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ORIGINAL ARTICLE

Efficacy of the App *esTOCma* Throughout Obsessive-Compulsive Disorder Contents: A *post hoc* Analysis of a Randomized Controlled Trial

Yuliya Saman[1] · Sandra Arnáez[1] · María Roncero[1] · Gemma García-Soriano[1]

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Abstract

Purpose Obsessive-compulsive disorder (OCD) is a disabling mental health condition associated with significant delays in professional help-seeking. Stigma and poor mental health literacy (MHL) contribute to these delays and vary depending on OCD symptom dimensions. This *post hoc* analysis aimed to evaluate the efficacy of the mobile application *esTOCma* in reducing stigma and improving MHL and intention to seek help across autogenous and reactive OCD symptom dimensions.

Methods A *post hoc* analysis was conducted using pre- and post-intervention data from 208 participants from a previous crossover randomized controlled trial. Participants had been assigned to a vignette describing either autogenous or reactive OCD symptoms and to the experimental or control group. Changes in stigma (*Attribution Questionnaire*, *Social Distance Scale*), MHL (*Mental Health Literacy Questionnaire*), and help-seeking intention (*General Help-Seeking Questionnaire*) were assessed using a 2 (Group: experimental and control) × 2 (Time: T0 [pre-intervention] and T1 [post-intervention]) mixed factorial analyses of variance performed for each symptom dimension (i.e., autogenous and reactive OCD symptoms dimensions).

Results Following the intervention, significant and similar improvements in stigma, social distance, MHL, and help-seeking intention were observed in the experimental group for both OCD content dimensions. These differences were not observed in the control group.

Conclusions This *post hoc* study suggests that *esTOCma* is an effective tool for reducing stigma and misinformation about both autogenous and reactive OCD symptoms in the general community. The original study was registered on ClinicalsTrials.gov on January 11th, 2022 (NCT04777292).

Introduction

Obsessive-compulsive disorder (OCD) is a mental health condition characterized by intrusive and recurring thoughts (obsessions) and repetitive behaviors or mental acts (compulsions) aimed at reducing anxiety or distress caused by these obsessions (American Psychiatric Association [APA], 2022). OCD is a heterogeneous disorder, with obsessions and compulsions differing in content and clinical presentation (García-Soriano et al., 2008; McKay et al., 2004). These different presentations can be grouped into two broad categories, as proposed by Lee and Kwon (2003): autogenous obsessions, which include aggression/ harm, sexual, and religious/ blasphemous/ immoral contents; and reactive

✉ Gemma García-Soriano
gemma.garcia@uv.es

Yuliya Saman
yuliya.saman@uv.es

Sandra Arnáez
sandra.arnaez@uv.es

María Roncero
maria.roncero@uv.es

[1] Departamento de Personalidad, Evaluación y Tratamientos Psicológicos, Universitat de València, Valencia, Spain

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obsessions, which encompass doubt/ checking, contamination/ washing, and superstition/ symmetry/ order contents. This categorization has been supported by empirical research (García-Soriano et al., 2011; García-Soriano & Belloch, 2013; Lee et al., 2005). Specifically, it is associated with distinct clinical features, treatment responses, symptom courses, and findings in physiological, biological, and behavioral studies (Rowsell & Francis, 2015). Recently, Yucens et al. (2024) have underscored the need for greater attention to this form of OCD classification.

Despite OCD's high lifetime prevalence (1.3%; Fawcett et al., 2020), its significant interference with daily life (Fontenelle et al., 2010; Markarian et al., 2010), and the existence of effective evidence-based interventions (McKay et al., 2015), help-seeking rates remain low. Between 38% (Torres et al., 2007) and 89.8% (Chong et al., 2012) of individuals with OCD do not seek help, and others delay treatment around 6.69 years (Pellegrini et al., 2025), which leads to significant personal, social, and economic burdens (Kochar et al., 2023; Veale & Roberts, 2014). Two key factors that hinder help-seeking are stigma and poor mental health literacy (MHL) regarding the disorder (García-Soriano et al., 2014). Stigma refers to the discrimination and prejudice that prevent individuals with mental disorders from achieving their personal goals (Corrigan et al., 2015). Mental health literacy, as defined by Jorm et al. (1997, pp. 182), refers to "knowledge and beliefs about mental disorders which aid their recognition, management or prevention". MHL includes the ability to recognize a disorder, understand its risk factors, causes, and available treatments, know how to find information on mental health, and hold attitudes that would promote recognition and help-seeking (Jorm et al., 1997). Two systematic reviews and a meta-analysis have consistently shown that stigma (e.g., internalized stigma, treatment stigma, negative attitudes towards help-seeking, and stigmatizing attitudes towards people with mental illnesses) is negatively associated with help-seeking attitudes, intentions, and behaviors (Clement et al., 2015; Schnyder et al., 2017). While these studies primarily focus on stigma as a barrier to help-seeking, other research highlights the important role of MHL in facilitating help-seeking (Lien et al., 2024). Increasing MHL has been shown to reduce stigma and improve attitudes toward seeking professional help, suggesting that interventions targeting both stigma reduction and enhancement of MHL could be particularly effective in promoting timely and real-world help-seeking behavior. However, as Schnyder et al. (2017) point out, improving knowledge alone may not be sufficient, given that personal negative attitudes and emotional factors such as shame also strongly influence help-seeking behaviors. Thus, comprehensive approaches that address both cognitive and affective components of stigma are necessary to effectively encourage help-seeking.

Importantly, evidence indicates that stigma and mental health literacy vary across different obsessive-compulsive (OC) symptom presentations. Specifically, autogenous symptomatology (i.e., aggression/ harm; sexual; and religious/ blasphemous/ immoral), has been associated with greater stigma and greater desired social distance, and lower mental health literacy compared to reactive symptomatology (Chaves et al., 2024b; Coles et al., 2023; Durna et al., 2019; García-Soriano & Roncero, 2017; Homonoff & Sciutto, 2019; McCarty et al., 2017; Ponzini et al., 2024; Ponzini & Steinman, 2022). Homonoff and Sciutto (2019) emphasize the importance of anti-stigma efforts to acknowledge different OC content dimensions as a part of OCD. They suggest that recognizing OCD as the underlying disorder may be particularly effective in reducing stigma for certain OC dimensions (i.e., autogenous) more than others.

In this context, it is essential to develop and implement community-level interventions that target stigma and improve MHL, while accounting for OCD heterogeneity. Reducing stigma and enhancing MHL within the general population could help people with OCD feel less stigmatized and misunderstood, increasing their willingness to disclose symptoms and seek help. Moreover, such interventions could equip individuals at risk for OCD with foundational knowledge that would facilitate earlier detection and timely help-seeking.

Despite the importance of addressing stigma and MHL in OCD in the general population, intervention research remains scarce. Moreover, most of these studies have either failed to account for OCD heterogeneity (i.e., Gürbüz et al., 2020; Jassi et al., 2016; Rees et al., 2014) or have focused on a single OC content dimension (i.e., Chaves et al., 2021; Snethen & Warman, 2018; Warman et al., 2015). In this context, a mobile-based intervention, *esTOCma* (described in the Method section), was developed to improve MHL and reduce the stigma associated with OCD (Chaves et al., 2022). The intervention has demonstrated its efficacy in an OCD clinical sample (Arnáez et al., 2025), as well as in the community through a pilot study and a randomized controlled trial (RCT) (Chaves et al., 2024a; García-Soriano et al., 2024). In the clinical sample, the intervention led to reductions in self-stigma, OC symptoms, and guilt, and improvements in quality of life, self-esteem, and knowledge about OCD (Arnáez et al., 2025). Furthermore, *esTOCma* has demonstrated its efficacy in increasing mental health literacy and help-seeking intentions while reducing stigma, desired social distance, and distress associated with OC symptoms in the general population, with large effect sizes (García-Soriano et al., 2024). Now, given the importance of considering OCD heterogeneity, a *post hoc* analysis is

warranted to examine whether *esTOCma* is effective across different symptom dimensions, specifically autogenous and reactive symptom dimensions. This is particularly important, as there is currently a lack of empirically tested interventions for the general population assessing efficacy in reducing stigma, and increasing MHL and help-seeking across different dimensions of OC symptoms.

Thus, this study aims to evaluate the efficacy of *esTOCma* across autogenous and reactive OCD contents in terms of reducing stigma, improving mental health literacy, and increasing help-seeking intentions in a community sample. We hypothesize that, following the intervention, the experimental group will show significant improvements across all outcome variables in both OCD symptom contents, whereas the control group is not expected to exhibit any significant changes.

Method

Study Design and Procedure

The present study is a *post hoc* analysis of a crossover randomized controlled trial with four assessment points and two conditions: immediate use of the *esTOCma* app (iApp) and delayed use (dApp). For this *post hoc* analysis, we conducted a pre-post comparison based on the first two assessments, comparing an experimental group that used *esTOCma* (labelled as iApp in the RCT) with a control waitlist group (labelled as dApp in the RCT) (Chaves et al., 2022; García-Soriano et al., 2024).

The sample was recruited via online advertisements on different social networks, flyers distributed at the university, and news coverage about the application in the media. Participants were invited to download the *esTOCma* app from Google Play or the Apple App Store. The app provided all necessary information about the study conditions and included an informed consent form to be signed by participants. Then, participants provided their sociodemographic data, and the application randomly assigned them to the experimental (i.e., received the intervention) or control (i.e., waitlist) group using a 1:1 allocation ratio. Within each group, the application randomly assigned participants, using a sampling without replacement method, to one of six vignettes describing different OCD content dimensions (i.e., aggression/ harm; sexual; religious/ blasphemous/ immoral; doubt/ checking, contamination/ washing; and superstition/ symmetry/ order). These dimensions align with the empirically derived structure proposed by García-Soriano et al. (2011). According to this model, these six-first order dimensions can be grouped in two second-order categories, corresponding to autogenous (i.e., aggression/ harm; sexual; religious/ blasphemous/ immoral) and reactive (i.e., doubt/ checking; contamination/ washing; and superstition/ symmetry/ order) symptom dimensions proposed by Lee and Kwon (2003). In the present study, we analyzed the data according to this two-factor structure. Vignettes were developed using real clinical cases (Belloch et al., 2017), and followed a consistent narrative and structure, differing only in specific OCD symptomatology. Each vignette ranged from 166 to 175 words in length. The protagonist, named A., was a middle-aged individual of unspecified sex who met DSM-5-TR (APA, 2022) criteria for OCD. Each vignette began with a description of their obsessions and compulsions, followed by information on the resulting interference. Terms such as obsession, compulsion, OCD or disorder were avoided. The severity, interference, and time spent on obsessions and compulsions were similar across vignettes. The six vignettes can be downloaded from Chaves et al. (2024b).

After randomization, participants in the experimental group completed baseline questionnaires via an online survey linked to the app (T0) and were given access to *esTOCma*. After finishing the game, they completed the questionnaires again (T1, post-intervention). Participants in the control group completed the outcome measures at baseline (T0) and again after 10 days without having received any intervention or having access to *esTOCma* (T1). Participants who scored ≥ 14 on the Marlowe-Crowne Social Desirability Scale were excluded from the original RCT, and subsequently from this study, due to suspected high social desirability bias in their responses ($n = 22$).

Participants

A total sample of 208 persons (M age = 39.38; $SD = 15.94$; 68.3% females) were included in the main analyses, as this was the sample used in the original RCT. Participants from the experimental ($n = 102$) and control ($n = 106$) groups were divided based on the content of their assigned vignettes: autogenous ($n = 109$; experimental group: $n = 52$; control group, $n = 57$) or reactive ($n = 99$; experimental group: $n = 50$; control group, $n = 49$). Inclusion criteria were: being at least 18 years old, reporting no prior OCD diagnosis, and possessing a mobile phone (Android or iOS) with Internet access. The flow of participants was described in the main RCT (See Online Resource 1) (García-Soriano et al., 2024).

Intervention

The intervention in the main RCT was conducted through a serious mobile game, *esTOCma* v.1. (Chaves et al., 2022; García-Soriano et al., 2024). The objective of the game was to free 10 characters imprisoned by a monster called *esTOCma*, which metaphorically represents the stigma surrounding OCD. As users progressed through the 10 sequential missions of the game (one per character) and acquired knowledge about OCD, the monster weakened until ultimately being defeated. They could not skip missions. Also, the app monitored participants' progress, enabling researchers to easily verify when all missions were finished. Participants were advised to complete one mission per day, though the pacing was flexible; they could complete multiple missions in a single day or spread the intervention over a longer period, depending on what suited them best. Nevertheless, if participants did not access the app for several days, they received a mobile notification reminding them to continue using *esTOCma*. All missions follow a consistent structure: they begin with a written explanation based on evidence-based information about an OCD-related topic, followed by a short quiz of six to eight multiple-choice questions. Users are given two attempts to answer each question correctly before the correct answer is revealed. At the end of each mission, a summary of the key points is provided, and users receive a key to free an imprisoned character. Additionally, some missions (e.g., Missions 6 and 7) include short video content. Each mission lasted between two and nine minutes (Chaves et al., 2024a).

EsTOCma integrates three modules featuring three distinct intervention mechanisms: (1) *Psychoeducation* (missions 1–5), which provides general information about OCD, evidence-based treatments, and help-seeking options; (2) *Indirect contact* (missions 6 and 7), which features 6 videos of approximately 2–3 min of patients diagnosed with OCD discussing their symptoms and the impact of the disorder on their lives; and (3) *Cognitive restructuring* (missions 8–10), which aims to replace dysfunctional beliefs about individuals with OCD and available treatments.

Special care was taken in the design of *esTOCma* to reflect the heterogeneity of OCD symptom content. In mission 1, the app explains that OCD is a heterogeneous disorder in terms of the content of obsessions and compulsions. It references six symptom dimensions (i.e., aggression/ harm; sexual; religious/ blasphemous/ immoral; doubt/ checking, contamination/ washing; and superstition/ symmetry/ order) following the proposal by García-Soriano et al. (2011) and Garcia-Soriano & Belloch (2013). Throughout missions 1 to 5, brief patient cases are presented illustrating each of these dimensions. Additionally, in mission 6, the app features video testimonies from three individuals with OCD who describe their symptoms. Specifically, three of the content dimensions are referenced: symmetry/ order; aggression/ harm; and contamination/ washing.

The app *esTOCma* is freely available on major app stores (Google Play and Apple App Store), and neither the authors nor the funding institutions receive any financial benefit from it. For a more detailed description of the game, refer to Chaves et al. (2022).

Instruments

Attribution Questionnaire (AQ-27; Corrigan et al., 2003; Spanish adaptation: Muñoz et al., 2015). Assesses the social stigma towards mental illness, specifically towards the assigned OCD vignette. This questionnaire consists of 27 items rated on a scale from 1 = "Not at all" to 9 = "Very much". It comprises nine subscales: responsibility (i.e., belief that the individual with OCD is to blame for their condition and can control it), pity (i.e., feeling sympathy toward them), anger (i.e., feeling anger toward them), fear (i.e., feeling afraid of them), no help (i.e., unwillingness to assist and help them), segregation (i.e., belief that they should be excluded from society), coercion (i.e., belief that they should be forced into treatment), dangerousness (i.e., perceiving them as a threat to others), and avoidance (i.e., unwillingness to live or work with them). Higher scores indicate greater stigma. While most subscales showed acceptable (e.g., $\alpha = 0.69$ for anger at T0) or good (e.g., $\alpha = 0.89$ for fear at T1) internal consistency, some exhibited lower internal consistency (i.e., $\alpha = 0.58$ for avoidance at T0, $\alpha = 0.50$ for responsibility at T0; $\alpha = 0.29$ for responsibility at T1, $\alpha = 0.36$ for pity at T0, and $\alpha = 0.39$ for pity at T1).

Social Distance Scale (SDS; Link et al., 1987). Measures the desire for social distance from the individual described in the assigned vignette. It includes 7 items rated from 0 = "Very willing" to 3 = "Very against". An example is "*Would you accept a person like A as a neighbour?*". Higher total scores indicate stronger desire for social distance. The SDS demonstrated good internal consistency ($\alpha = 0.87$ for T0 and $\alpha = 0.86$ for T1).

Mental Health Literacy Questionnaire (MHL Questionnaire; Chaves et al., 2022). Developed ad hoc based on previous studies (Chaves et al., 2021; García-Soriano & Roncero, 2017). It assesses OCD-related mental health literacy through two sections that appraise (1) recognition, identification, causality, and treatment knowledge related to the assigned OCD vignette; and (2) general knowledge of OCD symptoms (obsessions and compulsions) and maintenance factors, unrelated to the vignette. The total score ranges from 0 to 8, and represents the number of correct responses

across both sections. Higher scores indicate greater mental health literacy regarding OCD.

General Help-Seeking Questionnaire (GHSQ; Wilson et al., 2007; Spanish adaptation: Pacheco del Castillo, 2017). Evaluates the intention to seek help from 10 formal and informal sources on a scale ranging from 1 = "Extremely unlikely" to 7 = "Extremely likely". Participants were asked to respond to the items as if they were experiencing a problem similar to that of person A (the protagonist of the assigned vignette). Higher scores reflect a greater intention to seek help. Internal consistency was acceptable ($\alpha = 0.75$ for T0 and $\alpha = 0.77$ for T1).

Marlowe-Crowne Social Desirability Scale (MC-SDS; Crowne & Marlowe, 1960; Spanish adaptation: Gutiérrez et al., 2015). Measures social desirability through 18 items. In line with the criteria established by Sanz et al. (2018), scores equal to or greater than 14 were considered indicative of a high level of social desirability. Participants who met or exceeded this cutoff were excluded from the study.

Statistical Analysis

Statistical analyses were conducted using IBM SPSS Statistics version 26. First, as a preliminary analysis, independent *t*-tests were conducted to compare autogenous and reactive vignettes on outcome measures at baseline (T0). Then, two mixed repeated measures ANOVAs were conducted: one for autogenous vignettes and one for reactive vignettes. These analyses examined the effects of time (T0 [baseline] and T1 [post]), group (experimental and control), and their interaction (time × group) on stigmatizing attitudes, MHL, and help-seeking intention.

Sensitivity analyses were performed to assess whether dropouts influenced the main interaction between group and time. Student *t*-tests were conducted separately for autogenous and reactive vignettes, comparing experimental and control groups on T0-T1 differences for each outcome variable. This analysis was performed using intention-to-treat (ITT) methods. Specifically, employing Last Observation Carried Forward (LOCF) and Expectation Maximization (EM) techniques. From the 685 participants initially randomized, analyses included those who at least completed T0 ($N = 528$), regardless of whether they finished the game or completed T1 questionnaires. Of those, 272 assessed autogenous vignettes (experimental group: $n = 142$; control group, $n = 130$), and 256 assessed reactive vignettes (experimental group: $n = 131$; control group, $n = 125$).

Effect sizes were calculated using Cohen's *d* (for *t*-tests) and partial eta squared (η_p^2) (for ANOVA models), with standard interpretation thresholds (small: $d = 0.2$, $\eta_p^2 = 0.01$; medium: $d = 0.5$, $\eta_p^2 = 0.06$; large: $d = 0.8$, $\eta_p^2 = 0.14$).

Results

Preliminary Analysis: Comparison between Autogenous and Reactive Vignettes at Baseline (T0)

To explore potential baseline differences between participants exposed to autogenous versus reactive vignettes, we conducted independent samples *t*-tests on stigma (AQ-27), social distance desire (SDS), mental health literacy (MHL Questionnaire), and help-seeking intentions (GHSQ). The results revealed significant differences in several AQ-27 subscales, as well as in help-seeking intentions. Specifically, participants in the autogenous condition reported significantly lower responsibility scores ($M = 7.78$, $SD = 3.15$) compared to those in the reactive condition ($M = 8.92$, $SD = 3.82$), $t(206) = -2.36$, $p = 0.010$, $d = 0.33$. In contrast, higher scores were found in the autogenous group for perceived dangerousness ($M = 6.82$, $SD = 4.56$ vs. $M = 5.51$, $SD = 3.18$), $t(206) = 2.38$, $p = 0.009$, $d = 0.33$, and fear ($M = 5.92$, $SD = 4.05$ vs. $M = 4.79$, $SD = 2.82$), $t(206) = 2.31$, $p = 0.011$, $d = 0.32$. The autogenous group also reported significantly higher levels of segregation ($M = 5.12$, $SD = 2.87$) compared to the reactive group ($M = 4.41$, $SD = 2.31$), $t(206) = 1.94$, $p = 0.027$, $d = 0.27$. Additionally, participants in the autogenous condition reported lower help-seeking intentions if they experienced the symptoms described in the vignette (GHSQ; $M = 4.20$, $SD = 1.07$ vs. $M = 4.45$, $SD = 0.95$), $t(206) = -1.73$, $p = 0.042$, $d = 0.24$. No significant differences emerged between groups for the pity, anger, avoidance, or coercion subscales of the AQ-27, nor for social distance (SDS) or mental health literacy (MHL Questionnaire) at baseline (T0).

Between-Group Differences (Experimental Versus Control Group) Regarding Autogenous Contents

Multivariate tests indicated a significant main effect of time, $F(13,95) = 7.345$, $p < 0.001$, $\eta_p^2 = 0.501$, and group, $F(13,95) = 2.492$, $p = 0.006$, $\eta_p^2 = 0.254$. Additionally, there was a significant interaction effect between time and group, $F(13,95) = 5.479$, $p < 0.001$, $\eta_p^2 = 0.428$. Univariate analyses revealed significant interaction effects for most of the outcome measures (except for the pity, coercion, and avoidance AQ-27 subscales) with medium-large effect sizes. The experimental group, compared to the control group, showed lower stigma (AQ-27) and social distance desire (SDS) after using the app (T1); as well as higher mental health literacy (MHL Questionnaire) and intention to seek help (GHSQ) (Table 1). See Online Resource 2 for a graphical representation of these results.

Student's *t*-test in the ITT population with the EM revealed significant differences between the experimental

Table 1 Autogenous contents comparisons across T0 and T1 for experimental and control groups.

	T0		T1		Time			Group			Time × group		
	EG	CG	EG	CG									
	M (*SD*)		*M* (*SD*)		$F_{(1, 107)}$	*p*	η_p^2	$F_{(1, 107)}$	*p*	η_p^2	$F_{(1, 107)}$	*p*	η_p^2
AQ-27													
Responsibility	7.90 (3.01)	7.67 (3.29)	6.21 (2.93)	7.95 (3.18)	5.477	0.021	0.049	2.112	0.149	0.019	10.700	0.001	0.091
Pity	17.10 (4.39)	17.02 (4.00)	17.58 (4.34)	16.63 (4.57)	0.016	0.900	0.000	0.477	0.491	0.004	1.324	0.252	0.012
Anger	8.33 (4.18)	6.88 (3.92)	5.69 (3.25)	6.79 (3.74)	15.619	< 0.001	0.127	0.076	0.784	0.001	13.670	< 0.001	0.113
Dangerousness	7.58 (4.61)	6.12 (4.43)	4.81 (2.65)	6.82 (4.52)	6.762	0.011	0.059	0.166	0.684	0.002	19.060	< 0.001	0.151
Fear	6.81 (4.46)	5.11 (3.47)	4.92 (2.93)	5.72 (4.44)	3.101	0.081	0.028	0.481	0.489	0.004	11.992	< 0.001	0.101
No help	8.08 (4.26)	7.21 (3.42)	5.94 (3.45)	7.84 (4.96)	4.029	0.047	0.036	0.563	0.455	0.005	13.648	< 0.001	0.113
Coercion	13.79 (5.76)	11.33 (5.70)	12.83 (4.77)	12.07 (5.97)	0.058	0.811	0.001	2.776	0.099	0.025	3.293	0.072	0.030
Segregation	5.87 (3.36)	4.44 (2.14)	4.21 (2.26)	4.61 (2.85)	8.280	0.005	0.072	1.307	0.256	0.012	12.677	< 0.001	0.106
Avoidance	11.08 (5.04)	11 (5.76)	9.10 (6.05)	10.96 (6.05)	3.265	0.074	0.030	0.886	0.349	0.008	3.042	0.084	0.028
SDS total score	1.01 (0.67)	0.92 (0.67)	0.56 (0.53)	0.86 (0.60)	26.766	< 0.001	0.200	0.916	0.341	0.008	16.414	< 0.001	0.133
MHL Questionnaire total score	6.56 (1.16)	6.70 (1.18)	7.28 (0.84)	6.96 (1.03)	21.894	< 0.001	0.170	0.264	0.609	0.002	4.846	0.030	0.043
GSHQ total score	4.31 (0.93)	4.11 (1.18)	4.90 (0.86)	4.09 (1.04)	15.462	< 0.001	0.126	7.848	0.006	0.068	17.638	< 0.001	0.142

T0, baseline, pre-intervention; T1, post-intervention, post-assessment; EG, experimental group; CG, control group; *M*, mean; *SD*, standard deviation; AQ-27, Attribution questionnaire; SDS, Social distance scale; MHL, Mental health literacy questionnaire; GHSQ, General help seeking questionnaire

and control groups for all study variables (p from 0.005 to <0.001) mostly with medium to large effect sizes. For LOCF, all outcome variables achieved significant differences (p from 0.005 to <0.001) with small-medium effect sizes, except for the pity subscale of the AQ-27 (p=0.230), and the MHL Questionnaire (p=0.187). See Online Resource 3 for detailed information on ITT analyses.

Between-Group Differences (Experimental Versus Control Group) Regarding Reactive Contents

Multivariate tests indicated a significant main effect of time, $F(13,85)=4.373$, $p < 0.001$, $\eta_p^2=0.401$, while the main effect of group was not significant, $F(13,85)=0.770$, $p = 0.689$, $\eta_p^2=0.105$. There was also a significant interaction effect between time and group, $F(13,85)=5.438$, $p < 0.001$, $\eta_p^2=0.454$. Univariate analyses revealed interaction effects for all variables assessed except for the stigma coercion dimension. After the intervention, the experimental group, in comparison with the control group, showed lower stigma (AQ-27) and social distance desire (SDS) and higher MHL (MHL Questionnaire) and intention to seek help (GHSQ). Effect sizes are detailed in Table 2. See Online Resource 2 for a graphical representation of these results.

Analyses using EM (ps<0.001) and LOCF (p from 0.003 to <0.001) revealed significant differences between the experimental and control groups for all study variables, except for the coercion subscale of the AQ-27 (p=0.359 and p=0.248 respectively). EM method reached mostly medium-large effect size differences; whereas differences using the LOCF method were small-medium. See Online Resource 3 for detailed information on LOCF analyses.

Discussion

The present study aimed to assess the impact on the community of the serious mobile game *esTOCma* on stigma, mental health literacy, and help-seeking intention related to two OCD content dimensions: autogenous and reactive symptoms. While *esTOCma* has been shown to effectively improve these variables in the community (Chaves et al., 2024a; García-Soriano et al., 2024), it remained unclear whether the app adequately captured the heterogeneity of OCD— that is, whether its effects extended to both autogenous and reactive symptom dimensions. This distinction is particularly relevant, as according to previous research, MHL and stigma vary across OC dimensions (e.g., Chaves et al., 2024b; García-Soriano & Roncero, 2017; Ponzini & Steinman, 2022), with autogenous contents being associated with higher misunderstanding and stigma. Despite the need, the scarce prior interventions targeting these variables have

Table 2 Reactive contents: comparisons across T0 and T1 for experimental and control groups

	T0		T1		Time			Group			Time x group		
	EG	CG	EG	CG									
	M (*SD*)		*M* (*SD*)		$F_{(1, 97)}$	*p*	η_p^2	$F_{(1, 97)}$	*p*	η_p^2	$F_{(1, 97)}$	*p*	η_p^2
AQ-27													
Responsibility	9.30 (3.86)	8.53 (3.76)	6.18 (2.98)	7.98 (2.83)	20.745	< 0.001	0.176	0.874	0.352	0.009	10.159	0.002	0.095
Pity	16.10 (4.65)	16.65 (4.31)	18.06 (4.59)	16.16 (4.23)	3.230	0.075	0.032	0.712	0.401	0.007	8.970	0.003	0.085
Anger	8.26 (4.54)	8.20 (4.50)	5.40 (3.32)	8.49 (4.27)	9.132	0.003	0.086	4.358	0.039	0.043	13.636	< 0.001	0.123
Dangerousness	5.50 (3.24)	5.51 (3.15)	3.92 (1.83)	5.69 (2.93)	6.195	0.015	0.060	3.197	0.077	0.032	9.883	0.002	0.092
Fear	4.86 (3.09)	4.71 (2.53)	3.74 (1.57)	5.00 (2.50)	2.096	0.151	0.021	1.861	0.176	0.019	5.950	0.017	0.058
No help	8.16 (4.26)	6.47 (3.18)	5.60 (3.41)	6.98 (3.88)	7.100	0.009	0.068	0.059	0.808	0.001	15.929	< 0.001	0.141
Coercion	11.88 (4.77)	13.33 (5.92)	11.54 (5.77)	12.61 (6.17)	1.337	0.250	0.014	1.445	0.232	0.015	0.169	0.682	0.002
Segregation	4.52 (2.41)	4.31 (2.22)	3.62 (1.12)	4.96 (2.66)	0.314	0.576	0.003	2.191	0.142	0.022	12.436	< 0.001	0.114
Avoidance	11.50 (4.91)	10.20 (4.62)	7.96 (5.85)	10.88 (5.49)	5.854	0.017	0.057	0.864	0.355	0.009	12.649	< 0.001	0.115
SDS total score	0.97 (0.64)	0.84 (0.55)	0.47 (0.62)	0.83 (0.56)	16.540	< 0.001	0.146	1.189	0.278	0.012	14.689	< 0.001	0.132
MHL Questionnaire total score	6.34 (1.94)	6.67 (1.40)	7.26 (1.13)	6.79 (1.51)	11.009	0.001	0.102	0.061	0.805	0.001	6.444	0.013	0.062
GSHQ total score	4.30 (0.95)	4.60 (0.92)	5.03 (0.92)	4.32 (0.96)	4.358	0.039	0.043	1.804	0.182	0.018	21.576	< 0.001	0.182

T0, baseline, pre-intervention; T1, post-intervention, post-assessment; EG, experimental group; CG, control group; *M*, mean; *SD*, Standard deviation; AQ-27, Attribution questionnaire; SDS, Social distance scale; MHL, Mental health literacy questionnaire; GHSQ, General help seeking questionnaire

not taken into account OCD content heterogeneity (e.g., Chaves et al., 2021; García-Soriano et al., 2024; Gürbüz et al., 2020; Snethen & Warman, 2018). Therefore, this *post hoc* study sought to fill this gap by evaluating the efficacy of *esTOCma* across both autogenous and reactive symptom dimensions to determine whether this is an intervention capable of adequately capturing the heterogeneity of OC contents.

Before evaluating the intervention's impact, we first examined whether previously reported differences in stigma and MHL across obsessive-compulsive symptom dimensions (e.g., Chaves et al., 2024b; García-Soriano & Roncero, 2017; Ponzini & Steinman, 2022) were replicated in this sample, specifically regarding autogenous and reactive vignettes. Overall, our findings align with the literature: autogenous symptoms were associated with higher levels of stigma on the AQ-27, particularly in terms of perceived dangerousness, fear, and segregation (i.e., social exclusion) (e.g., Chaves et al., 2024b; García-Soriano & Roncero, 2017; Ponzini & Steinman, 2022). By contrast, reactive symptoms were linked to higher attributions of personal responsibility, possibly reflecting the trivialization of such contents (Ponzini et al., 2024). However, this finding should be interpreted with caution given the low internal consistency of the responsibility subscale. Contrary to previous studies (e.g., Chaves et al., 2024b; Durna et al., 2019; Ponzini & Steinman, 2022), no significant differences emerged between the two content groups on MHL (MHL Questionnaire) or desire for social distance (SDS). This discrepancy may be attributable to the smaller sample size in the current study relative to prior research (e.g., Chaves et al., 2024b, $n = 487$; Durna et al., 2019, $n = 621$; Ponzini & Steinman, 2022, $n = 5{,}806$), or to limitations inherit in the MHL measure itself. As noted in previous work, the MHL Questionnaire may be prone to ceiling effects due to the intuitive nature of many of its items (García-Soriano et al., 2024). Finally, participants exposed to autogenous vignettes reported lower help-seeking intentions (GHSQ total score) than those in the reactive group. This reluctance may reflect a greater tendency to conceal autogenous symptoms (Cathey & Wetterneck, 2013), which is likely driven by heightened embarrassment, guilt, and shame associated with taboo-like contents such as sexual or aggressive thoughts (Berman et al., 2020), in contrast to more socially accepted symptoms like contamination. Notably, this difference in help-seeking intention had not been observed in previous research (Chaves et al., 2024b).

Following with the efficacy of the intervention, as hypothesized, using *esTOCma* led to significant reductions in stigmatizing attitudes toward both autogenous and reactive OCD symptoms. Specifically, after completing the app, participants showed fewer stereotypes as they perceived individuals with autogenous or reactive OC contents as less

dangerous and less responsible for their condition. Higher perceived responsibility has been linked to greater hostility from family members toward patients (Renshaw et al., 2006), Thus, this reduction in attribution of responsibility is especially significant, as it could contribute to decreased hostility within the broader community. Participants also exhibited fewer negative affective reactions like anger and fear, and fewer discriminatory attitudes, such as social exclusion (i.e., segregation) and reluctance to offer help. Most stigma-related decreases had moderate effect sizes, though larger effects were observed in the dangerousness and no help subscales of the AQ-27 in the autogenous and reactive groups, respectively. Additionally, participants showed a reduced intention to socially distance themselves (SDS) from individuals with these symptoms. These findings align with previous studies using *esTOCma* (Chaves et al., 2024a; García-Soriano et al., 2024) and underscore the app's efficacy in addressing OCD-related stigma across different symptom profiles in the community. While other interventions have reported reductions in dangerousness perceptions (Snethen & Warman, 2018; Warman et al., 2015) and the desire for social distance (Gürbüz et al., 2020; Snethen & Warman, 2018; Warman et al., 2015), they have not comprehensively assessed OCD-related stigma (i.e., across multiple stigma dimensions) or considered symptom heterogeneity. This is particularly relevant because stigma is associated differently with autogenous and reactive OC dimensions (e.g., Ponzini et al., 2024); however, the app is effective in reducing stigma for both content dimensions. Furthermore, *esTOCma* significantly reduced the unwillingness to live or work with individuals displaying reactive symptoms (i.e., avoidance) and increased sympathy (i.e., pity) towards them. However, regarding autogenous contents, the results were contradictory. While no significant interaction effect was found on these variables, intention-to-treat analyses revealed significant differences in avoidance and pity between groups after using the app, with medium-small effect sizes. Additionally, there was also a significant medium-sized reduction in social distance desire, as measured by the SDS. The SDS may be considered a more reliable indicator of unwillingness to interact with individuals with OCD than the AQ-27 avoidance subscale, as it demonstrated higher internal consistency scores in the present study. Moreover, the SDS has shown good psychometric properties in previous research (Eghaneyan et al., 2021; Grandón et al., 2015; Link et al., 1987), and its longer format—comprising 7 items compared to only 3 in the AQ-27 avoidance subscale—may allow for a more comprehensive assessment of social distancing attitudes. Notably, the AQ-27 avoidance and pity subscales demonstrated poor internal consistency. Therefore, these findings should be interpreted with caution, and further research is needed to explore *esTOCma*'s effect on avoidance and pity related to autogenous OC contents. Future studies should employ alternative measures to determine whether these results reflect a true limitation of the app or are an artifact of measurement.

Finally, *esTOCma* was not able to reduce the belief that individuals with OCD should be forced into treatment (i.e., coercion) in either the autogenous or reactive groups, replicating findings from previous *esTOCma* studies (Chaves et al., 2024a; García-Soriano et al., 2024) and the study by Chaves et al. (2021). As suggested by García-Soriano et al. (2024), this may be due to the app's lack of direct content addressing this aspect of stigma. However, ITT analyses for the autogenous group did reveal significant changes in coercion, though this finding should be interpreted cautiously.

Regarding MHL, consistent with our hypothesis, there was an increase in OCD knowledge and understanding of its treatment (MHL Questionnaire) from pre- to post-intervention in the experimental groups for both autogenous and reactive symptoms, with small effect sizes. This small effect size may be due to a ceiling effect, as baseline scores were already high. Future studies should consider using an alternative instrument to more accurately assess MHL. Improvements in MHL after psychoeducation-based interventions have also been reported in previous studies with *esTOCma* (Chaves et al., 2024a; García-Soriano et al., 2024) and other interventions (Chaves et al., 2021; Jassi et al., 2016), though these studies did not account for OCD heterogeneity. It is noteworthy that the improvement in knowledge was also significant regarding reactive OC contents, which are more widely known, perhaps due to their prevalence in media representations of OCD (Coles et al., 2023; García-Soriano & Roncero, 2017), although in this study we did not capture those differences at the baseline assessment.

Finally, as hypothesized, there was a large effect size increase in help-seeking intention for both autogenous and reactive OC symptoms. These findings align with previous *esTOCma* studies (Chaves et al., 2024a; García-Soriano et al., 2024) and add value by clarifying that the observed improvements in help-seeking intention apply to both OCD symptom dimensions. The app *esTOCma* includes direct information on professional help-seeking in two of its modules (*Psychoeducation* and *Indirect Contact*), which may have facilitated changes in this variable. Additionally, the improvements in both groups may be a result of reduced stigmatizing attitudes and greater knowledge of OCD, as research has shown that stigma and low mental health literacy are negatively associated with help-seeking attitudes, intentions, and behaviors (Clement et al., 2015; Lien et al., 2024; Schnyder et al., 2017). In this context, the observed changes in stigmatizing attitudes and help-seeking intentions in the current study could potentially translate into

earlier real help-seeking. However, a longitudinal study is needed to verify this assumption. Notably, to the best of our knowledge, *esTOCma* remains the only community stigma intervention with data on help-seeking intention, as previous studies with alternative interventions did not assess this outcome (Chaves et al., 2021; Gürbüz et al., 2020; Jassi et al., 2016; Rees et al., 2014; Snethen & Warman, 2018; Warman et al., 2015). Promoting help-seeking intention for OCD-like symptomatology—regardless of its content—could have important implications, as untreated OCD is associated with significant functional impairment and lower quality of life (Hollander et al., 1996; Macy et al., 2013). *EsTOCma* could facilitate early diagnosis and treatment for both autogenous and reactive symptom dimensions, potentially alleviating the suffering associated with untreated OCD and improving treatment response (Fineberg et al., 2019).

This study presents some limitations. First, as a *post hoc* subgroup analysis, it is subject to testing biases, and its findings should be interpreted with caution. Second, the study experienced a high attrition rate. This may be attributed to the app's online dissemination, the absence of direct contact with researchers, and the lack of financial compensation for participation. Participants encountered the app independently or through social media and voluntarily chose to download it, which may have contributed to the dropout rate. Nonetheless, this pattern aligns with previous research indicating high attrition rates in mHealth interventions (Torous et al., 2020). Moreover, the study targeted a community sample rather than a clinical or subclinical population, who may be less personally affected by or identified with OCD, potentially influencing engagement. Despite the elevated dropout rate, data from the *esTOCma* pilot study suggests that those who use the app find it useful and are satisfied with the experience (Chaves et al., 2024a). Importantly, intention-to-treat analyses were conducted to assess the impact of attrition, and results continued to support the intervention's efficacy. Third, some AQ-27 subscales (i.e., avoidance, responsibility, and pity) had low internal consistency. As a result, the observed changes in the experimental group—such as decreased attribution of responsibility, reduced unwillingness to live or work with individuals with OCD, and increased feeling of sympathy—should be interpreted with caution, as the reliability of these specific findings is limited. Notably, this issue has been previously reported in the Spanish validation of the measure (Muñoz et al., 2015), suggesting the need for an alternative or complementary stigma measure in future research. Fourth, high baseline MHL Questionnaire scores raise concerns about the questionnaire's difficulty level, as noted in the main RCT (García-Soriano et al., 2024). Future studies should consider a more robust measure of MHL that can better differentiate learning outcomes resulting from the intervention. Fifth, the use of a waitlist control group may limit interpretation of *esTOCma*'s impact. Future research should consider using an active control condition (e.g., reading an informative sheet about OCD) to better determine the effects of the app. Sixth, although participant recruitment was conducted through social media and the study was open to the general public, the resulting sample was overrepresented by female and university-affiliated individuals. This may be due to greater awareness of OCD and a higher interest in mental health topics among these groups. As a result, the generalizability of the findings is limited. Future studies should aim to recruit a more heterogeneous sample. Lastly, this study did not assess the long-term maintenance of intervention effects. Nevertheless, the original RCT provides some insight into the durability of these outcomes, showing that improvements in stigma, MHL, and intention to seek help persisted at a three-month follow-up (García-Soriano et al., 2024). Future studies should explore the long-term effects of the intervention. Additionally, further research could benefit from a more detailed examination of *esTOCma*'s impact across different OCD symptom contents, for example by analyzing the six vignettes separately.

Conclusions

This study expands previous RCT findings (García-Soriano et al., 2024) suggesting that *esTOCma* might be able to effectively capture OCD heterogeneity, as it replicates the observed results in both autogenous and reactive OC contents. Although reactive obsessions are generally associated with higher identification and lower stigma (e.g., Chaves et al., 2024b; Ponzini & Steinman, 2022), the app seems to significantly improve knowledge and understanding of both autogenous and reactive OC content dimensions while increasing help-seeking intention and decreasing stigmatizing attitudes for both. Promoting these changes within the community could facilitate earlier detection and treatment of OCD, regardless of its specific symptom presentation, ultimately improving patient well-being. Additionally, normalizing non-clinical intrusions of different content dimensions, might help protect vulnerable individuals from developing OCD. Thus, the current study further supports *esTOCma* as a mobile intervention that, at the community level, could help bridge the gap between prevalence, diagnosis, and service utilization in OCD (Senter et al., 2021). To achieve these important outcomes, large-scale implementation of *esTOCma* is necessary. This could involve dissemination through mass media and integration into public services, such as health clinics. It is also particularly relevant to target key populations, including teachers, healthcare professionals, and families of individuals with OCD. Integrating

esTOCma into educational systems could provide school staff with accurate information about OCD—an important step given the significant amount of time they spend with youth, a population vulnerable to developing the disorder. Similarly, incorporating the app into health services could provide at-risk individuals and families of OCD patients with a valuable resource to better understand the condition. Such widespread dissemination might maximize the app's ability to reduce stigma, improve MHL, and encourage earlier help-seeking across diverse community settings.

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Data Availability The datasets analyzed will be deposited in the Zenodo repository (https://zenodo.org/) once the manuscript has been published.

Declarations

Conflict of interest The authors declare no competing interests.

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