



What Do Adolescents Think About an App Designed to Reduce Cognitive Risk Factors for Eating Disorders? A mixed methods study

Laura Carratalá-Ricart

Sandra Arnáez

Odalís Isabel Merchán

Marta Corberán

Yuliya Saman

Universitat de València

Belén Pascual-Vera

Universidad Nacional de Educación a Distancia

Guy Doron

Baruch Ivcher School of Psychology, Reichman University

Gemma García-Soriano

María Roncero

Universitat de València

In recent years, there has been a growing interest in eHealth interventions as a means of reducing risk factors

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Guy Doron is a co-developer of GGOCD.app. Guy Doron is also a co-founder of GGtude Ltd. GGED-AD module is the subject of this evaluation and therefore has financial interest to GGtude Ltd. Address correspondence to María Roncero, Departamento de Personalidad, Evaluación y Tratamientos Psicológicos, Universitat de València, Av. Blasco Ibáñez, 21, 46010 Valencia, Spain. e-mail: maria.roncero@uv.es.

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related to eating disorders (EDs). However, these interventions are often faced with high dropout rates and low adherence. The objective of this study was to analyze the usability and acceptability of GGED-AD, a mobile app designed to reduce cognitive risk factors associated with EDs in adolescents. The study involved 42 adolescents (61.9% female) with a mean age of 13.98 years, and employed a convergent mixed-methods approach. The results indicate that GGED-AD has satisfactory usability and acceptability—it was considered easy to use, attractive, encouraging of positive behaviors, and was perceived as useful by the participants. However, certain difficulties were observed, such as in understanding some specific content. Consequently, this study offers valuable insights for improving the design of GGED-AD and of similar eHealth interventions, with the objective of enhancing their potential for adoption in “real world” settings.

Keywords: eating disorders; eHealth; usability; acceptability; mixed methods

EATING DISORDERS (EDs) are defined as severe mental disorders characterized by dysfunctional attitudes, beliefs, and behaviors related to eating, body weight, and body shape (American Psychiatric Association [APA], 2022). They lead to considerable physical and psychosocial impairments and are associated with numerous psychiatric and medical complications (Hambleton et al., 2022), including high mortality rates (Auger et al., 2021). Moreover, in terms of treatment, patients with EDs report low levels of help-seeking behavior (Nicula et al., 2022), low treatment uptake, and high rates of treatment dropout (Linardon et al., 2018), which can lead to prolonged illness and a poor prognosis (Miskovic-Wheatley et al., 2023).

Although EDs can affect individuals of all ages, they tend to develop during adolescence and emerging adulthood, with a decreasing trend in the age of onset among younger generations (Favaro et al., 2018). Accordingly, in terms of prevalence, an exponential increase in the incidence of EDs in adolescents has been observed (Galmiche et al., 2019). The literature indicates that 11.7% to 30.1% of adolescents in Spain are at risk of developing an ED (López-Gil et al., 2023; Tarifa et al., 2023). Thus, given the focus on a critical age group, the seriousness and complexity of EDs, and the low rates of detection and early intervention (Koreshe et al., 2023), reducing risk factors in at-risk populations should be a public health priority.

Given the critical age for EDs, secondary schools are an ideal setting for implementing interventions to reduce risk factors for these disorders. Secondary schools can usually provide the extensive infrastructure required for recruiting, disseminating, and delivering these programs, while targeting high-risk populations, such as adolescents. In terms of risk factors, maladaptive cognitions, including weight overvaluation, body image dissatisfaction, need for control, perfectionism, and low self-esteem, are recognized as significant risk factors in the development and maintenance of EDs (Fairburn et al., 2003; Krauss et al., 2023; Stice et al., 2011). From a transdiagnostic perspective, a key element is the overestimation of the importance of weight and body shape, where an individual's self-esteem largely or exclusively depends on their eating habits, body shape, weight, and their perceived ability to control these factors (Fairburn et al., 2003). This excessive preoccupation is considered a pivotal factor in not only anorexia nervosa and bulimia nervosa, where it is a diagnostic criterion according to the DSM-5-TR (APA, 2022), but also in

binge eating disorder (Linardon, 2017; Sonnevile et al., 2015). Body dissatisfaction also emerges as a crucial cognitive factor, strongly linked to the initiation of dieting and predictive of binge eating development (Goldfield et al., 2010). In fact, studies like Stice et al. (2011) identify it as the strongest predictor of any ED onset. Additional cognitive factors include clinical perfectionism, which involves an excessive focus on achieving high standards despite negative consequences, often applied to weight and shape control (Ralph-Nearman et al., 2024). Low self-esteem has been identified as a further negative predictor of EDs symptoms, characterized by an unconditional and pervasive negative self-view that hinders change and motivates an intense pursuit of success in weight and shape control (Abdoli et al., 2024; Krauss et al., 2023). As a result, there are many school-based interventions that frequently target these modifiable attitudinal and cognitive risk factors. There is reasonable evidence to support the effectiveness of these programs, with established feasibility and generally high acceptability (Koreshe et al., 2023).

In recent years, scientific attention has increasingly focused on the potential of eHealth interventions to reduce risk factors for mental health problems, given their capacity to address typical barriers such as scalability, flexible access, geographical constraints, cost-effectiveness, adaptability, or convenience (e.g., Andersson & Titov, 2014). Moreover, the efficacy of these interventions has been proven (e.g., Deady et al., 2017; Stratton et al., 2017). In this context, smartphone apps are becoming increasingly common as they facilitate interventions aimed at addressing mechanisms in real-life situations and in real-time (Reininghaus et al., 2016). However, they present certain limitations. App-based interventions are associated with relatively low rates of uptake, engagement, and adherence. For example, in the meta-analysis conducted by Torous et al. (2020), which examined adherence in clinical trials of smartphone apps, the pooled dropout rate was 26.2%, which increased to 47.8% when publication bias was considered.

In the specific context of the prevention of EDs through eHealth, we found no literature reporting on the use of mobile apps. Instead, we found preventive interventions delivered mainly through internet-based programs, such as *Student Bodies*, an extensively tested cognitive-behavioral online program, includes online sessions that address primary risk factors associated with EDs (e.g., weight and shape issues) (Jacobi et al., 2012). Another example is *The Body Project*, an internet-delivered version of the dissonance-based preven-

tion program, in which women with high levels of body dissatisfaction are recruited for online group sessions to engage in verbal, written, and behavioral exercises that address the negative effects of pursuing the thin ideal (Stice et al., 2017). There is also *ProYouth*, a prevention program that offers participants information materials, self-testing and monitoring, peer support and chat counseling (Bauer et al., 2019). Overall, the evidence suggests that these programs offer a promising approach to ED prevention (Bauer & Moessner, 2013). However, there is a need to improve adherence and reduce attrition, as high dropout rates have been reported. For instance, in a randomized controlled trial (RCT) evaluating the effectiveness of *ProYouth*, only 11.8% of participants attended all (six) sessions (Ali et al., 2022) and in another RCT evaluating *Student Bodies*, the program dropout rate was 55% (Saekow et al., 2015). This increased dropout rate may suggest that the programs lack the necessary engagement and/or user-friendliness to retain the participants' interest over time (Fuller-Tyszkiewicz et al., 2018). This issue has also been observed in the utilization of mobile apps for EDs treatment. Despite the proven effectiveness of evidence-based apps such as *Noom* (Hildebrandt et al., 2017), *Recovery Record* (RR; Tregarthen et al., 2019) or *Break binge eating* (Linardon, Shatte, et al., 2022), various limitations in terms of feasibility have been identified. For instance, in the RCT investigating the efficacy of RR, of those who were initially randomised, only 23.6% provided outcome data, and even fewer did so at the follow-up stage (17.5%) (Tregarthen et al., 2019). Similarly, an RCT testing the efficacy of *Break binge eating* showed an overall attrition rate of 35% following the conclusion of the trial (Linardon, Shatte, et al., 2022).

In this regard, usability and acceptability issues are important factors in the implementation, engagement rates, and effectiveness of eHealth interventions (Campos et al., 2018; Linardon, King, et al., 2022). In fact, usability factors, such as the perception of navigability and content quality, are widely recognized as crucial for improving the acceptance of information and communication technologies (Miralles et al., 2020). On the contrary, usability problems (such as complicated login codes or unattractive aesthetics) have been reported as strong predictors of nonadherence (Beatty & Binnion, 2016). Nevertheless, despite the growing number of eHealth interventions available, there is currently a lack of usability and acceptability studies, and the perspectives of end users have rarely been reported. It is important to assess these variables to ensure that eHealth

interventions are effective and meet the needs of users.

Therefore, we aim to examine the usability and acceptability of a mobile app-based intervention (GGED-AD) designed to reduce cognitive risk factors for EDs in adolescents, using a mixed methods design. This will allow us to provide guidance for future reviews of GGED-AD, which is currently in a pilot test phase. Also, we expect to obtain information that may also be of interest for the development and review of other eHealth interventions for EDs. In this sense, qualitative information can facilitate a more comprehensive and detailed understanding of the adolescents' perspectives, since it is imperative to identify user perceptions surrounding usability issues, such as visual design, user engagement, and content. This approach is expected to provide a more nuanced and comprehensive understanding of the end-user experience.

Method

PARTICIPANTS

A total of 42 adolescents (61.90% women) from an educational center in the Valencian Community (Spain) participated in the study. The students were in their 3rd year of Compulsory Secondary Education of the Spanish Education System (ISCED level 2 in the International Standard Classification of Education) and ranged in age from 13 to 16 years old ($M = 13.98$; $SD = 0.51$).

The sample was obtained from an RCT where the participants were randomly allocated by gender to two groups: experimental (used GGED-AD) and control (used a neutral app) (Corberán, et al., 2024). The target group for the present study included participants who had finished using the GGED-AD (experimental group).

The study's inclusion criteria were: (1) participants aged between 13 and 16 years; (2) signed informed consent from both parents or guardians and adolescents; (3) having a smartphone with Internet access; and (4) prior use of GGED-AD as part of the RCT.

STUDY DESIGN

A mixed methods design with a convergent approach was employed, whereby both types of data were collected simultaneously and analysed separately, with the objective of informing each other. Quantitative ratings were obtained from self-reported questionnaires, while qualitative evaluations of perceived usability and acceptability were extracted from a qualitative interview and analysed using a coding template analysis

approach. Thus, integrating both types of information enables improved data mining and better insights into the adolescents' experience of the app's usability and acceptability. The reported findings adhere to the Mixed Methods Article Reporting Standards (MMARS) recommendations of the JARS-Quality Working Group (Levitt et al., 2018).

INTERVENTION: THE MOBILE APP

GGED (GG Eating Disorders) is a module within the OCD.app mobile platform. The OCD.app platform is an evidence-based platform comprised of brief game-like exercises targeting a wide range of psychological symptoms including anxiety, depression, OCD, self-esteem and body image-related symptoms (Ben-Zeev et al., 2021; Cerea et al., 2021; Gamoran & Doron, 2023; Giraldo-O'Meara & Doron (2021)). Previous studies, including 10 RCTs conducted in different countries (US, Spain, Italy, Turkey, and Israel) have indicated that 2 to 4 weeks of daily use (averaging 3 min per day) decreases maladaptive beliefs and associated symptoms (Aboody et al., 2020; Abramovitch et al., 2024; Akin-Sari, Inozu, Haciomeroglu, Cekci, et al., 2022; Akin-Sari, Inozu, Haciomeroglu, Trak, et al., 2022; Ben-Zeev et al., 2021; Cerea et al., 2020, 2021, 2022; Gorelik et al., 2023; Roncero et al., 2019).

The platform promotes the relative activation of adaptive versus maladaptive cognitions in various ways. For instance, users have daily categorization tasks whereby they are asked to respond to cognitions using contrasting bodily movements (i.e., swiping upwards or downwards). Such exercises are designed to increase users' awareness of their inner monologue and lead to more distinct cues regarding the relevance of the cognition to users' mental health goal (i.e., embodied cognition). Daily categorization exercises also include repeated presentation of often inaccessible adaptive cognitions, thereby promoting users' ability to generate and retrieve such cognitions. Brief psychoeducation scripts (e.g., "Believing one should achieve physical perfection promotes food and eating preoccupation; Learning to accept physical imperfections is crucial for reducing eating and body image distress") may increase users' motivation and knowledge of fundamental cognitive-behavioral therapy (CBT) principles (Gamoran & Doron, 2023).

The GGED track consists of 49 levels, which are grouped into themes similar to those addressed in CBT (Fairburn, 2008). These themes include fear of being judged, perfectionism related to physical appearance, the desire to control body weight,

self-esteem, fear of food-related thoughts, portrayal of physical appearance in the media, and fear of shame, among others. The GGED exercises follow the same structure as the other modules on the OCD.app. Each level presents adaptive (e.g., "imperfection is being alive") and maladaptive (e.g., "everyone criticizes me for my looks") statements on the screen. The individual is asked to identify and "embrace" functional or adaptive beliefs by swiping downwards towards the lower part of the screen. Conversely, they are asked to "reject" dysfunctional, maladaptive, and negative beliefs by swiping upwards towards the upper part of the screen.

Recently, the GGED module has been adapted for the adolescent population (GGED-AD; Corberán et al., 2024) and was used by participants in the present study. The content of the new app has been tailored to the age and level of understanding of adolescents, and closely follows that of GGED. Furthermore, the language used is clear and objective, avoiding biased or emotional language.

In the present study, part of an RCT (Corberán et al., 2024), the experimental group used the app (GGED-AD) whereas the control group used another module of the OCD.app called GGNEUTRAL, which is designed exclusively for research purposes. Both apps function similarly by displaying sentences on the screen, with GGNEUTRAL containing factually true or false content. If the statement is true (e.g., "Spain is a country"), the person must swipe downwards towards the lower part of the screen, while if it is false (e.g., "Dogs can fly"), the person has to swipe upwards towards the upper part of the screen.

MEASURES

Sociodemographic characteristics. Participants indicated their age, gender, height, and weight.

The *Spanish adaptation of the Systems Usability Scale* (SUS; Brooke, 1996; translated and validated in Spanish by Castilla et al., 2023) was used, as it is the most widely employed standardized questionnaire for assessing perceived usability, and existing research has demonstrated its high reliability and validity, as well as its adaptability to different contexts (Lewis, 2018). The SUS comprises 10 items rated on a 5-point Likert scale, with 1 = "Strongly Disagree," 2 = "Disagree," 3 = "Neither Agree nor Disagree," 4 = "Agree," and 5 = "Strongly Agree," and scores ranging from 0 to 100. Higher scores indicate greater perceptions of usability, with a score above 68 being considered above average. The original wording of the items was modified by replacing the term "system"

with “app.” Cronbach’s α for the total score was .64 in this study.

The *Usefulness, Satisfaction, and Ease of Use Questionnaire* (USE; Gao et al., 2018; Lund, 2001) was utilized as it allows the assessment of more specific constructs with regard to usability and acceptability (in particular, satisfaction and usefulness). The USE comprises 30 items rated on a 7-point Likert scale, with 1 = “Strongly Disagree,” 2 = “Disagree,” 3 = “Somewhat Disagree,” 4 = “Neither Agree nor Disagree,” 5 = “Somewhat Agree,” 6 = “Agree,” and 7 = “Strongly Agree,” and with an “N/A” option. The items are categorized into four dimensions: usefulness, ease of use, ease of learning, and satisfaction. For the present study, only 6 items were used (3 items from the usefulness dimension, and 3 items from the satisfaction dimension). This approach was adopted because the remaining dimensions had previously been assessed using the SUS, and the objective of maintaining a concise assessment protocol to ensure the engagement of the adolescents. This was further sustained by the fact that the internal consistency of the USE remains very high even if a single item is dropped from the scale. The USE was translated into Spanish by members of the research group. In this study Cronbach’s α was .95 for the total score, .91 for the usefulness dimension and .87 for the satisfaction dimension.

Qualitative interview. A semistructured qualitative interview designed *ad hoc* was held face-to-face after completing the app program (see Supplementary material: Qualitative interview script). The interview evaluated the usability and acceptability of the app and covered the following topics: (1) general attitude toward the app, including positive and negative feedback; (2) participants’ subjective evaluation of the app; (3) evaluation of the intervention’s usability; (4) app feasibility; (5) app acceptability; and (6) evaluation of the study procedure. The mean interview length was approximately 15–20 minutes.

PROCEDURE

First, the management and guidance team of an educational center in the Valencian community was contacted to explain the study procedure, its objectives, and the possible benefits of participation. Once they agreed to participate, information and coordination meetings were held with the school staff, and written informed consent was obtained from the parents of the participants, who were minors, and the participants themselves. The intervention was then conducted. The detailed procedure can be found in Corberán et al. (2024). All students in the experimental group who com-

pleted the intervention (all the GGED-AD app levels) filled in an assessment that included socio-demographic data, evaluation instruments, and were also interviewed individually during an hour of class by two trained psychologists (L.C. and O.M.). The interviews were transcribed verbatim for coding at the time they were conducted.

This investigation is part of a research project approved by the Ethics Committee of Research in Humans of the University of Valencia (2557724) and accepted at Clinical Trials (NCT06039514) and is in accordance with the ethical and moral principles established by the Declaration of Helsinki (World Medical Association, 2013).

DATA ANALYSIS

The analysis of quantitative data from the SUS and the USE was conducted using descriptive statistics. Subsequently, *t*-tests were calculated to ascertain sex differences.

To conduct qualitative data analysis, we organized the data using a coding template analysis approach based on the six themes proposed by Baumel et al. (2017) to evaluate the quality of health apps: (1) usability, (2) visual design, (3) user engagement, (4) content, (5) therapeutic persuasiveness, and (6) therapeutic alliance. Following recent usability studies (Fuller-Tyszkiewicz et al., 2018; Linardon, King, et al., 2022), topics were adopted in advance, rather than derived from the interview transcripts, to prioritize themes that are more frequently discussed in the academic literature on the subject. In addition, a “perceived usefulness” theme was incorporated *a posteriori* into the analysis, as participants provided information on their perception of the app’s usefulness, and this information was not aligned with any of the other six themes. Consequently, perceived usefulness was defined as the participants’ perception of the practical value of the app (i.e. whether and how they found it useful). While other themes, such as therapeutic persuasiveness or user engagement, may be related to this aspect, they focus on a more motivational dimension: the app’s capacity to encourage users to implement positive changes, and the extent to which the app’s design attracts users to utilize it. Therefore, these existing categories did not fully capture the entire range of information concerning the perceived usefulness of the intervention expressed by the participants and, as a result, it was deemed necessary to incorporate the additional theme. Then, coding was independently conducted by three researchers (L.C., O.M., and A.O.), who subsequently met to discuss their level of agreement. The suitability of the

answers for the different themes was unanimously agreed upon by the three researchers.

The Consolidated Criteria for Reporting Qualitative Research (COREQ), proposed by Tong et al. (2007), was employed to report the qualitative data (see Supplementary material: Table 1). Furthermore, to ensure the rigor and credibility of the study, a number of techniques were employed, including researcher triangulation, which involved the input of two researchers; methodological triangulation, which incorporated both quantitative and qualitative methods; codification triangulation, which included the input of three analysts; and theoretical triangulation, review, and discussion of previous literature. The combination of these techniques enhances the reliability and validity of the study (Denzin & Lincoln, 2008).

Results

SOCIODEMOGRAPHIC AND PARTICIPANT DATA

Sociodemographic and participant data are presented in Table 1.

QUANTITATIVE DATA

Statistically significant differences were not observed between the sexes of participants in relation to SUS scores, $t(40) = 1.31$, $p = 0.197$, $d = 0.42$, or USE scores, $t(40) = -0.55$, $p = 0.587$, $d = 0.17$.

Table 2 shows the total and item scores for the SUS. The mean total score exceeds the threshold for acceptable usability. Furthermore, the results of the USE questionnaire indicated that the participants found the app useful and reported fairly high levels of satisfaction.

QUALITATIVE DATA

The content obtained from the qualitative interview is presented below according to the six themes proposed by Baumel et al. (2017).

Theme 1: Usability

Overall, feedback on *usability* was positive. First, all participants reported that they found it very easy to learn how to use the app.

It [the app] is simple to operate and easy to learn. It's a really straightforward app that shows you exactly what you need to do to complete each activity. The first time I used it, I learned pretty quickly.

Similarly, regarding the basic functioning of the app's main exercise (swiping adaptive sentences towards the bottom of the screen and maladaptive sentences towards the top), most respondents did not report any issues with it. Nevertheless, one girl commented that after reading many sentences, "I no longer knew whether I was swiping to accept or reject." Furthermore, in relation to the feedback provided by the app when the user makes a mistake, another girl expressed a preference for receiving clarification on whether they had correctly slid the sentence at the end of each level, rather than at the moment of making the mistake. Regarding specific activities within the app (such as meditation, pointing out meaningful phrases, etc.), no participants reported any difficulties in how to use them, except for two respondents, a boy and a girl, who indicated that they did not understand how to do the meditation exercise.

Also, the majority of participants (79%; 84.6% of the girls and 68.7% of the boys) found the language easy to follow and had no difficulty comprehending the sentences. However, a few participants (21%) reported struggling to understand certain words without being able to recall the exact terms. Additionally, one boy noted the need to read some sentences several times to fully comprehend them.

Theme 2: Visual Design

All participants (100%) found the app's design appealing and/or attention-grabbing. The feature

Table 1
Characteristics of the Sample

Variable	Variable <i>M (SD) or N (%)</i> ; Range
Age years	13.98 (0.51); 13-15
Sex	
Male	16 (38.1%)
Female	26 (61.9%)
BMI	20.30 (3.30); 15.39-30.13

Note. For continuous variables, means (standard deviation) and range reported; for nominal variables, frequencies and percentages reported; BMI: Body Mass Index.

Table 2
Descriptive Statistics Derived From the SUS and the USE

Variable	M (SD)	Range
SUS scale items		
1. I think that I would like to use the app frequently.	2.76 (1.32)	1-5
2. *I found the app unnecessarily complex.	2.29 (1.17)	1-5
3. I thought the app was easy to use.	4.24 (1.21)	1-5
4. *I think that I would need support of a technical person to be able to use the app.	1.64 (0.88)	1-4
5. I found the various functions in the app were well integrated.	3.90 (1.08)	2-5
6. *I thought there was too much inconsistency in the app.	2.64 (1.39)	1-5
7. I would imagine that most people would learn to use the app very quickly.	4.38 (0.91)	2-5
8. *I found the app very cumbersome to use.	1.38 (0.91)	1-5
9. I felt very confident using the app.	4.00 (0.96)	2-5
10. *I needed to learn a lot of things before I could get going with the app.	2.00 (1.41)	1-5
SUS total score	73.33(13.84)	50-100
USE scale items		
1. The app is useful.	4.60 (1.67)	1-7
2. The app meets my needs.	3.88 (1.87)	1-7
3. The app does everything I would expect it to do.	4.26 (1.83)	1-7
4. I am satisfied with the app.	4.79 (1.76)	1-7
5. I would recommend the app to a friend.	4.38 (2.11)	1-7
6. I feel I need to have the app.	3.17 (1.82)	1-7
USE usefulness score	4.25 (1.65)	1-7
USE satisfaction score	4.11 (1.70)	1-7
USE total score	4.18 (1.64)	1-7

Note. Items marked with an asterisk (*) are reversed scored; Means (standard deviation) and range reported; SUS: Systems Usability Scale; USE: Usefulness, Satisfaction, and Ease of Use.

that was most frequently highlighted was the appropriateness of the colors, followed by the images.

The colors are vivid and instill encouragement and hope.

The app is very eye-catching and makes you want to use it.

Nevertheless, one girl expressed a desire for the inclusion of more graphic elements, and another girl reported that she thought the design should be more “striking.”

In reference to the structure of the app (regarding the manner in which information is displayed, if the important information stands out, etc.), all participants thought it was well organized.

Everything is very accessible and easy to locate.

Theme 3: User Engagement

Ratings of *user engagement* were mixed. There was agreement across participants that the app was captivating, as it piqued their curiosity and interest. For example, a significant amount of participants (64.3%; 73.1% of the girls and 50% of the boys) would like to use the app again in the future.

Yes [I would like to use it again], it seems entertaining, thought-provoking.

I think I would use it again to ask myself those questions [referring to the app sentences] and see how I feel. I would like to try other modules as well.

However, a minority of respondents (14.3%) indicated that they would not use it again as it did not appeal to them and/or did not think they would need it. Additionally, a small proportion of users (21.4%) expressed uncertainty, stating that their decision would depend on their circumstances. Nevertheless, all respondents (100%) indicated that they would recommend its use to other students.

Also, in terms of how the content is presented, several participants (16.7%; 25% of the boys and 11.5% of the girls) pointed out that they found the app interesting, entertaining, diverse, and had made them curious. However, two girls said they found it boring, and another girl thought it was a waste of time.

I liked it because it made me curious and because I would like to study psychology and I found it interesting how an app can make you change.

Theme 4: Content

First, trust in the presented content (i.e., whether the participants consider the information to be accurate) was assessed by asking participants whether they trusted the app's feedback. The app's feedback consists of informing the user if they have correctly identified whether a statement is adaptive (they must accept it) or maladaptive (they must reject it). Most participants (61.9%; 68.7% of the boys and 57.7% of the girls) agreed with the app's indication to accept or reject the different sentences, indicating trust in the presented content.

I agreed with all the indications, and if the app told me I was wrong I reflected and changed my mind.

However, some users (38.1%) disagreed with the feedback provided in very few specific sentences. In particular, the rejection of phrases like "A beautiful body is a trained body" that identified a beautiful body in purely aesthetic terms, led to confusion.

Most participants (73.8%; 76.9% of the girls and 68.7% of the boys) found the content easy to understand and therefore provided in a clear way. One user also specifically commented that the content was very varied. On the contrary, four users reported excessive repetition of certain phrases. Finally, two participants, a boy and a girl, suggested adding information for individuals who wish to gain weight or feel too thin.

Theme 5: Therapeutic Persuasiveness

The *therapeutic persuasiveness* was assessed by asking the users if the app encouraged them to make positive behavior changes or to maintain positive aspects of their life. Most participants (73.8%; 75% of the boys and 73.1% of the girls) reported that completing the app had helped them make positive behavioral changes, primarily by thinking more positively or paying less attention to negative thoughts.

I have noticed that fewer negative thoughts come to me. And when they do come, I pay less attention to them.

Both, I have more positive thoughts, and when the negative ones come to me, I don't pay as much attention to them.

In particular, when asked if they think more positively or pay less attention to negative thoughts, they respond:

Yes, especially with regard to food.

Yes, sometimes I have negative thoughts and I think about some sentences, and they make me think that our body has nothing to do with the way we are.

Yes, I kind of think now... if I see someone who feels bad about themselves, well, before I didn't care and now, I show more empathy, I try to say something to them, I help them.

Additionally, some interviewees reported changes in their thinking regarding specific areas, such as self-esteem, anxiety, or body related issues:

I used to look in the mirror and think I looked terrible, and now this has changed a lot. Even my mother has noticed it too.

I have more self-esteem and more confidence in myself.

Similarly, half of the users (50%; 61.5% of the girls and 31.3% of the boys) claimed that they remembered the content of the app in their daily lives, which helped them to maintain these positive changes:

When I had thoughts like "I need to eat less," I remembered the app and that helped me to ignore these thoughts and do what I wanted to do.

Yes, for example (...), during exams period I got really overwhelmed, and [I remembered] the app said that I was strong, and I could do it, and it helped me a lot. There are times when I remember that, and it helps me.

When trying on clothes, you get an intrusive thought and then I remember [the app sentences like] "everybody is unique," it's fine, don't worry.

Theme 6: Therapeutic Alliance

In relation to the *therapeutic alliance*, and to aspects related to the acceptance and support of the app, the narratives of most participants showed that the app contains helpful content. In addition, several respondents (11.9%, all girls) spontaneously highlighted the role of the app as a complement to professional help, as well as an additional support tool.

It helps you, sometimes you don't talk to anyone, and this can be a source of positive messages.

Yes, because I think it's a good way to ... people who can't afford to pay for a psychologist or talk to someone about it, I think it's a good way to give information, a good resource.

I know several people who have various self-esteem problems and I think the app could help them, because not everyone feels comfortable talking to someone.

Although I don't have this problem now, I have seen the tools that exist so that in the future it won't happen to me, and so that I can control it better.

Theme 7: Perceived Usefulness

Participants refer to different aspects of the app's usefulness when discussing its utility. A small group (9.5%; 18.7 of the boys and 3.9% of the girls) found it useful without specifying how. More precisely, some (11.9%; 12.5% of the boys and 11.5% of the girls) found it helpful for improving their self-esteem and self-acceptance, while others (16.7%; 23.1% of the girls and 6.3% of the boys) reported that it aided in self-reflection and self-discovery.

I think the app (...) helps you to think and reflect on things you don't normally think about, and to get to know yourself better.

It has helped me to feel better, to accept myself.

From my point of view, it can help a lot if you don't love yourself.

Additionally, some users (11.9%; 15.4% of the girls and 6.3% of the boys) found it useful for reflecting on their relationship with their body and food.

It helps you understand whether you feel good or bad about your body.

It does help to raise awareness that all bodies are unique, nobody is perfect.

Furthermore, a few respondents (9.5%; 15.4% of the girls) pointed out that it improved their mood, particularly by encouraging them to think more positively.

Some interviewees (16.7%; 31.3% of the boys and 7.7% of the girls) indicated that they did not find it useful because they did not need it, while others (11.9%; 18.7% of the boys and 7.7% of the girls) acknowledged that although they did not find it useful, they understood that it could be helpful to others.

I personally don't [find the app useful] because it's for people who don't like themselves, and I have a good self-esteem, but I understand that other people can benefit from it.

Finally, a few participants (11.9%; 15.4% of the girls and 6.3% of the boys) stated that they did not find it useful without more specification.

Discussion

The objective of the present study was to assess the acceptability and usability of an app-based inter-

vention designed to reduce cognitive risk factors associated with EDs in adolescents. Results for acceptability showed that most participants were satisfied with the app and were willing to use it again in the future, and even recommend it to friends. These findings coincide with previous studies showing that web-based prevention programs for EDs are well accepted, in terms of expectations and satisfaction (Carrard et al., 2023; O'Brien et al., 2024; Saekow et al., 2015).

Regarding the evaluation of the app's usability, participants' SUS scores were above the threshold for what is considered to be an acceptable level of usability (Bangor et al., 2009) and were comparable to the SUS scores associated with other accepted app-based interventions for EDs (Laboe et al., 2024; Langlet et al., 2021; Linardon & Fuller-Tyszkiewicz, 2020). Furthermore, no statistically significant differences in the scores were observed between boys and girls. Therefore, the quantitative data suggests that there is no significant influence of sex on the usability and acceptability of the GGED app. These results are consistent with the finding that adherence and attrition rates are unrelated to demographic variables (including sex) in smartphone-delivered interventions for mental health problems (Linardon & Fuller-Tyszkiewicz, 2020).

Qualitative data derived from seven different themes also revealed important insights into the usability of the app. Participants consistently identified three positive aspects: usability, perceived usefulness, and visual design. In terms of the app's usability, users found it very easy to use, as reported through the SUS. Previous research has indicated that the user-friendliness of a product is one of the factors associated with the intention to use the same product again in the future (Palos-Sanchez et al., 2021; Simblett et al., 2019). This is consistent with the fact that most participants indicated that they would use the app again, and with SUS items that refer to the app's ease of use showing high scores (e.g., "I thought the app was easy to use"; "I would imagine that most people would learn to use the app very quickly"). This highlights the suitability of GGED-AD for its use with adolescents. Nevertheless, although most participants found the language easy to follow, a few users had difficulty understanding some of the terms. This finding may be associated with the relatively high score for the SUS item "I found the app unnecessarily complex." It suggests that the perceived complexity may stem from challenges in understanding specific terminology, especially since the majority of participants reported finding the app easy to

learn and use. In a related study where a similar issue was identified, the creation of a glossary of terms was proposed as a potential solution (Fuller-Tyszkiewicz et al., 2018). This could also be applied and incorporated into GGED-AD in the future. In addition, a relatively high score was observed for the item “I thought there was too much inconsistency in the app.” However, during the interviews, none of the participants cited any inconsistencies. In fact, all participants indicated that they found the app to be well structured. This may be due to a lack of comprehension regarding the inconsistency question among the participants; therefore, future GGED-AD reviews should investigate this issue in greater depth.

Regarding *perceived usefulness*, it appears to be one of GGED-AD’s strongest assets. Only five of the 42 users indicated that they did not find the app helpful at all, although they did not provide any further reasons for this assessment. The majority of participants indicated that they found the app to be useful for a variety of purposes (self-reflection, self-discovery, improving self-esteem and self-acceptance, reflecting on their relationship with their body and food, and to think more positively). In accordance with the Technology Acceptance Model (TAM; Davis et al., 1989), one of the most frequently employed frameworks for examining the adoption of technology, there are two principal factors that influence the acceptability and use of a novel technology: perceived usefulness and perceived ease of use. Consequently, it can be hypothesized that GGED-AD will exhibit high acceptability and promising engagement. This is also consistent with other research evaluating eHealth tools, which indicates that perceived usefulness has a statistically significant impact on behavior intention to use the app (Palos-Sanchez et al., 2021). Similarly, previous research indicates that users of eHealth tools directly related to EDs are more likely to install the app if they perceive it to be useful (Naccache et al., 2021). Regarding differences in perceived usefulness according to sex, no significant statistical differences were identified. However, qualitative findings revealed discrepancies, where a considerably lower percentage of boys compared to girls found the app useful. It can be hypothesized that, given the historical and cultural association between body image problems and the female gender (Parker, 2009), female participants may have felt more personally connected to the intervention. This could have resulted in an elevated perceived usefulness, although this was not reflected in the questionnaire scores. This is also consistent with the finding that a significantly higher percentage of girls than boys remembered

the content of the app in their day-to-day lives, not just at the time of the intervention. These results emphasise the importance of incorporating qualitative data in usability and acceptability studies, as it can reveal significant differences that might otherwise remain unidentified. However, it is challenging to draw definitive conclusions regarding the influence of sex on usability and acceptability variables in eHealth prevention programs for EDs due to a paucity of research that includes male subjects. Further studies should investigate the influence of this variable on people’s perception of, and opinion on, eHealth prevention tools.

In reference to the *visual design*, adolescents provided highly positive ratings, with all users agreeing that they found GGED-AD attractive and well organized. Given that the aesthetic appeal of an app is known to greatly influence user engagement (Perrig et al., 2023), and teenagers in particular place a high value on design (Naccache et al., 2021), this could therefore be considered a significant strength of GGED-AD.

The *therapeutic persuasiveness* of the app, defined as the capacity of a system to modify users’ behavior or attitude in a desired manner (Fogg, 2009), has been demonstrated to be highly effective. The majority of participants indicated that completion of the app had resulted in a shift towards more positive thinking or a reduction in the influence of negative thoughts. Nevertheless, further research is required to elucidate the rationale behind the responses and to determine what part of the app’s design is responsible for this.

With regard to the theme *content*, a potential issue was identified based on some expressed concerns. Some users disagreed with a few of the app’s feedback, which means that the participant has identified a sentence as adaptive while the app indicates that it is maladaptive, and vice versa. This happened particularly in relation to sentences that identified a beautiful body in purely aesthetic terms, which led to confusion when the app pointed out that this was not true. This phenomenon can be attributed to the fact that adolescents place significant emphasis on their body image and appearance, additionally influenced by the internalization of cultural norms that place a high value on looks (Krebs et al., 2024; Reel et al., 2015). Consequently, to facilitate comprehension of the app’s feedback, brief explanations could be incorporated to highlight the significance of considering other aspects beyond mere aesthetic appeal. In fact, research conducted by Engel et al. (2023) indicates that when individuals place greater emphasis on functional aspects beyond

mere aesthetic appeal, it is associated with increased positive body image (i.e. body appreciation and functionality appreciation) and decreased negative body image (in terms of appearance dissatisfaction). Moreover, in some cases, it may be appropriate to rephrase sentences so that the maladaptive nature can be rendered more clearly—for example, with the incorporation of nuances such as “only,” “always,” or “never.” Furthermore, although the concern about the repetition of certain phrases may appear to be minimal, four participants reported this as an issue. It is understandable that users feel this way, as some sentences are indeed repeated in the different levels they need to complete. However, repetition is a key aspect of the cognitive training (Akin-Sari, Inozu, Haciomeroglu, Trak, et al., 2022). In future app revisions, this issue should be addressed by providing a brief explanation of the rationale behind the repetition of sentences.

Two users (a boy and a girl) made a valuable contribution by suggesting the addition of content that would appeal to adolescents who feel too thin or wish to gain weight. This is consistent with research arguing that in recent years, adolescents, both boys and girls, are increasingly feeling aesthetic pressures to achieve a certain ideal of beauty defined by an athletic body and increased muscle mass (Hoffmann & Warschburger, 2019; Rodgers et al., 2020).

Finally, with respect to *user engagement* and *therapeutic alliance*, it is first necessary to acknowledge that certain aspects may be influenced by the design of the RCT from which the sample was drawn. In terms of *user engagement*, the guidelines proposed by Baumeister et al. (2017) emphasize the significance of personalization in relation to the choice of content to be received by the user. However, for research purposes, participants in this study were provided with specific instructions regarding the module of the app to be utilized and were not allowed to select the content they may wish to receive. Similarly, participants were required to utilize the app on a daily basis under the supervision of the research team, even if they found the app unattractive. Nevertheless, it is possible to identify certain user engagement variables. The narratives of the majority of participants indicate that they find the app captivating and that it piques their curiosity, and all the participants found it interesting that the app could be completed by other students. These findings are consistent with those of a similar study that examined the feasibility and acceptability of an internet-based prevention program for perfectionism in reducing eating disorder symptoms in

adolescents. All participants in the intervention stated that they would recommend the program to a family member or a friend (O'Brien et al., 2024).

In reference to the topic of *therapeutic alliance*, the research group staff supervised the daily use of the app by the adolescents and were available to answer any doubts or concerns. This makes it challenging to assess the role of the app in terms of its ability to establish an alliance with the user, as this role is being partially covered by the research staff. Indeed, some participants in the interviews highlighted the assistance and guidance provided by the research staff as a positive aspect. This is consistent with the literature, which indicates that the lack of professional support or a human element is a concern among users of mental health apps (Fuller-Tyszkiewicz et al., 2018). This is particularly the case in the context of eHealth interventions associated with ED (Linardon et al., 2020; Linardon, King, et al., 2022). It is worth noting that four respondents spontaneously identified the app as a resource to turn to if they did not feel comfortable talking to someone in person. Other investigations have reported that adolescents with ED symptoms are often reluctant to seek assistance, due in part to the stigma surrounding EDs and the limited support they receive from family and friends (Nicula et al., 2022). In such instances, GGED-AD could be a valuable tool. If introduced in educational settings, teachers could serve as an ideal agent for encouraging adolescents to use the app, thereby acting as a preliminary step for at-risk individuals who may feel embarrassed to seek assistance or to communicate with others.

The present study has certain limitations that need to be considered. The sample's relatively homogeneous nature and the sole recruitment through one primary source limit the applicability of the findings to a wider target population. Furthermore, of the total number of adolescents who were offered the opportunity to participate in the RCT, from which this research is a part of, the sample for the present study was selected on the basis of voluntary acceptance, the completion of the informed consent form, and the completion of the intervention itself (completing GGED-AD). Consequently, it can be assumed that participants in the current study demonstrated greater motivation and had a more positive experience with the app than those who chose not to participate or who dropped out prior to the end of the intervention. In addition, it is important to acknowledge that during the intervention the adolescents were supervised by the research team. This enabled them to seek guidance and assistance

should they encounter any technical difficulties or have any questions regarding the app. It is possible that this may have influenced their responses and could have resulted in overly positive feedback. Moreover, the qualitative results of perceived usability and acceptability are contingent upon participants identifying and communicating any challenges and positive impressions they encounter while completing tasks related to the app. As a result, the recollection of such experiences is subject to significant biases, which depend on the user's awareness of the events in question. As proposed by Fuller-Tyszkiewicz et al. (2018), alternative methodological approaches, such as laboratory-based experimental studies, could potentially provide further insight. Finally, a number of individual factors (e.g., eating symptomatology or BMI) as well as participants' pre-intervention expectations (e.g., beliefs about EDs treatment or beliefs about eHealth interventions) have not been assessed and it is possible that these variables could have influenced adolescents' perception of the app's usability and acceptability.

In sum, in light of the quantitative and qualitative data, the findings suggest that adolescents perceive the GGED-AD app to be adequately usable and acceptable. Consequently, it represents an ideal instrument for the reduction of cognitive risk factors associated with EDs in adolescents, as it is perceived as a highly useful, easy, and attractive tool to use. Furthermore, it could serve as a preliminary step for those adolescents who are at risk of developing an ED, but are reluctant to seek assistance, which is of particular importance in view of the low rates of detection and early intervention. However, as previously noted, participants have identified certain areas for potential improvement. Future research may benefit from evaluating how the aforementioned improvements could increase the usability, acceptability, and feasibility of GGED-AD, as well as the optimal design of apps for EDs.

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