant reductions at both post-treatment ($d = 1.08, p < .001$) and follow-up ($d = 0.98, p < .001$), while the control group showed significant increases at both timepoints. Between-group differences were significant at post-treatment ($d = -0.99, p < .001$) and follow-up ($d = -0.90, p < .001$).

These consistent interaction effects indicate that the intervention group experienced greater reductions in both internalising and externalising symptoms relative to controls.

3.4.3.5. Effects on prosocial behavior

A significant main effect of Time, $F(2, 132) = 9.97, p < .001, \eta^2p = .131$, and a significant Time $\times$ Group interaction, $F(2, 132) = 9.70, p < .001, \eta^2p = .128$, were found. The intervention group showed significant increases in prosocial behavior from pre- to post-treatment ($d = -0.95, p < .001$) and pre- to follow-up ($d = -1.07, p < .001$), with no significant changes in the control group. Between-group differences emerged at follow-up ($d = 0.64, p = .012$) but not at post-treatment ($p = .084$).

3.4.3.6. Effects on irrational beliefs

A significant main effect of Time, $F(2, 132) = 12.38, p < .001, \eta^2p = .158$, a significant Time $\times$ Group interaction, $F(2, 132) = 29.76, p < .001, \eta^2p = .311$, and a significant main effect of Group, $F(1, 66) = 11.65, p = .001, \eta^2p = .150$, were observed. The intervention group showed significant reductions in irrational beliefs from pre- to post-treatment ($d = 1.17, p < .001$) and pre- to follow-up ($d = 1.14, p < .001$), with effects maintained between post-treatment and follow-up. No significant changes occurred in the control group. Between-group differences were significant at post-treatment ($d = -1.13, p < .001$) and follow-up ($d = -1.24, p < .001$), consistent with the intervention's theoretical focus on maladaptive cognitive processes.

3.4.3.7. Results of the exploratory network analysis of mechanisms of change

The bootstrapped average-weight network identified the strongest overall edge as the positive link between Planning and Positive Reappraisal ($w = .52, 100\%$ stability). The intervention node (Group) showed its clearest direct associations with lower Rumination ($w = -.52, 75\%$) and lower CASI ($w = -.50, 75\%$), along with higher Acceptance, Positive Refocusing, and Perspective, and a negative association with Other-Blame. The direct Group–SDQ edge was weaker and less stable ($w = -.15, 33\%$), suggesting the intervention was more strongly linked to process variables than directly to the outcome. SDQ itself was most strongly connected to higher Catastrophizing ($w = .36, 95\%$) and negatively to Positive Reappraisal ($w = -.20, 67\%$), with weaker links to Planning, CASI, Self-Blame, and Group.

Figure 1

Average Weights

Edge Strength (Average Weights)

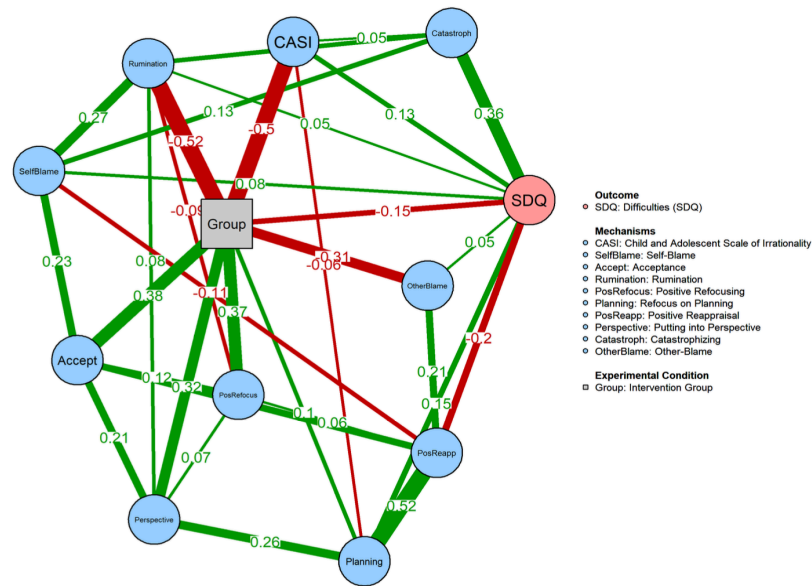
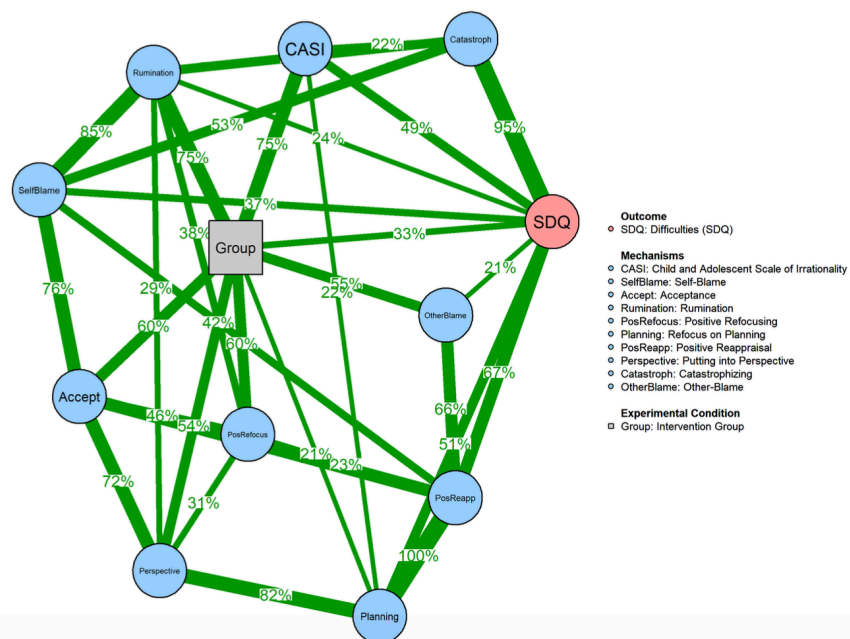


Figure 2

Edge Stability

Edge Stability (Appearances in 10,000 Bootstraps)



3.4.3.8. Summary of findings

A summary of the repeated-measures ANOVA results across all outcome variables is presented in Table 6. Overall, the findings are characterised by consistent Time $\times$ Group interaction effects across emotional symptoms, emotion regulation, behavioral difficulties, prosocial behavior, and irrational beliefs, suggesting that the intervention was associated with differential trajectories of change over time relative to treatment as usual alone.

Table 8

Summary of Repeated Measures ANOVA Results

Outcome	Effect	F (df)	p	η^2p
Secondary outcomes – Behavioral				
SDQ internalizing	Time	4.74 (2, 132)	.010	.07
	Time $\times$ Group	37.91 (2, 132)	< .001	.37
SDQ externalizing	Time	1.67 (2, 132)	.192	.03
	Time $\times$ Group	38.05 (2, 132)	< .001	.37
Prosocial behavior	Time	9.97 (2, 132)	< .001	.13
	Time $\times$ Group	9.70 (2, 132)	< .001	.13
Secondary outcomes – Emotion regulation				
CERQ adaptive	Time	55.34 (2, 132)	< .001	.46
	Time $\times$ Group	33.27 (2, 132)	< .001	.34
Mechanisms (exploratory)				
CASI	Time	12.38 (2, 132)	< .001	.16
	Time $\times$ Group	29.76 (2, 132)	< .001	.31

Note. Greenhouse-Geisser correction applied where sphericity was violated. η^2p = partial eta squared. SDQ total and CERQ maladaptive were analyzed using ANCOVA (see Tables 6 and 7).

3.4.4. Discussion and Conclusions

3.4.4.1. General overview of findings

This randomized controlled trial examined the efficacy of the RETHink Game as an adjunctive digital intervention for children and adolescents with psychiatric diagnoses, focusing on emotional symptoms, emotion regulation, behavioral functioning, and irrational beliefs. Overall, the intervention group showed more favourable trajectories across all assessed domains than the treatment-as-usual group. These effects were reflected mainly in robust Time $\times$ Group interactions rather than isolated between-group differences, suggesting the intervention influenced the rate and direction of change rather than producing a static endpoint, consistent with process-oriented models of psychological change.

3.4.4.2. Intervention effects on emotional symptoms

Consistent with the primary objective, the RETHink Game was associated with greater reductions in emotional symptoms than the control condition, extending existing evidence on cognitive-behavioral and digital interventions to an underrepresented clinically diagnosed population. This aligns with cognitive-behavioral models in which maladaptive cognitions and ineffective regulation strategies maintain emotional distress; by targeting these processes through structured practice, the intervention may have altered how participants interpret and respond to emotionally salient situations. However, given the baseline differences between groups, the possibility that higher initial symptom levels in the control group influenced the magnitude of change cannot be fully excluded, and future studies with larger samples and stricter randomisation are needed to clarify this.

3.4.4.3. Emotion regulation as a central mechanism of change

A theoretically important finding was the consistent, large effects on both adaptive and maladaptive emotion-regulation strategies, with the intervention group showing greater increases in adaptive strategies and greater reductions in maladaptive ones. These results support conceptualising emotion regulation as a transdiagnostic mechanism, whereby improved regulatory flexibility translates into broader emotional gains. Although formal mediation analysis was not possible, the parallel changes in emotion regulation and emotional symptoms are consistent with a mechanism-based interpretation, plausibly reflecting reduced rumination and catastrophizing alongside increased reappraisal and problem-solving. This supports the thesis's broader framing of emotion regulation as a central process linking vulnerability and intervention response.

3.4.4.4. Behavioral functioning and social adaptation

The intervention was also associated with reductions in overall behavioral difficulties and increases in prosocial behavior, suggesting effects extending beyond symptom reduction into social functioning. This may reflect that enhanced emotion regulation supports more adaptive social responses, such as better frustration management and reinterpretation of interpersonal situations, consistent with developmental models linking regulatory capacity to social competence and with the study's transdiagnostic perspective.

3.4.4.5. Effects on internalising and externalising symptoms

Significant reductions were found in both internalising and externalising symptoms, reflected in consistent interaction effects; notably, the significant interaction for externalising symptoms despite the absence of a general time effect suggests changes were specific to the intervention condition. This supports the idea that targeting core cognitive and regulatory processes can produce broad effects across both inwardly and outwardly directed symptoms, consistent with transdiagnostic approaches.

3.4.4.6. Effects on irrational beliefs and cognitive restructuring

Reductions in irrational beliefs in the intervention group support the theoretical framework underlying the RETHink Game, suggesting successful modification of maladaptive cognitive patterns central to REBT. This offers preliminary evidence that cognitive restructuring can be effectively delivered through a digital, game-based format, with implications for scalability in pediatric populations where engagement is often a barrier. The alignment between changes in irrational beliefs and improvements in emotional/behavioral outcomes further supports a mechanism-based interpretation, though formal mediation testing is needed.

3.4.4.7. Mechanisms of change within a digital intervention framework

The overall pattern suggests the RETHink Game operates through multiple interrelated mechanisms: modifying maladaptive cognitive appraisals, enhancing emotion-regulation capacities, and increasing engagement through gamification. This integration may be especially valuable in pediatric clinical populations facing motivational and accessibility barriers, though the study does not directly test these mechanisms, and future research using longitudinal mediation models or ecological momentary assessment is needed.

3.4.4.8. Findings from the exploratory network analysis

Two plausible indirect pathways between Group and SDQ were identified: Group → CASI → SDQ, given the strong negative link between Group and CASI and the positive link between CASI and SDQ; and Group → Acceptance → Positive Reappraisal → SDQ, reflecting a possible route through adaptive emotion-regulation processes. As these are undirected associations from an exploratory network rather than a formal mediation model, they should be regarded as hypothesis-generating rather than confirmatory.

3.4.4.9. Limitations and future directions

Key limitations include partial baseline nonequivalence for maladaptive emotion regulation and behavioral difficulties, though ANCOVA confirmed these did not account for the intervention effects; reliance on self-report measures, which introduces potential response bias; and a relatively short follow-up period limiting conclusions about long-term durability. Future research should incorporate multi-informant and behavioral measures, extended follow-up, and examine moderators (e.g., age, diagnosis, baseline severity) as well as formal mediational pathways.

3.4.5.0. Conclusions and implications

Overall, the study provides preliminary evidence that the RETHink Game may be an effective adjunctive intervention for improving emotional and behavioral outcomes in children and adolescents with psychiatric diagnoses. The consistent pattern of change across multiple domains supports its potential as a scalable, transdiagnostic intervention targeting core cognitive and regulatory mechanisms, contributing to the thesis's broader positioning of emotion regulation as central to both vulnerability and intervention response, and highlighting the potential of theory-driven digital interventions in clinical practice, particularly for populations with limited access to traditional care.

IV. GENERAL CONCLUSIONS AND IMPLICATIONS

4.1. General Conclusions

The thesis aimed to advance a multi-level understanding of emotion regulation in children and young people with chronic illnesses, integrating meta-analytic, psychometric, network-analytic, and intervention-based methodologies across four studies. Together, the findings show that chronic illness is associated with elevated emotional vulnerability, that this vulnerability is shaped by identifiable regulatory mechanisms, and that these mechanisms are both measurable and responsive to targeted intervention.

Study One, a meta-analysis of 30 studies on technology-based interventions for cancer-related anxiety, found a moderate, significant reduction in anxiety post-intervention, with virtual reality tools showing stronger, more sustained effects than self-guided mobile apps. Despite substantial heterogeneity, no moderator reached significance, suggesting broad effectiveness across subgroups, though this may partly reflect limited statistical power rather than true homogeneity.

Study Two validated the Romanian adaptation of the Emotion Regulation Index for Children and Adolescents (ERICA), demonstrating good internal consistency, a clear three-factor structure, satisfactory construct validity, and measurement invariance across age and gender. This provided a psychometrically sound tool underpinning the subsequent network analysis and trial.

Study Three used network analysis to show that chronically ill youth display a densely connected, rigid network in which maladaptive cognitions (rumination, self-blame, irrational thinking) are strongly linked to anxiety and depression, with stress as the most central node and irrational thinking as a key bridge variable. Healthy peers showed a more

modular, flexible network with adaptive strategies more central. This suggests chronic illness reorganises regulatory processes toward rigidity rather than introducing novel processes.

Study Four, a randomized controlled trial, tested whether these identified mechanisms could be modified through the RETHink Game, a gamified digital intervention. Results showed consistent, clinically meaningful improvements in emotional symptoms, emotion regulation, behavioral functioning, and irrational beliefs, driven by differential trajectories of change over time rather than static post-intervention differences, with simultaneous strengthening of adaptive strategies and reduction of maladaptive ones, plus gains in prosocial behavior.

Collectively, the four studies form a coherent, mechanism-oriented programme: the meta-analysis establishes population-level potential for digital interventions, the psychometric study supplies valid measurement tools, the network analysis identifies central regulatory targets, and the trial demonstrates these targets are experimentally modifiable. The findings support a transdiagnostic account in which core regulatory mechanisms, rather than diagnosis-specific symptoms, drive broad-spectrum clinical improvement, and demonstrate the feasibility of delivering rational-emotive and cognitive-behavioral principles through scalable, engaging digital formats.

4.1.1. Clinical and Practical Implications

The validated Romanian ERICA offers clinicians a reliable tool for assessing emotion regulation in youth, complemented by network findings highlighting stress responsivity, irrational thinking, and rumination as key targets for clinical assessment. The meta-analytic and trial findings support integrating technology-based cognitive interventions, particularly the RETHink Game, into care pathways for chronically ill youth, given their scalability and suitability for healthcare systems facing clinician shortages and logistical barriers to

face-to-face therapy. The findings also suggest clinicians should proactively assess irrational beliefs and rumination, even when not spontaneously reported, to improve case formulation and therapeutic alliance.

4.1.2. Strengths, Limitations, and Directions for Future Research

Strengths include the convergent validity offered by four complementary methodologies, the high evidentiary standard of the randomized controlled trial, and the use of trajectory-based rather than purely post-intervention analyses. Limitations include modest sample sizes in Studies Three and Four, which constrain power and network stability, and a follow-up period in Study Four too short to establish long-term durability of effects. Future research should include longer follow-ups (six and twelve months), intensive longitudinal designs such as ecological momentary assessment to test whether cognitive changes precede symptom changes, and dynamic or time-series network modelling to better capture how regulation processes evolve during intervention.

4.1.3. Conclusions

The thesis offers a mechanistically grounded understanding of emotional vulnerability in youth with chronic illness, showing emotion regulation to be a dynamic, multi-component process shaped by illness experience, reliably measurable, structurally representable through network methods, and modifiable through theory-driven digital intervention. By moving from descriptive association to mechanistic explanation and targeted intervention, the work aims to bring research closer to clinical practice and to meaningful change for young people navigating illness and psychological vulnerability.

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