

Combining e-Health and Gamification in a Psycho-Family Intervention for Childhood Obesity: A Pilot Study

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Abstract

The ENTREN-Galaxy program incorporates e-Health and gamification into a family-based multidisciplinary intervention for childhood obesity. This pilot study aimed to: 1) assess the feasibility and acceptability of the new e-Health delivery method of the ENTREN-Galaxy program for childhood obesity, and 2) explore potential improvements in children's psychological well-being, lifestyle habits, weight status, and family environment. The intervention consists of 16 structured weekly sessions grounded in Cognitive Behavioral Therapy and motivational interviewing, with an interdisciplinary approach involving parents. The pilot study included fifteen children, aged 8 to 12 years, with overweight or obesity ($z\text{-BMI} \geq 85\text{th}$), and at least one parent. Feedback and acceptability from children and parents were obtained at the end of the intervention. Questionnaires and weight status were collected at baseline (T_0), post-intervention (T_1), and at a three-month follow-up (T_2). The e-Health delivery method showed high levels of acceptability, with 82.4% of parents agreeing that online sessions made the program more accessible, and 76.5% noting the time savings and convenience. Despite the small sample size, some clinical improvements exhibited small to medium effect sizes. Only physical activity scores showed a statistically significant difference over time. This study highlights the feasibility and acceptability of integrating e-Health and gamification in psycho-family childhood obesity interventions, offering the potential to reduce access barriers, enhance adherence, and motivating experience.

Keywords: digital; intervention; childhood obesity; behavior change; bullying.

Combinación de e-Health y gamificación en una intervención psico-familiar para la obesidad infantil: un estudio piloto

Resumen

El programa ENTREN-Galaxy incorpora la e-Health y la gamificación en una intervención multidisciplinar familiar para la obesidad infantil. El estudio piloto tuvo como objetivos principales: 1) evaluar la viabilidad y aceptabilidad del formato e-Health del programa, y 2) explorar posibles mejoras en el bienestar psicológico de los niños/as, los hábitos de vida, el estatus de peso y el entorno familiar. La intervención consta de 16 sesiones semanales estructuradas, basadas en la Terapia Cognitivo-Conductual y entrevista motivacional, desde un enfoque interdisciplinar con implicación de los padres. El estudio piloto incluyó a quince niños de entre 8 y 12 años con sobrepeso u obesidad ($z\text{-IMC} \geq \text{percentil } 85$), así como al menos uno de sus progenitores. La satisfacción y la aceptabilidad por parte de los niños/as y sus progenitores se recogieron al finalizar la intervención. Los cuestionarios y el estatus de peso se evaluaron en la línea base (T_0), tras la intervención (T_1) y en un seguimiento a los tres meses (T_2). El formato e-Health mostró altos niveles de aceptabilidad: el 82,4 % de los progenitores indicó que las sesiones online hacían el programa más accesible, y el 76,5 % señaló el ahorro de tiempo y la comodidad como ventajas principales. A pesar del tamaño reducido de la muestra, algunas mejoras clínicas presentaron tamaños del efecto pequeños a moderados. Únicamente las puntuaciones de actividad física mostraron diferencias estadísticamente significativas a lo largo del tiempo. Se destaca la viabilidad y aceptabilidad de integrar e-Health y la gamificación en intervenciones psico-familiares para la obesidad infantil, ofreciendo un potencial para reducir barreras de acceso, mejorar la adherencia y favorecer una experiencia motivadora.

Palabras clave: digital; intervención; obesidad infantil; cambio de conducta; acoso escolar.

Childhood obesity is widely recognized as a condition with multifactorial nature, involving biological and psychological individual vulnerability factors, as well as sociocultural, interpersonal, and family aspects (Smith et al., 2020). Children with obesity are at an increased risk of developing medical comorbidities (Kumar & Kelly, 2017; Sharma et al., 2019). Additionally, they are more likely to experience psychological comorbidities such as depression (Quek et al., 2017; Sanders et al., 2015). According to the WHO European Childhood Obesity Surveillance Initiative (COSI), Spain is among the seven countries with the highest prevalence of childhood obesity in Europe (COSI, 2025).

This situation underscores the need for the implementation of effective programs to address childhood obesity, particularly its psychological consequences. In this context, considering the crucial role of parents in the development and maintenance of childhood obesity, special attention has been given to developing interventions at the family level (Chai et al., 2019). Research indicates that treatments with the most empirical support are those with a multicomponent approach, which include modules on behavior modification, physical activity, and nutrition, and actively involve parents as agents of change in their children's health (Barlow, & Expert Committee, 2007; Quattrin & Wilfley, 2017). However, their effectiveness remains moderate, and one of the main limitations is the low adherence of participants to these interventions, with dropout rates ranging from 27% to 73% (Rojo et al., 2022; Skelton & Beech, 2011). Furthermore, given the negative impact of weight stigma on children's health and well-being, these interventions also face the challenge of ensuring that such stigma is not inadvertently reinforced (Haqq et al., 2021).

In recent years, advancements in new technologies have significantly impacted the healthcare sector, leading to the emergence of TeleHealth and e-Health (Eysenbach, 2001). The use of new technologies and the internet (e.g., videoconferencing and mobile applications) is beginning to be implemented in the field of childhood obesity, with the primary goal of reducing logistical barriers that partially explain low adherence to programs (Cohen et al., 2012; Fleischman et al., 2016; Irby et al., 2012). Although the literature on this topic is still limited, existing reviews suggest the potential of these digital approaches and indicate that they may be as effective as face-to-face interventions in reducing childhood obesity (DeSilva & Vaidya, 2021; Whitley & Yahia, 2021). Additionally, the field of e-Health has been enhanced by the incorporation of gamification, defined as the use of game design elements in non-game contexts, such as points, missions, and narratives (Deterding et al., 2011). Gamification primarily aims to increase user motivation and thereby improve the effectiveness of interventions (Pardos et al., 2022; Sardi et al. 2017). However, the use of gamification in interventions targeting childhood obesity is limited and primarily focuses on the development of self-guided mobile applications centered mostly on nutrition and physical activity (Alghamdi & Bitar, 2023).

In this context, the ENTREN-Galaxy program - interdisciplinary, family-based, and delivered through a gamified e-Health format - emerges as an innovative intervention aimed at enhancing the overall health of children with obesity. It is important to highlight that, in order to avoid reinforcing weight stigma, this program adopts a weight-neutral approach.

The primary aim is to improve overall health and psychological well-being by fostering a healthy relationship with food, physical activity, and body acceptance, rather than focusing on weight reduction. This approach is reflected in the content of the intervention sessions (Table 1).

The primary aim was to examine the feasibility and acceptability of the e-Health delivery method and the overall satisfaction with the ENTREN-Galaxy program. The secondary aim was to explore whether the program would lead to improvements in the psychological well-being of children aged 8 to 12, lifestyle habits, and weight status (measured by *z*-BMI). Additionally, the study aimed to examine potential improvements in family-related factors.

Based on the reviewed literature and the results of the ENTREN-F program (Sepúlveda et al., 2020, 2024), the following hypotheses are proposed: (1) a high degree of acceptability of the e-Health delivery method, as expressed by both children and parents, and (2) exploratory trends toward improvements in children's psychological well-being, lifestyle habits, and weight status, as well as improvements in family factors. However, given the small sample size, no significant differences in clinical outcome measures were expected.

Method

A pilot study was conducted using a single-arm pre-post-follow-up design. Data were collected at three time points: baseline (T_0), immediately following the intervention (T_1), and at a three-month follow-up (T_2). During T_0 , as well as at T_1 and T_2 , anthropometric data were collected, and both children and parents completed self-reported questionnaires on paper. Acceptability levels were assessed at T_1 . Prior to data collection, participant confidentiality was ensured. Participation was voluntary, with no incentives provided. Parents signed written informed consent forms, and children gave their assent for participation. The study received ethical approval from the Niño Jesús Children's Hospital (R-0094/22) and the University Committee (UAM, Research Ethics Committee CEI-76-1394).

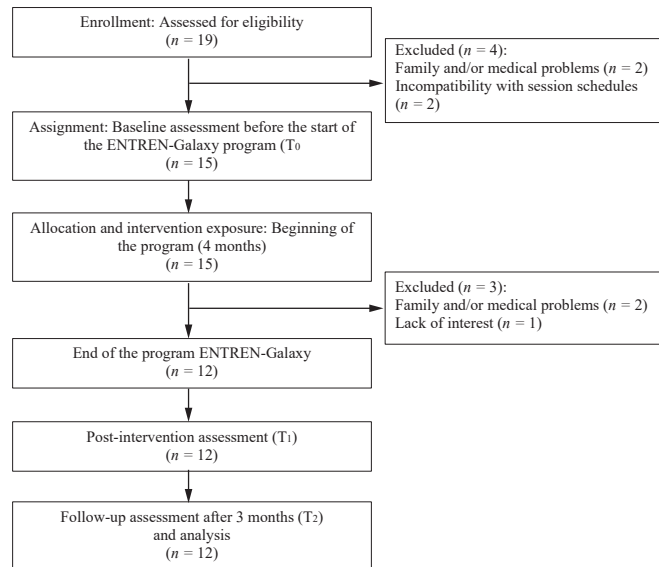
Participants' Recruitment and Eligibility Criteria

Children were recruited over two periods (November 2021-January 2022; October-November 2022). During these intervals, information about the ENTREN-Galaxy program was provided to nurses and pediatricians at two healthcare centers in the northern and southern areas of the Community of Madrid. The inclusion criteria for child participants were: (a) age between 8 and 12 years, (b) *z*-BMI scores $\geq 85^{\text{th}}$ percentile according to age and sex (Sobradillo et al., 2004), (c) fluent in Spanish, and (d) access to an electronic device with an Internet connection. In alignment with pilot study sample size recommendations (Julious, 2005), the objective was to recruit a minimum of 12 participants. A total of 19 families were invited by healthcare professionals and subsequently contacted by researchers via telephone. The flow of participants is illustrated in the CONSORT diagram (Figure 1). Three families withdrew from the program due to medical or family issues, or lack of interest. These families were excluded from the data analysis as they attended less than 66.7% of the sessions and did not complete the assessment measures (Rojo et al., 2022). The final sam-

ple comprised 15 children and 17 parents, including 12 mothers and 5 fathers. Given the single-arm design, all children were assigned to a group receiving the ENTREN-Galaxy program.

The age range of the children in the final sample ($n = 15$) was between 8.93 and 12.0 years ($M = 10.38$, $SD = 1.04$). Regarding gender distribution, 66.7% ($n = 11$) were female, and 33.3% ($n = 4$) were male. All participants were of Spanish nationality and belonged to families with a medium-to-high socioeconomic status (level IV/V) as classified by Hollingshead's criteria (1975). The z -BMI of the participants ranged from 1.01 to 3.52 ($M = 2.15$, $SD = 0.83$).

Figure 1. CONSORT diagram of the study for child participants.



Development and Structure of the Program

The present program, ENTREN-Galaxy, is based on a multidisciplinary, cognitive-behavioral, motivational interviewing, family-based intervention developed by the same research group, “[ENTREN-F]”, which has yielded promising results (Sepúlveda et al., 2020, 2024). For further information regarding the theories utilized in designing this behavioral intervention, the protocol of the ENTREN-F study can be referenced, as the content of both programs is identical (Rojo et al., 2022). The adaptation of the program to an e-Health and gamified format was carried out between 2020 and 2022. Compared to the previous version, this adaptation required substantial changes of the dynamics and activities to incorporate gamification elements and tailor it to an online delivery method. Gamification elements such as levels, points and badges were incorporated to emulate game mechanisms. Additionally, an online conferencing platform (*Microsoft Teams*) and *ClassDojo* platform were used.

ENTREN-Galaxy is a group program consisting of 16 weekly sessions (90 minutes each) for children, spanning a total of 4 months, and four webinars of the same duration for their parents. Fourteen of the sessions are conducted via an e-Health delivery method through synchronous videoconferencing, while the first and final sessions are held face-to-face at the Primary Care Center. Although effective therapeutic alliances can be established in online interventions, incorporating some face-to-face sessions is recommended (Cohen et al., 2012). The program is structured around the metaphor of a spaceship journey through the “Galaxy of Health”, featuring seven planets that represent the key areas of intervention related to childhood obesity. Detailed information on the content can be found in

Table 1. Content and structure of the ENTREN-Galaxy program.

Planets	Area of interest	Session	Objective	Participants	Professional
Tierra (Earth) ^a	Introduction	0	Explanation of the ENTREN-Galaxy program and the delivery of the materials.	Children and parents	Psychologist, Experts in physical education and nutrition
Motimeta	Psychology	1	Introduction to the concepts of integral health (physical and mental) and the importance of raising awareness about them.	Children	Psychologist
		2	Understand how to recognize behaviors that hinder habit change, including the benefits and costs associated with making those changes.	Children	
		3	Establish small personal goals to facilitate habit change. Understand the challenges of implementing new habits.	Children	
		4	Addressing relapses: Introduction of the first “Monster” (obstacle) and the corresponding Superpower (strategies acquired) to confront it.	Children	
Movi +	Physical education	5	Psychoeducation on the benefits of physical activity, along with a reflection on personal levels of active and sedentary behaviors. Establish personal physical activity goals while recognizing barriers to engaging in physical activity. Explanation of the Monster and Superpower.	Children and parents	Expert in physical education
Emotionen	Psychology	6	Psychoeducation on basic emotions, including their physiology, associated thoughts, actions, and adaptive functions. Learning to distinguish between emotions and their corresponding responses, as well as understanding their adaptive functions and influence on daily habits and emotional regulation.	Children	Psychologist
		7	Learning to identify situations that elicit high-intensity emotions and understanding their consequences.	Children	
Nutricio	Nutrition	8	Understand the fundamentals of healthy eating and establish personal nutrition goals. Explore emotional eating by explaining how emotions can influence eating behaviors. Explanation of the Monster and Superpower.	Children and parents	Expert in nutrition

Planets	Area of interest	Session	Objective	Participants	Professional
Emotionen	Psychology	9	Galactical training: Identifying physiological signals of emotional activation and training in relaxation practices. Positive visualization exercises to discover personal safe spaces.	Children	Psychologist
		10	Identify how maladaptive thoughts influence emotions and daily habits, and create alternative thoughts that are aligned with reality. Explanation of the Monster and Superpower.	Children	
Habiloide	Psychology	11	Interpersonal communication: understanding aggressive, passive, and assertive styles. Explore the importance of social relationships for health and learn how to communicate assertively.	Children	Psychologist
		12	Psychoeducation on the effects of bullying, along with training in assertive strategies to confront jokes. Explanation of the Monster and Superpower.	Children	
Corporeus	Psychology	13	Psychoeducation on self-esteem, including the identification of self-critical thoughts. Develop strategies to evaluate oneself holistically and foster self-acceptance. Explanation of the Monster and Superpower.	Children	Psychologist
Solventium	Psychology	14	Define and identify obstacles on the path to health. Training in problem-solving techniques and relapse prevention. Explanation of the Monster and Superpower.	Children	Psychologist
Tierra (Earth) ^a	Conclusion	15	Returning to Earth: A review of the program's content. Activities focused on composing the Health Formula.	Children and parents	Psychologist, Experts in physical education and nutrition

Note. ^a Face-to-face session at the Health Center. At the beginning of each session, a review of the missions completed during the week was conducted, and at the end, the new missions were explained.

Table 1. The sessions are conducted by trained psychology, nurses, and physical activity professionals. Children, referred to as “Galactic Explorers”, travel through the seven planets with the help of their parents (“Engineers-Guides”), to recover the pieces of the “Health Formula” that have been destroyed. After each session, three weekly challenges -one each for physical activity, nutrition, and psychology- are uploaded to *ClassDojo*. These missions aim to implement the habits discussed in the sessions. To earn virtual rewards (e.g., points, badges), which are a key element of the gamification strategy, participants must complete these tasks.

Regarding the intervention directed at parents, the program includes four webinars with a psychoeducational approach, aimed at promoting behavioral change within the household. Additionally, parents participate alongside their children in nutrition and physical activity sessions. Their involvement is also crucial for completing the weekly missions assigned to their children at home.

Measures

Sociodemographic Data

A structured interview was conducted with each child and one of their parents to gather information regarding their age, gender, job occupation, and educational level. The family's socioeconomic status was assessed using Hollingshead's (1975) criteria.

Acceptability of the E-Health Delivery Method

Acceptability was defined as the degree to which the e-Health delivery method of the ENTREN-Galaxy program is perceived by participants as appropriate, satisfactory, and engaging (Bowen et al., 2009). After completing the program, the acceptability of the e-Health delivery method was assessed through separate written questionnaires that covered the following themes: feasibility, interest, utility and helpfulness. The chil-

dren's questionnaire included four items rated on a 5-point Likert scale (ranging from “strongly disagree” to “strongly agree”), such as “I was satisfied with the online sessions”. It also included an open-ended section for feedback and comments (e.g., “Could you describe the advantages (or disadvantages) of completing the sessions online?”). The parents' questionnaire contained 14 items rated on the same 5-point Likert scale (e.g., “I was satisfied with the online sessions”) and an open-ended section for feedback (e.g., “Could you describe the advantages of completing the sessions online?”). The items are presented in Table 2.

General Satisfaction with the ENTREN-Galaxy Program

The questionnaire administered to both parents and children included several items designed to assess overall satisfaction. The first item rated using a visual analogue scale (VAS; 1-10), measured overall satisfaction with the program. The second item, a dichotomous question (yes/no), assessed whether participants would recommend the program to other children or families. The third item, a Likert-scale question (1-5, ranging from “not useful at all” to “very useful”), evaluated the perceived usefulness of the strategies learned during the program. The fourth item, in a dichotomous format (yes/no), assessed whether participants perceived changes in their healthy lifestyle habits, followed by an open-ended question exploring the specific changes reported.

Furthermore, parents completed additional items assessing the perceived adequacy of the content of the children's sessions and the parent webinars (1-5, ranging from “not suitable at all” to “very suitable”). Parents were also asked to rate their child's level of motivation to participate in the sessions using a Likert scale (1-5, ranging from “not at all motivated” to “very motivated”) as well as their perceived interest in the program content using a 5-point Likert scale (1-5, ranging from “strongly disagree” to “strongly agree”).

Finally, the attrition rate was calculated as an indicator of program acceptability, defined as the percentage of children who, once having initiated the intervention, did not complete it.

Outcome Measures

Child's Psychological Well-Being

Child Depression Inventory (CDI; Davanzo et al., 2004). This inventory consists of 27 items from 0 to 2. Higher scores indicate a higher intensity of depressive symptomatology. The Cronbach's alpha (α) for the Spanish version is .85.

Spence Children's Anxiety Scale (SCAS; Orgilés et al., 2012). A self-report questionnaire consisting of 44 Likert-scale items from 0 to 3. Higher scores indicate greater severity of anxiety symptoms. The internal consistency of the Spanish version is .89.

Body Esteem Scale (BES; de Gracia et al., 2007). This self-report questionnaire consists of 24 items with two response options (yes or no). Higher scores indicate greater body esteem. The internal consistency of the Spanish version is .80.

Child's Healthy Habits

Physical Activity Unit 7 Item Screener (PAU-7S; Schröder et al., 2021). This tool consists of six questions about weekly physical activity with four response options. Higher scores indicate a greater amount of physical activity of the children. The internal consistency of the original version is .76.

Mediterranean Diet Quality Index for children and adolescents (KIDMED; Serra-Majem et al., 2004). Nutritional habits were measured using the self-report questionnaire KIDMED, which includes 16 items with two response options (yes or no). Higher scores indicate greater adherence to the Mediterranean diet. The internal reliability of the original version is .79 (Carrillo & Ramírez-Vélez, 2020).

Dutch Eating Behaviour Questionnaire for Children (DEBQ-C; Baños et al., 2011). This instrument evaluates three eating tendencies considered to be risk factors for developing obesity: emotional eating, external eating, and food restriction. It consists of 20 items rated on a 3-Likert point scale. The internal consistency of the Spanish version is .70.

Child's anthropometric measures

The weight and height of the child were measured using digital scales and stadiometers, and body mass index (BMI) was calculated (kg/m^2). To determine the child's z-BMI, the mean and standard deviation for their sex and age were used (Sobradillo et al., 2004). Although the intervention adopts a weight-neutral approach and does not target weight reduction as a primary outcome, z-BMI was included as a secondary outcome measure. This is due to the clinical context of the study, as participants were children referred from Primary Care services for overweight or obesity follow-up, in which anthropometric monitoring is routinely conducted. Therefore, this measure was included to allow future comparison with standard clinical practice and to explore potential changes over time.

Parental Outcome Measures

Child Feeding Questionnaire (CFQ; Navarro & Reyes, 2016). This instrument consists of 31 items that assess parents' attitudes, beliefs, and practices about child feeding, using a Likert-type (1 to 5). For this study, the three subscales of parental feeding practices were utilized: restriction, pressure to eat, and monitoring. The internal consistency is reported as .86.

Physical Activity module of the Home Environment Survey (HES-S-PA; Sepúlveda et al., 2021). It consists of 37 items and 4

subscales designed to evaluate the overall home environment's capacity to support physical activity in children: availability (22 items), accessibility (4 items; $\alpha = .49$), parental role modeling (6 items; $\alpha = .69$), and parental policies (5 items; $\alpha = .79$). Higher scores reflect a more supportive home environment for physical activity.

Problem Scale of the Lifestyle Behaviour Checklist (LBC; Flores-Peña et al., 2015). This instrument consists of 26 items measured on a 7-point Likert scale (1 to 7). It assesses parents' perceptions of behavioral issues related to eating, physical activity, and overweight as problematic for their child. Higher scores indicate a greater prevalence of problematic lifestyle behaviors. The internal consistency of the Spanish version has been reported as .86.

Data Analysis

Statistical analyses were conducted using SPSS version 25.0. Nonparametric Friedman tests were used to compare self-report measures and z-BMI scores across time (T_0 , T_1 , and T_2). Effect size statistics for these comparisons were derived from Wilcoxon signed rank tests, calculated by dividing the z-value by the square root of N (number of observations over the two time points). An effect size of approximately 0.10 indicates a "small" effect, around 0.30 a "medium" effect, and 0.50 or higher a "large" effect (Cohen, 1988). Descriptive statistics, specifically frequencies, were used to assess acceptability levels. Qualitatively, the most representative responses from the open-ended questions for both children and parents are presented. Due to the small number of fathers actively engaged in the sessions, the exploratory analysis of the intervention's impact was restricted to data from mothers who participated fully. All tests were two-tailed, and the significance level was set at $p < 0.05$.

Results

Acceptability of the E-Health Delivery Method

Table 2 presents the results of the satisfaction and acceptability questionnaire regarding the e-Health delivery method, completed by both parents and children. All participants who completed the program responded to the questionnaire, including 12 children and 17 parents. Most parents (82.4%, $n = 14$) strongly agreed that the e-Health sessions increased the program's accessibility for their families compared to face-to-face sessions. Additionally, 76.5% ($n = 13$) strongly agreed with the statements, "online sessions saved travel time" and "attending online sessions is more convenient and easier". Just over half (52.9%, $n = 9$) strongly agreed that "the online sessions fit better with my schedule" and that they were "satisfied with the online sessions". An open question was asked to find out the barriers that might make it difficult for them to attend the sessions if they were face-to-face. Some of the responses were: "Our work schedules would make it difficult for us to attend", "it would be very complicated to attend in person because of the travel", "because of family logistics it would not be feasible", "the barriers of travel, not being able to arrive on time".

A total of 41.2% of parents ($n = 7$) strongly agreed that "conducting the sessions online was as effective as in-per-

son sessions”, and 35.3% ($n = 6$) strongly disagreed that the e-Health format negatively impacted the quality of the program. When asked if they would have preferred the program to be conducted face-to-face, 52.9% ($n = 9$) completely disagreed. When asked about the reasons for their responses, some of the answers were: “The quality is the same and online makes it easier to attend”, “I don’t think it (e-Health format) had a negative effect”, “sometimes I think my daughter was distracted during the online sessions”, “I think that face-to-face is more enjoyable for the children”, “direct contact is always good, but starting the program face-to-face, then continuing online and finishing face-to-face was perfect”, “I prefer online because it is versatile and adaptable, and is equally effective and usable”, “face-to-face seems closer to me”.

When parents were asked about the advantages, they find in the Telehealth format they commented: “The availability to attend and the convenience. The time factor is important”, “there was no expense in travel time. Something basic in the life we lead”, “being able to attend all the sessions. If it had been face-to-face, we would have missed more than one”, “less travel

time”, “better organization of time”, “we have saved a lot of time and they have been able to maintain their extracurricular activities”, “better attendance and better organization among parents”. When asked about the disadvantages of the Telehealth format, the answer “none” was repeated, as well as those related to technical failures (e.g. “sometimes the connections did not work properly” or “maybe sometimes the connection failed for a few minutes”). In addition, other parents answered, “it does not ensure full involvement of the children” or “I don’t think I could get the full benefit of the workshop”.

Finally, 76.6% ($n = 12$) strongly agreed with, “I felt comfortable in video conferencing and was able to express myself effectively with professionals”. Additionally, 29.4% ($n = 4$) agreed that accessing the online sessions was easy, and 41.2% ($n = 7$) found the website platform to be user-friendly.

Regarding the children’s feedback, 66.7% ($n = 8$) strongly agreed and 25% agreed with the statement, “I felt satisfied with the online sessions”. Additionally, 33.3% ($n = 4$) strongly agreed that they would have been more attentive and motivated if the sessions had been conducted face-to-face, and 50% ($n = 6$)

Table 2. Percentages of responses for key items evaluating acceptability rates and satisfaction with the e-Health format by parents and children.

Items	Strongly agree	Agree	Neither Agree Nor Disagree	Disagree	Totally Disagree
Completed by parents ($n = 17$)					
Compared to face-to-face sessions, online sessions have made the program more accessible for my family.	82.4% ($n = 14$)	5.9% ($n = 1$)	11.8% ($n = 2$)		
Online sessions saved us travel time.	76.5% ($n = 13$)	11.8% ($n = 2$)	5.9% ($n = 1$)	5.9% ($n = 1$)	
Attending online sessions is more convenient and easier.	76.5% ($n = 13$)	5.9% ($n = 1$)	17.6% ($n = 3$)		
The online sessions fit better with my schedule.	52.9% ($n = 9$)	17.6% ($n = 3$)	23.5% ($n = 4$)	5.9% ($n = 1$)	
I felt satisfied with the online sessions.	52.9% ($n = 9$)	29.4% ($n = 5$)	17.6% ($n = 3$)		
Conducting the sessions online was as effective as if they had been held in person.	41.2% ($n = 7$)	29.4% ($n = 5$)	17.6% ($n = 3$)	11.8% ($n = 2$)	
Conducting the sessions in a e-Health format affected the quality of the program.		23.5% ($n = 4$)	23.5% ($n = 4$)	17.6% ($n = 3$)	35.3% ($n = 6$)
I would have preferred to participate in the program face-to-face.	5.9% ($n = 1$)	11.8% ($n = 2$)	5.9% ($n = 1$)	23.5% ($n = 4$)	52.9% ($n = 9$)
I felt comfortable using video conferencing and was able to express myself effectively with the professionals.	70.6% ($n = 12$)	23.5% ($n = 4$)	5.9% ($n = 1$)		
Through video conferencing, I was able to communicate with professionals as if I were there in person.	58.8% ($n = 10$)	23.5% ($n = 4$)	11.8% ($n = 2$)	5.9% ($n = 1$)	
It was easy to access the online sessions.	23.5% ($n = 4$)	29.4% ($n = 5$)	23.5% ($n = 4$)	23.5% ($n = 4$)	
The <i>Microsoft Teams</i> platform was easy to use.	23.5% ($n = 4$)	41.2% ($n = 7$)	17.6% ($n = 3$)	11.8% ($n = 2$)	5.9% ($n = 1$)
Completed by child ($n = 12$)					
I felt satisfied with the online sessions.	66.7% ($n = 8$)	25.0% ($n = 3$)			8.3% ($n = 1$)
If the sessions had been face-to-face, I would have been more attentive and motivated.	33.3% ($n = 4$)	16.7% ($n = 2$)	25.0% ($n = 3$)	16.7% ($n = 2$)	8.3% ($n = 1$)
I would have preferred to participate in the program face-to-face.	50.0% ($n = 6$)	8.3% ($n = 1$)		16.7% ($n = 2$)	25.0% ($n = 3$)
Through the video conference, I felt comfortable and could express myself effectively with the professionals.	83.3% ($n = 10$)	8.3% ($n = 1$)			8.3% ($n = 1$)
I found the <i>ClassDojo</i> platform easy to use.	58.3% ($n = 7$)	25.0% ($n = 3$)	8.3% ($n = 1$)		8.3% ($n = 1$)

Note. E-Health refers to delivering sessions through synchronous video conferencing. $n=17$ parents and $n=12$ children.

strongly preferred the program to have been held in person. Moreover, 83.3% ($n = 10$) strongly agreed that “Through the videoconference, I felt comfortable and could express myself effectively with the professionals”. When asked in open format about the advantages of the Telehealth format, some of the responses were: “I could express myself better”, “I didn’t have to travel or reschedule”, “I had time to do homework before connecting”, “we were less embarrassed”. Among the disadvantages, some comments were: “none”, “I get distracted a lot”, “we can’t see each other in person”, “I occasionally lost connection”, and “We couldn’t meet in person”. Finally, when asked about their preference for having completed the program in a face-to-face format, participants’ responses mainly highlighted aspects related to social interaction and perceived enjoyment of the experience, such as: “I think it would have been more fun”, “we would have spent more time together, as a team”, “it is more enjoyable”, and “I prefer seeing people in real life”.

General Satisfaction with the ENTREN-Galaxy Program

The overall satisfaction with the ENTREN-Galaxy program was high for both children ($M = 9.00$; $SD = 0.74$) and parents ($M = 8.00$; $SD = 2.09$). All children (100%, $n=12$) and 88.2% of parents ($n = 15$) indicated they would recommend the program to other families. 50% of the children ($n = 6$) perceived the strategies learned as very useful (33.3% useful; 16.7% moderately useful). On the other hand, 47.1% of parents ($n = 8$) rated them as useful (41.2% very useful; 11.8% not very useful).

Most of the children (91.7%; $n = 11$) and 76.5% of the parents ($n = 13$) stated that the program had resulted in a change in their healthy lifestyle habits. When asked in an open-ended format about the modified habits and strategies used, most parents highlighted changes in the level of physical activity and eating habits. For example: “I perceive her as more sensitive to having healthy physical activity and food habits”, “the strategy of counting steps has been very useful and motivating”, “healthier eating for the whole family”, “moving, acquiring healthy habits, how to manage food cravings”. One of the parents mentioned one of the missions related to emotional regulation: “We have used mission 10. Stop. Think. Breathe. As for

the children, some of the responses were: “not to sit so much and the benefits of some meals”, “not to care about what people tell me”, “the step strategy because it has helped me to walk more”, “that it is very important to exercise and eat healthy”.

Among parents, 52.9% ($n = 9$) rated the content of the children’s sessions as very suitable (35.3% suitable; 5.9% somewhat suitable; 5.9% not very suitable). 47.1% of parents ($n = 8$) perceived the content of the webinars as very suitable (47.1% suitable; 5.9% somewhat suitable).

A total of 35.3% parents ($n = 6$) reported that their child was motivated to participate in the sessions (23.5% somewhat motivated, 23.5% slightly motivated, and 17.6% very motivated). In addition, 47.1% of parents agreed with the item “your child was interested in the content of the program” (29.4% strongly agree, 17.6% neither agree nor disagree, and 5.9% disagree).

A total of 15 children were enrolled in the intervention, of whom 12 completed the program, resulting in an attrition rate of 20%.

The Preliminary Impact of the ENTREN-Galaxy Program on Children’s Outcomes

Given the small sample size and the lack of a control group, the following findings regarding the program’s impact on clinical outcomes should be interpreted as preliminary and descriptive, and no causal inferences can be drawn.

Children’s Psychological Well-being

Regarding the psychological well-being of the children, all three outcome measures showed descriptive changes in the expected direction, with a decrease in depression and anxiety, and an increase in body esteem, particularly from baseline to post-intervention. Effect sizes were medium, ranging from 0.30 to 0.41. However, none of these changes reached statistical significance, as presented in Table 3.

Children’s Lifestyle Habits (Nutrition and Physical Activity)

The results indicated no statistically significant differences in nutritional habit scores (KIDMED) across the three time

Table 3. Distribution of children’s scores over time (T_0 , T_1 and T_2): results of the Friedman Test and Effect Size Statistics ($n = 15$).

Variables	Baseline (T_0) M (SD)	Post-intervention (T_1) M (SD)	Follow-up (T_2) M (SD)	Global Comparisons $T_0-T_1-T_2$ Statistical ^z (p)	Paired Comparisons		
					T_0-T_1	T_0-T_2	T_1-T_2
Effect Size							
Depression (CDI)	8.83 (3.76)	7.42 (7.96)	7.92 (8.83)	5.89 (0.05)	0.30	0.19	0.16
Anxiety (SCAS)	26.83 (13.70)	23.08 (17.93)	25.33 (19.44)	2.39 (0.30)	0.32	0.14	0.08
Body Esteem (BES)	14.08 (6.85)	16.58 (5.21)	15.91 (6.33)	1.69 (0.43)	0.41	0.29	0.08
Adherence to the Mediterranean Diet (KIDMED)	7.72 (3.06)	8.08 (1.88)	7.92 (2.06)	0.32 (0.85)	0.16	0.10	0.17
Physical Activity (PAU-7S)	94.46 (58.72)	117.14 (52.66)	121.43 (55.26)	8.19 (0.017)	0.36	0.45*	0.19
Emotional Eating (DEBQ-C)	1.25 (0.62)	1.08 (0.18)	1.07 (0.18)	0.50 (0.78)	0.15	0.22	0.20
External Eating (DEBQ-C)	2.07 (0.59)	1.75 (0.47)	1.67 (0.59)	5.09 (0.08)	0.44	0.42	0.26
Restriction (DEBQ-C)	1.86 (0.56)	1.83 (0.56)	1.92 (0.61)	2.74 (0.25)	0.05	0.08	0.25
z-BMI	2.15 (0.83)	1.97 (0.87)	1.96 (0.93)	3.37 (0.18)	0.30	0.15	0.25

Note. $n = 12$ children; M = mean; SD = standard deviation; z-BMI = BMI adjusted for age and sex differences among children; CDI = Children’s Depression Inventory; SCAS = Spence Children’s Anxiety Scale. BES = Body Esteem Scale; DEBQ-C = Dutch Eating Behaviour Questionnaire for Children; KIDMED = KIDMED questionnaire; PAU-7S = Physical Activity Unit 7 Item Screener; ^z = χ^2 Friedman test; Effect size = derived from Wilcoxon Signed Rank Tests, calculated by dividing the z-value by the square root of N (number of observations over the two time points); p = significant ($p < .05$) or with a trend towards significance ($p = 0.05-0.20$). *Significant ($p < .05$) according to post hoc test (with Bonferroni correction for multiple testing).

points, with effect sizes categorized as small (0.10-0.17). Conversely, a statistically significant difference was observed in physical activity scores (PAU-7S) across the three time points ($\chi^2 = 8.19$, $p = 0.017$). Specifically, there was an increase in average daily minutes of physical activity from pre-intervention ($MT0 = 94.46$) to post-intervention ($MT1 = 117.14$) and follow-up ($MT2 = 121.43$). Post-hoc tests, adjusted with Bonferroni correction showed significant differences between T0 and T2, from small to medium (0.19-0.45). In terms of eating behaviors, no statistically significant differences were found in restrained, emotional, or external eating (DEBQ-C). However, effect sizes for external eating were medium, suggesting a possible decrease, from 0.26 to 0.44.

Children's Anthropometric Variables

As evidenced in Table 3, results revealed no statistically significant differences in z-BMI scores across the three time points. Effect sizes were small to medium (0.15 to 0.30).

The Preliminary Impact of the ENTREN-Galaxy Program on Family-related Outcomes

As shown in Table 4, analysis of parental feeding practices revealed no significant changes in the restriction scores (CFQ). Monitoring practices exhibited a descriptive downward pattern, with scores decreasing from baseline to post-intervention, and further decreasing at follow-up.

Regarding parental modeling and policies related to physical activity (HES-S-PA), with respect to the availability of physical activity, statistical analysis did not indicate significant differences across the three time points and the overall effect size was small. Notably, a moderate effect size of 0.43 was observed between baseline ($MT0 = 10.83$) and follow-up ($MT2 = 11.83$), which was statistically significant according to Bonferroni correction. Regarding accessibility and modeling in physical activity scores, there were no significant changes. Regarding parental perceptions of problematic lifestyle behaviors in their children, statistical analyses did not reveal significant differences over time.

Discussion

The main aim of this exploratory pilot study was to examine the acceptability and preliminary impact of the pilot program ENTREN-Galaxy. This interdisciplinary and psycho-family intervention aims to improve the overall health of children with obesity through an innovative approach that incorporates e-Health and gamification.

Overall, the findings support the first hypothesis, indicating that the e-Health delivery method of the ENTREN-Galaxy program is highly acceptable, satisfactory, and useful for participants. Moreover, the program was generally rated as highly satisfactory by both parents and children. Consistent with prior studies, most participants perceived the e-Health modality of the ENTREN-Galaxy program as enhancing accessibility by reducing transportation and time barriers, and as being comparable to face-to-face interventions (Chai et al., 2021; Cohen et al., 2012; Fleischman et al., 2016). For these reasons, most parents in the study preferred to participate in the program via e-Health, as it provided greater convenience for their families. Delivering sessions via technology, further enhances accessibility by addressing barriers even within metropolitan areas, such as rising fuel costs and traffic congestion (Slusser et al., 2016). Moreover, the observed adherence rate of 80% (12 out of 15 participants completing the program) supports the acceptability of the intervention. This rate is higher than those typically reported in childhood obesity interventions, which range from 27% to 73% (Skelton & Beech, 2011). Similarly, most children and parents perceived the program content and sessions as satisfactory and useful, and reported that they would recommend the program to other children and families. Overall, these findings provide preliminary evidence supporting the acceptability of the program in a real-world clinical context. An important point to highlight is that most participants perceived that this new modality did not negatively impact the quality of the program. They felt comfortable expressing themselves and were able to communicate in the same way as they would in a face-to-face setting. In the open-ended questions,

Table 4. Distribution of mothers' scores over time (T_0 , T_1 and T_2): results of the Friedman Test and Effect Size Statistics ($n = 15$).

Variables	Baseline (T ₀) M (SD)	Post-intervention (T ₁) M (SD)	Follow-up (T ₂) M (SD)	Global Comparisons T ₀ -T ₁ -T ₂ Statistical ^z (p)	Paired Comparisons		
					T ₀ -T ₁	T ₀ -T ₂	T ₁ -T ₂
					Effect Size		
Restriction (CFQ)	3.00 (0.60)	3.02 (0.42)	2.88 (0.51)	1.56 (0.46)	0.01	0.25	0.24
Pressure to eat (CFQ)	1.50 (1.12)	1.25 (0.32)	1.33 (0.37)	1.23 (0.54)	0.03	0.07	0.27
Monitoring (CFQ)	4.25 (0.70)	4.00 (0.90)	3.75 (0.89)	5.36 (0.07)	0.30	0.42	0.30
Availability of Physical Activity (HES-PA)	10.83 (2.33)	11.42 (2.43)	11.83 (2.17)	3.16 (0.20)	0.20	0.43*	0.15
Accessibility of Physical Activity (HES-PA)	2.63 (0.75)	2.65 (0.58)	2.88 (0.72)	3.06 (0.22)	0.07	0.30	0.30
Modeling in Physical Activity (HES-PA)	2.24 (0.65)	2.11 (0.60)	2.25 (0.37)	2.18 (0.34)	0.17	0.04	0.24
Parental support in Physical Activity (HES-PA)	2.55 (0.51)	2.62 (0.43)	2.67 (0.38)	2.32 (0.31)	0.12	0.28	0.13
Dysfunctional Behaviors in lifestyle habits (LBC)	72.33 (26.85)	72.33 (28.16)	67.00 (28.82)	4.44 (0.11)	0.01	0.28	0.45*

Note. $n = 12$ mothers; M = mean; SD = standard deviation; CFQ = Child Feeding Questionnaire; HES-PA = Physical Activity module of the Home Environment Survey; LBC = Problem Scale of the Lifestyle Behaviour Checklist; ^z = χ^2 Friedman test; Effect size = derived from Wilcoxon Signed Rank Tests, calculated by dividing the z-value by the square root of N (number of observations over the two time points); p = significant ($p < .05$) or with a trend towards significance ($p = 0.05-0.20$). *Significant ($p < .05$) according to post hoc test (with Bonferroni correction for multiple testing).

children highlighted several advantages of e-Health, not only citing time savings but also emotional benefits, such as feeling more comfortable expressing themselves and experiencing less embarrassment. This aligns with findings from other studies, such as Slusser et al. (2016), which also emphasize that conducting sessions remotely, in a location chosen by the family, can provide a sense of protection and security, encouraging communication without fear of judgment. Children with obesity may engage more in programs if they feel safe from stigma and teasing.

Although most children reported being satisfied with the online sessions, many indicated that they would have felt more motivated and attentive if the program had been delivered in person, and most expressed a preference for a face-to-face format. This finding is noteworthy and suggests that future research should examine whether delivering the program in person, rather than via videoconference, may yield different outcomes. It is also important to consider whether the increased accessibility afforded by the e-Health format, one of its main advantages for parents, may be associated with lower levels of motivation or satisfaction among children. Depending on the specific family context, a balance may need to be struck between ensuring access to such programs and accommodating children's preferences regarding the delivery modality.

The secondary aim was to explore potential improvements in children's psychological well-being, lifestyle habits, weight status, and family environment at the end of the intervention. Due to the small sample size, the study was likely underpowered to assess the efficacy of the results. Accordingly, the following results are interpreted as exploratory and descriptive, without implying causal effects. In relation to the psychological well-being outcomes, descriptively, mean scores decreased in depressive and anxiety symptoms (CDI and SCAS), especially from baseline to post-intervention, although these changes were non-significant, with effect sizes ranging from small to medium. This is in line with the findings of ENTREN-F, which demonstrated significant reductions in these variables (Sepúlveda et al., 2020). Furthermore, mean scores increased in body esteem (BES). However, these changes did not reach statistical significance. Despite being a variable often overlooked in both the content of interventions and their outcomes, a recent meta-analysis highlights the potential of multicomponent programs to improve this variable (Gow et al., 2020).

Regarding healthy lifestyle habits, in terms of nutrition, we observed a descriptive non-significant increase in mean adherence to the Mediterranean diet (KIDMED) alongside a non-significant decrease in mean scores in risky eating behaviors (DEBQ-C), particularly concerning emotional eating. These findings are consistent with those from similar research studies (Chai et al., 2021; Davis et al., 2013; Enright, 2020). Furthermore, physical activity levels (PAU-7S) significantly increased following the intervention, similar to previous evidence (Davis et al., 2013; Enright, 2020; Sepúlveda et al., 2020). The use of gamification elements - reinforcing physical activity missions through badges and points - may have had a particularly impactful effect on this outcome.

With regard to the anthropometric outcomes, participants exhibited a non-significant decrease in mean *z*-BMI scores, with a medium effect size, following the ENTREN-Galaxy program. This is, consistent with the results of the majority of

family-based multicomponent programs, both in face-to-face (Chai et al., 2019; Elvsaas et al., 2017; Sepúlveda et al., 2024) and e-Health delivery methods (Davis et al., 2013; Fleischman et al., 2016).

Concerning family outcomes, specifically parental feeding practices (CFQ), mean monitoring scores decreased among mothers, without reaching statistical significance. Furthermore, perceived dysfunctional behaviors related to their children's health habits (LBC) significantly decreased between post-intervention and follow-up outcomes. This may suggest that changes in the family environment require time to manifest and be recognized. Additionally, mean scores increased in the availability and accessibility of resources and equipment, along with greater parental support for physical activity (HES-S-PA). Collectively, these findings suggest that involving parents as agents of change can positively influence the family environment, which in turn impacts the lifestyle habits and well-being of children (Chai et al., 2019; Sepúlveda et al., 2024).

From the perspective of both children and families, as derived from the acceptability questionnaire, most participants reported perceived changes in their lifestyle habits following the intervention, suggesting that the program may have been experienced as relevant and applicable to daily life. Although these findings are based on self-reported perceptions and should therefore be interpreted with caution, they provide preliminary support for the potential of the intervention to promote behavior change.

Study Limitations

Despite the encouraging results, this study has several limitations that should be addressed in future research. Firstly, the small sample size and specific characteristics of the participants limit the validity of the findings and restrict their generalizability. For example, all participating families were from a middle-to-high socioeconomic background and lived in urban areas of the Community of Madrid. Therefore, the perceived advantages of the e-Health format may not generalize to more rural or less densely populated settings, where different experiences and needs may emerge. The sample size was insufficient to provide the statistical power necessary to identify significant changes. Moreover, the result of the HES-S-PA Accessibility subscale should be interpreted with caution, when considering internal consistency. However, we were able to observe some descriptive changes, as indicated by some psychological well-being, lifestyle habits, weight status, and family environment measures. Second, the lack of a control group precludes any conclusions about the causal relationship between the program and the observed changes in the dependent variables. It is possible that the changes may be attributed to non-specific effects. Thirdly, although open-ended questions were included in the satisfaction questionnaire, a more in-depth qualitative approach, such as focus groups, could not be conducted. This limitation may have reduced the depth of the information obtained regarding participants' experiences and perceptions. Another limitation of the present study is that conclusions regarding the acceptability and perceived equivalence of the e-Health format compared to face-to-face delivery are based solely on participants' perceptions, without a direct comparative evaluation between modalities. Although families

reported a high level of satisfaction with the online format, it remains unclear whether similar or different outcomes would have been observed under face-to-face conditions. Therefore, the findings should be interpreted with caution in this regard.

Nevertheless, conducting a pilot study enables us to identify which components of the program require adjustment before a full-scale randomized controlled trial. It also helps evaluate the protocol for variables that appear sensitive to change and assess the program's acceptability among children and their parents. In this regard, the acceptability results indicate that some participants found the digital platforms difficult to use. In response, a unified digital platform is currently being developed to integrate videoconferencing and gamified tasks within a single environment, simplifying access and navigation. This platform incorporates a more intuitive design aligned with the program's galactic narrative, and automates key processes such as the allocation of points and badges, which were previously managed manually. Additionally, to address a decline in motivation observed mid-intervention to complete the missions, symbolic rewards are exchanged midway through the program for tangible, activity-based incentives (e.g., balls, frisbees, or tennis paddles). These improvements are expected to enhance user experience and engagement, while also supporting scalability by reducing clinicians' workload and enabling more consistent reinforcement after mission completion. Finally, to further examine whether differences exist between the e-Health and face-to-face delivery formats, a larger-scale comparative study directly evaluating both versions of the program is currently underway, which will allow for a more robust assessment of their relative effectiveness and acceptability.

Implications for Practice

This study presents an innovative gamified e-Health delivery method, which was positively received by children and parents, yet is seldom used in comprehensive interventions of this nature despite its significant potential. This novel approach may enhance children's motivation by gamifying the experience while concurrently reducing logistical barriers. Overall, the findings highlight the promise of digital tools in enhancing weight interventions for childhood obesity.

Conflict of interest

The authors declare no conflicts of interest.

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