

Personalized online intervention based on a risk algorithm for the universal prevention of anxiety disorders: Design and development of the prevANS intervention

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Abstract

Objective: To describe the design and development of prevANS, a personalized online intervention for the universal prevention of anxiety disorders based on a predictive risk algorithm. A user-centered approach was followed, considering the feedback of potential users and mental health professionals.

Methods: The study had three phases: (a) designing the intervention based on existing scientific literature; (b) piloting and evaluating the beta version involving potential users and health professionals; and (c) refining the intervention based on participants' suggestions. This iterative process aimed to refine the prevANS intervention before testing in a randomized controlled trial.

Results: The prevANS intervention provides personalized anxiety risk reports and components tailored to individuals' needs. Participants at low risk receive psychoeducation and access to a set of tools to enhance protective factors. Moderate/high-risk individuals also receive cognitive-behavioral training. Both groups have access to a reward system and forum. Results from the design evaluation indicate that the prevANS interface is attractive and user-friendly and the psychoeducational materials helpful and engaging. The cognitive-behavioral training module received positive feedback. Participants suggested changes related to usability, content clarity, attractiveness, and engagement, which were implemented afterwards.

Conclusions: This article describes the development of a personalized intervention for preventing anxiety disorders using a validated risk prediction algorithm. The prevANS intervention was designed based on current scientific literature by a team of experts employing a user-centered approach. Research on the effectiveness of information and communication technologies in mental health prevention interventions considering user needs and preferences is warranted.

Keywords

Prevention, risk algorithm, mental health, anxiety disorders, internet-based interventions, mobile-based interventions

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Introduction

Anxiety disorders are among the most prevalent mental disorders globally,^{1,2} with increasing numbers due to the impact of the COVID-19 pandemic.³ According to the Global Burden of Disease study (GBD), around 300 million people had an anxiety disorder in 2020, and after adjusting for the COVID-19 pandemic, the estimates increased by 25.6% on average, reaching 374 million (320–436) people.² Moreover, regarding the burden of anxiety in terms of DALYs (disability-adjusted life-years), it is stated that these disorders caused 44.5 million (30.2–62.5) DALYs globally in 2020.⁴ Furthermore, anxiety disorders have a significant economic impact on healthcare systems, as demonstrated by a recent study showing that anxiety disorders account for an average of \$135 billion in healthcare expenses annually among countries in the Organization for Economic Cooperation and Development.⁵ These data highlight that anxiety disorders constitute a major public health concern due to their worldwide impact on health loss.⁶ Indeed, the promotion of better mental health and well-being has been identified as a priority internationally and is included as a target by the United Nations Sustainable Goal 3, “Good health and well-being.”⁷

Despite the fact that there are effective treatments for anxiety disorders,^{8,9} these treatments alone may not be enough to address the significant burden and impact of these disorders. This is due to the new cases of anxiety, which can only be reduced through preventive measures aimed at promoting mental health, well-being, and resilience. Though the effect size of preventive interventions for anxiety disorders may be small,^{10–12} their generalization and scalability to larger populations could have a meaningful impact on improving overall health, reducing economic and social costs, and enhancing quality of life.

One promising avenue for reaching large populations with evidence-based preventive interventions for anxiety is using information and communication technologies (ICTs), such as mobile devices like smartphones and tablets. These technologies have become ubiquitous, with an estimated 3.8 billion people owning a smartphone globally by 2021.¹³ Therefore, using ICTs could offer a unique opportunity to deliver preventive interventions.¹⁴ Research has shown that digital interventions for treating mental health disorders, including anxiety disorders, are effective,^{15,16} while studies focusing on preventive digital interventions have also shown promising data.^{17,18} In this vein, a recent meta-analysis examining the efficacy of self-guided internet and mobile-based interventions for preventing anxiety showed a small but significant effect in reducing anxiety symptoms in the short-term.¹⁹ However, the authors highlighted that most preventive interventions were indicated or selective, and few studies have been conducted assessing universal prevention interventions. Therefore,

designing and assessing universal preventive interventions tailored to individual needs, using robust and high-quality methods, and including long-term follow-ups is warranted.

An additional challenge for prevention efforts is the multi-factorial nature of anxiety disorders since multiple factors have been related to the onset and continuation of anxiety disorders.^{20,21} For instance, sociodemographic variables such as gender or ethnicity,²² lifetime depression,²³ financial strain,²⁴ alcohol and substance use,²⁵ or childhood adversity²⁶ have been found as risk factors for anxiety disorder development. In order to overcome this challenge, studies have been conducted to identify and validate risk factor identification tools.²⁷ Rosellini et al.,²⁸ using a machine learning approach, developed several algorithms to predict the first onset of internalizing disorders, including generalized anxiety disorder, panic disorder, social phobia, depression, and mania. Another example is the PredictA risk algorithm developed in primary care attendees without anxiety disorders in four European countries,²⁹ including Spain,³⁰ which has been shown to be effective in detecting early at-risk populations by predicting anxiety disorders at 12 months. The predictA risk algorithm includes eight risk factors (sex, age, physical and mental quality of life, dissatisfaction with paid and unpaid work, financial difficulties, medication for anxiety, depression, or stress) and has shown good calibration and discriminant validity (C-Index = 0.80).³⁰ These risk prediction algorithms could be useful for preventive efforts as they allow the identification of individuals at the highest risk and also a greater personalization of preventive interventions based on the specific risk factors of each individual. The next step is testing whether applying a risk algorithm for tailoring preventive interventions to the risk level of each individual is effective in reducing the incidence of anxiety disorders.

Following this idea, in the current study, we describe the design and development process of prevANS, a personalized online intervention (delivered through a smartphone app or via the web) based on a risk algorithm (PredictA) for the universal prevention of anxiety disorders in the general population. Recent research suggests involving users and health professionals in designing mental health apps can lead to more effective and widely accepted interventions.³¹ As a result, a user-centered design strategy was used, including potential users and mental health professionals, to provide information about usability, attractiveness, engagement, and content utility.

Methods

The present study follows a descriptive-qualitative approach with a three-phase procedure: (a) design and development, (b) piloting and design evaluation, and (c) changes and intervention refinement (Figure 1).

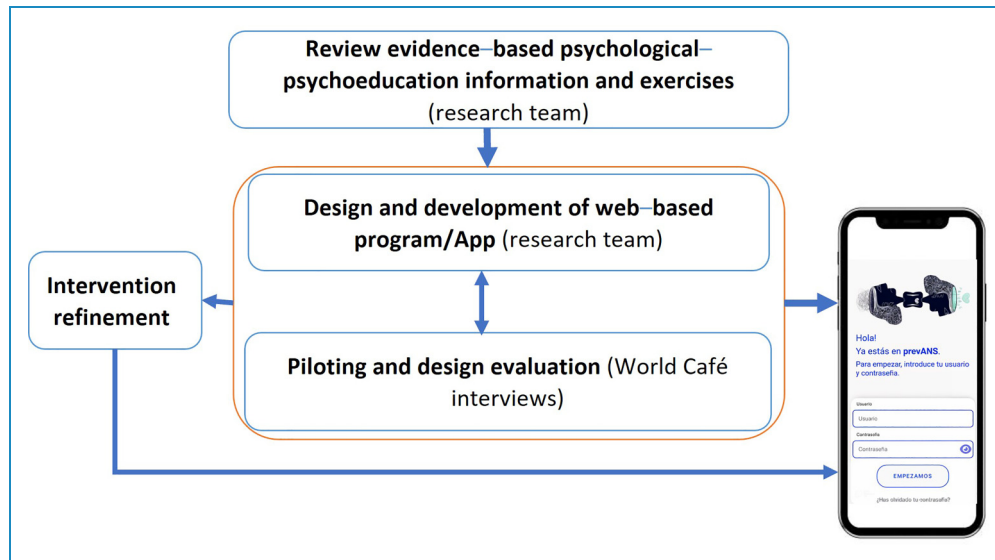


Figure 1. Overview of the three phases procedure used to design the prevANS intervention.

Design and development

This preventive intervention was designed as part of the prevANS project,³² which aims to establish the effectiveness of a personalized and self-guided intervention to prevent anxiety disorders through a randomized controlled trial (NCT05682365).³² The research team that developed the intervention comprised five health and clinical psychologists from the University of Malaga, the University of Santiago de Compostela, and the Malaga Biomedical Research Institute and Nanomedicine Platform. Weekly work sessions of the research team were conducted in which the design and intervention content was discussed and reviewed. In addition, a graphic designer was involved in the esthetic design, and a technology-based company specializing in the eHealth sector led the software development. This process to obtain a beta version lasted for approximately 10 months (December 2021 to October 2022).

The PrevANS content was designed from psychoeducational, mindfulness-based, and cognitive-behavioral interventions supported by the empirical literature, providing an evidence-based framework and theoretical grounding.^{11,33,34} Concretely, the cognitive-behavioral training module of the intervention was designed based on cognitive-behavioral therapy, which is premised on that maladaptive behaviors and cognitions are developed and maintained through associative learning in terms of classical and operant conditioning.³⁵ Therefore, it uses the learning principles to reduce symptoms and improve functioning targeting behavioral and cognitive processes involved in psychological disorders, including the identification of cognitive bias, changing negative thoughts, social skills training or problem-solving training.

Piloting and design evaluation

In order to test and improve the beta version of the prevANS intervention, a qualitative approach was followed using a sample of potential users and health professionals. The “World Café” method was conducted to gather information regarding the usability, content utility, attractiveness, and engagement of the prevANS app and website. This methodology is defined as “a simple yet powerful conversational process for fostering constructive dialogue, accessing collective intelligence and creating innovative possibilities for action,”³⁶ and it has been used to collect qualitative data and provide information on physical and mental health promotion and prevention.^{37,38} The World Café method consists of creating a comfortable and informal environment where people are seated at different tables (of 4–5 members each) and encouraged to engage in debates about one or more themes proposed by the host, creating what Brown and Isaacs refer to as “conversations that matter.”³⁶ At the end of each conversation round, which usually lasts between 20 and 30 minutes, participants are randomized again into new tables with the aim of enriching their new group with previous conclusions and listening to new insights from the people in the new table. During the whole process, everyone is able to write or draw whatever they consider useful in the center of the table, using a board or a paper tablecloth, which the other members can see and interact with. Finally, all the conclusions from each table are shared with the rest of the group.³⁶

For this study, the target participants included health-related professionals and potential users of the preventive intervention. A total of 17 participants were invited purposefully through professional and colleague contacts of the research team by telephone or e-mail. In

this first contact, the main characteristics, procedures and objectives of the study were explained. Four of them refused to participate due to schedule incompatibilities, resulting in a sample of 13 participants (53.8% males; $M_{\text{age}} = 32.08$; $SD = 13.65$; age range = 21–69) of which nine were potential users (69.2%) and four were health-related professionals (30.8%) (three psychologists and one primary care physician). No specific eligibility criteria were used to select the participants, although not having an anxiety disorder diagnosis (self-informed) and providing informed consent was required to be part of the study. After verbally consenting to participate, they were given access to the moderate-to-high-risk modality of the prevANS intervention (via web), which was the most complete modality of the intervention, including all the components of the intervention. They were all instructed to test the web as much as possible for 5 days.

The World Café meeting was hosted in the University of Málaga's Psychology building on November 7th, 2022 and lasted for 2 hours approximately. The meeting was led by three of the research team professionals (all of them were female and had a Master degree in General Health Psychology).

After the hosts had introduced themselves, they gave a brief explanation of the main aim of this procedure, which was to gather information from their points of view in order to refine the beta version of prevANS and improve the engagement as much as possible. Then, the following steps were conducted: (a) participants were randomized into three groups of four to five participants, including at least one health professional per group; (b) the research team introduced a debate theme or question regarding one of these three topics: (i) facilitators (which aspects of the prevANS intervention have you found likeable, useful, or have made your experience easier?); (ii) barriers (which aspects of the prevANS intervention have you found unlikable, useless, or have worsened your experience?); and (iii) changes (which aspects of the prevANS intervention would you change, and how would you do it?). At that point, participants were asked to discuss their opinion for 25 to 30 minutes and to use a small board and sheets of paper to write or draw ideas if necessary; (c) then, when the members of the research team determined participant responses were repetitive/reoccurring and no new insights or information emerged, participants were asked to write the conclusions of their debate on a sheet of paper so that the research team could collect them; (d) finally, a new randomization was conducted, and this procedure was repeated three times. A researcher was present at each table as a facilitator during these processes. After the third round, when all the topics had been discussed, the final conclusions were shared with the rest of the participants. Then, the research team collected all the sheets of paper, photographed the annotations on the small boards and thanked the participants for their collaboration.

Changes and intervention refinement

After the World Café session, a research team member transcribed all the information from the papers and boards to a digital document and shared it with the complete research team. Then, a meeting was scheduled to analyze the qualitative information gathered using a deductive thematic analysis approach regarding the following topics: (a) usability (the degree to which the prevANS web was easy to use); (b) content utility (the degree to which the prevANS components were perceived as relevant and useful in a practical way daily); (c) attractiveness (the degree to which it was visually pleasing); and (d) engagement (the degree to which it encouraged people to be interested in using the intervention). These themes were selected based on previous research highlighting the relevance of these aspects when designing technology-based mental health interventions.^{39,40}

Finally, possible changes in the intervention according to the suggestions made by the participants were discussed among the research team, discarding those changes or suggestions that would have compromised the study methodology/budget (i.e. “making the questionnaires shorter”; “including a night mode”) or contradicted previous research results (i.e. “not providing information about the risk probability as it could have a negative effect”).

Ethics

The Ethics and Research Regional Committee of Malaga approved this study (CEIPM 27/01/2022). Participants involved in the World Café signed a written informed consent form to participate.

Results

Design and development

An overview of the prevANS intervention according to the risk level for anxiety disorder is displayed in Figure 2. The research group designed the content of the prevANS intervention based on the following thematic blocks/components:

- (a) A report based on the PredictA algorithm offering information about participant's protective and risk factors with specific suggestions for addressing them briefly in plain Spanish is provided (see Figure 3 and Supplementary Material). Participants also receive information about the probability of having clinical anxiety in the next year from a positive perspective and enhancing participants' resources (e.g. “*Maria, despite being exposed to circumstances or factors that make it more probable that you will experience anxiety in the next year, you are not currently*”).

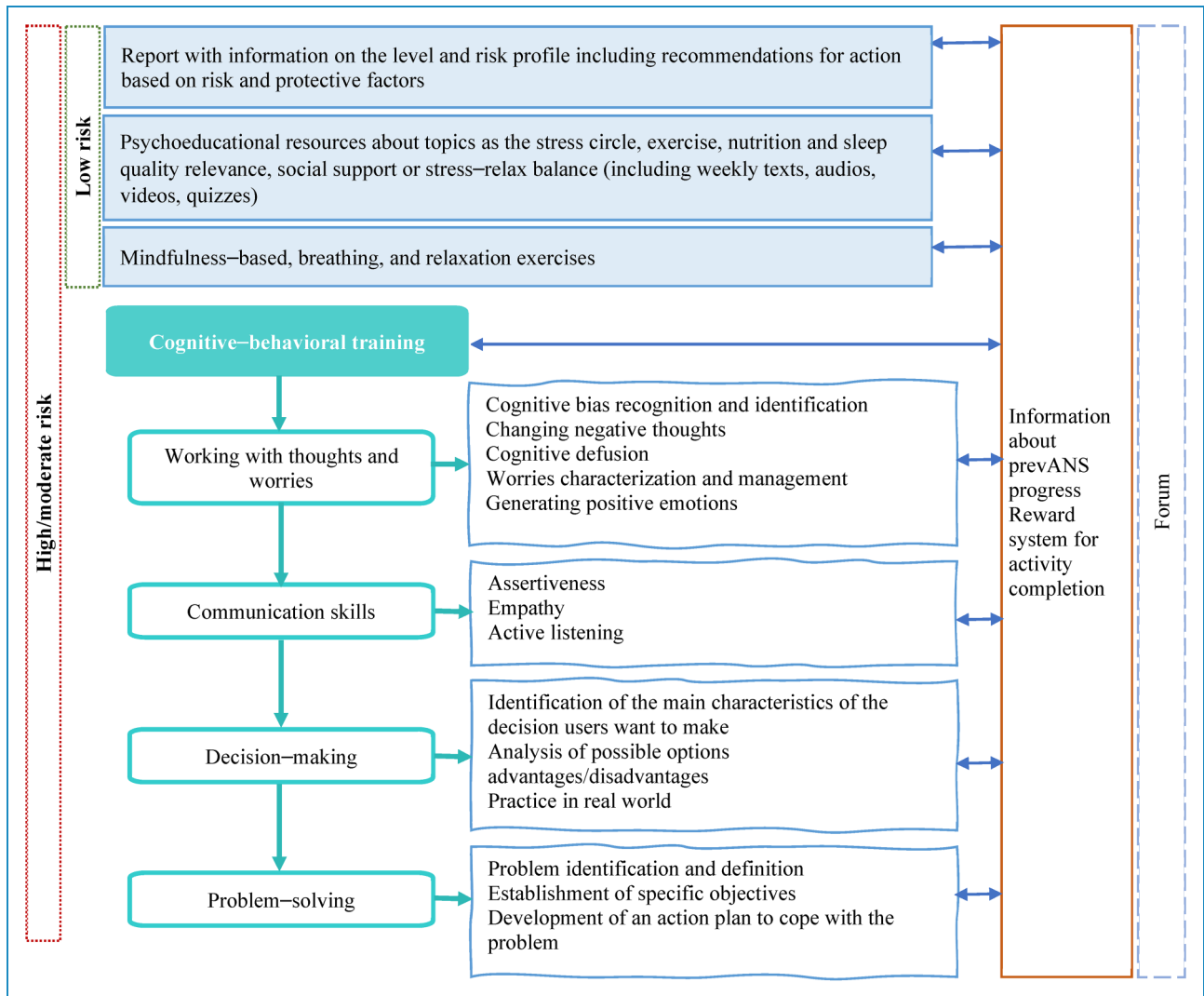


Figure 2. Summary of components of the prevANS intervention.

experiencing anxiety. Congrats! The results indicate a probability of 43.5%, which suggests that some aspects of your life could be improved so your mental and physical health would be more satisfactory. We encourage you to use all the tools available at prevANS. These tools are designed to provide resources that help you feel better physically and mentally.”). After receiving their risk reports, participants are classified through the predictA risk algorithm into: (a) low risk (probability of suffering anxiety $\leq 7\%$) or (b) moderate/high risk (probability of suffering anxiety above 7%). This classification is based on the predictA study validation³⁰ and refers to the 50th percentile of the scores on the probability of risk of having anxiety disorders in the next year. This threshold has been used to rank the participants as low versus moderate/high risk and, consequently, to personalize the intensity of the intervention so that participants with

a low risk receive a psychoeducational intervention and have access to a series of mindfulness-based, breathing, and relaxation-guided exercises, while participants with moderate/high risk additionally receive cognitive-behavioral training.

- (b) Common features and components for both low and moderate/high risk of anxiety (see Supplementary Material):

- (i) *Psychoeducation.* This component consists of a series of audios, videos, texts, and quizzes that provide information regarding topics such as the stress circle, exercise, nutrition and sleep quality relevance, and social support importance, among others. Participants receive one text, audio, video or quiz per week following an alternate sequence (i.e. week 1: an audio; week 2: a text; week 3: a quiz; week 4: a video). In addition, the web/app interface has videos explaining what



Figure 3. Screen of the predictA reports upon completing the questionnaires in which participants receive information related to their risk and protective factors (previous mental health problems, job satisfaction, social support, etc.) and the probability of developing anxiety in the next year.

anxiety is, the prevANS intervention, and information about the balance between risk and protective factors.

- (ii) *Tools for managing stressors and enhancing protective factors.* This component consists of mindfulness-based, breathing, and relaxation-guided exercises.
- (iii) *Reward system for activity completion.* A system of reinforcers for activity completion was designed to increase intervention engagement.
- (iv) *Forum to share thoughts, experiences, and opinions with other participants.* This tool consisted of a set of sections where open-ended questions related to the prevANS intervention were posted by the research team (for instance, “Which strategies to manage anxiety are more useful to you?” or “What are your thoughts about the materials offered in the App?”). The forum is moderated

by the research staff, and users only can post anonymously and interact with other posts through “likes.”

- (c) *Cognitive-behavioral training (only for moderate/high risk of anxiety)* including (see Supplementary Material):
 - (i) The working with thoughts module intends to reduce automatic negative thoughts and worries (Figure 4). For this, participants are instructed to understand cognitive bias and recognize their most frequent automatic negative thoughts to finally change them and turn them into positive thoughts. The module also includes a section on cognitive defusion, aimed at making participants more aware of their thoughts as just thoughts (rather than reality), leading to more adaptive behavior. Regarding the worries section, the main goal is to analyze the nature of worries by



Figure 4. Screen of the working with thoughts module included in the cognitive-behavioral training, only available for moderate/high risk of anxiety, in which different exercises and tools are available to identify cognitive bias and work with automatic negative thoughts to change them into more adaptive thoughts.

ranking them by relevance and priority and reducing them through monitoring, relaxing exercises, mindfulness, and psychoeducation. Finally, a section for generating positive emotions is also included. In this section, participants are trained to identify positive moments in life and the positive emotions associated with them so they can evoke them when necessary. Participants are also recommended to write a gratitude journal.

- (ii) **Communication skills module.** Participants are instructed regarding effective communication principles and related difficulties. This includes exercises addressing assertiveness, empathy, and active listening. In the assertiveness section, participants learn to identify assertive behaviors and strategies about how to say “no,” make a request, or defend their ideas and opinions, working with a series of situations in which they have to identify the assertive answer receiving feedback afterwards. In the empathy section, participants receive information regarding what empathy is and how it is related to communication and social relationships. They also work with a series of empathy-related sentences and receive feedback accordingly. In the same line,

in the active listening section, participants receive information about the verbal and non-verbal components of this skill and its impact on communication. They also work with different situations in which they have to identify whether active listening is happening and receive feedback after each answer. Finally, participants are encouraged to apply what they have learned in real-life contexts.

- (iii) **The decision-making module** instructs participants to apply several steps based on decision-making strategies. First, participants are guided to specify the main characteristics of the decision they want to make. Then, the advantages and disadvantages of the possible options are assessed and analyzed. Participants are encouraged to practice these strategies in a natural context.
- (iv) **Problem-solving module.** The aim of this module is to help participants adopt a more effective way to cope with problems. This section includes interactive exercises to apply problem-solving strategies, aiming to identify and define a problem, transform the problem into a specific objective, and develop an action plan to cope with the problem and reduce the associated distress.

Results of piloting and design evaluation

Information gathered from the World Café groups is summarized in Table 1, including those aspects mentioned as facilitators, barriers, and suggestions for change. Overall, participants pointed out that the prevANS interface was attractive, intuitive, and easy to use. When asked for usability improvement, participants suggested incorporating an “app tutorial,” adding explanatory videos, converting the main menu to a dropdown, and possibly resuming the videos if you close them before they finish.

Regarding the psychoeducational information, participants reported finding the material helpful and clear, although they noted that some materials were too basic. In addition, they commonly reported that the variety of formats to deliver such information was engaging (texts, audios, videos, quizzes). Suggestions for improvements were changing technique language, reducing text extension, including more images, and providing extended feedback on quizzes.

Generally, they also noted that the cognitive-behavioral training module was useful, including activities that made them feel like working on relevant aspects of mental health. Another relevant aspect is that participants found the app/web design attractive and visually pleasant. They also reported that the organization of activities, the lock/

Table 1. Information gathered from the World Café groups regarding facilitators, barriers, and suggestions for change in the intervention.

| | Facilitators | Barriers | Changes |
|------------------------|---|--|---|
| Usability | <p><i>“The interface is intuitive and learning how to use it is easy”</i></p> <p><i>“The dropdown home menus make following the intervention very simple and effortless”</i></p> <p><i>“The web allows you to download informative documents, so that you can access some of the information without having internet access”</i></p> | <p><i>“The initial questionnaires take too much time to complete and the web does not save the answers if someone exits before finishing them”</i></p> <p><i>“It lacks an app tutorial”</i></p> | <p><i>“Incorporating an app tutorial the first time you log in would be useful”</i></p> <p><i>“I would add some introductory videos”</i></p> <p><i>“Improving the mobile version will facilitate reading”</i></p> <p><i>“Converting the main menu to dropdown so that the icons do not cover the text”</i></p> <p><i>“Having the possibility to resume the videos if you close them before they finish”</i></p> |
| Content utility | <p><i>“The videos are very educational”</i></p> <p><i>“The activities are personalized and adequately explained”</i></p> <p><i>“The variety of very dynamic activities is something desirable”</i></p> <p><i>“I liked that the interpersonal problems module follows your social relationships and gives you advice”</i></p> <p><i>“The activities seem easy to do”</i></p> <p><i>“The app generally uses an accessible language and it conceptualizes the contents beforehand”</i></p> <p><i>“I liked that some of the activities have a quiz format”</i></p> <p><i>“The intervention makes you work”</i></p> <p><i>“The initial questionnaires are easy to complete, and the feedback they provide is reassuring”</i></p> | <p><i>“Knowing one’s risk probability may cause anxiety”^a</i></p> <p><i>“I found that some of the activities use more technical language, difficult to understand for non-health professionals”^a</i></p> <p><i>“Some activities with a quiz format seem too general or too basic in their content”</i></p> <p><i>“It may be a little intense for non-anxious users”</i></p> <p><i>“When choosing an incorrect answer, feedback about why it is wrong is sometimes missing”</i></p> | <p><i>“I would like to receive some feedback when I choose an incorrect answer”</i></p> |
| Attractiveness | <p><i>“The app is well organized and it has a correct color palette”^a</i></p> <p><i>“The used colors produce calmness”</i></p> <p><i>“It is visually pleasant for continuous use”</i></p> | <p><i>“It lacks of a dark mode”</i></p> <p><i>“It does not have enough images”</i></p> <p><i>“Some screens have too much text without the option of skipping it”^a</i></p> <p><i>“The videos are not personal, not attention-grabbing and sometimes boring”^a</i></p> | <p><i>“Reducing the amount of initial written information and making the rest of it more dynamic (using different methods such as tabs or dropdowns)”</i></p> <p><i>“Adding a dark mode is important”</i></p> <p><i>“Editing the videos and including images and some words on the screen would make a difference”^a</i></p> <p><i>“Adding more customization options like the possibility of uploading your own profile picture would be nice”</i></p> |
| Engagement | <p><i>“The freedom to use it whenever one wants, and spending any amount of time working on it”</i></p> <p><i>“The intervention does not punish</i></p> | <p><i>“The intervention does not really encourage its use”</i></p> <p><i>“The initial feedback received after the questionnaires may cause people to</i></p> | <p><i>“I would add the possibility of introducing one’s daily achievements so that they are</i></p> |

(continued)

Table 1. Continued.

| Facilitators | Barriers | Changes |
|---|---|--|
| <p><i>its disuse, but it rewards its use by giving “little gifts”, stars, and diplomas”</i></p> <p><i>“Being able to unlock some of the modules as one progresses is motivating and it also feels like a reward”</i></p> <p><i>“The app gives you positive reinforcement such as positive or motivational messages”</i></p> <p><i>“Knowing their anxiety risk probability can encourage people to work on the app with the goal of lowering their risk and also increasing their “protection level” on the stress-relax balance tab”</i></p> <p><i>“The format of the activities—presented as quizzes, games or weekly challenges—was enjoyable for me”</i></p> | <p><i>lose interest in the intervention itself, since they already know their risk probability”</i></p> <p><i>“Some people may get addicted to the reward system”</i></p> | <p><i>visible and accessible, for example, marking them with a tick”</i></p> |

aStatements whose content was given by more than one group independently.

unlock mode when completing a module, and the reward system were motivational and engaging.

Additional aspects for improvement were: including a “dark mode,” editing the videos to include some images and keywords, and adding customization options (i.e. uploading a profile picture).

Results on changes and intervention refinement

After reviewing the qualitative information extracted from the World Café method, a series of modifications were made in the final app/web version of the intervention. Overall, changes were related to improving the clarity of language, including more feedback, adding icons and gifs, and including notifications. A detailed description of all the changes included is summarized in Table 2.

Discussion

This paper describes the procedures for developing and designing a personalized intervention based on a validated risk prediction algorithm for preventing anxiety disorders. In recent years, there has been a growing interest in mHealth technology for improving mental health and promoting general well-being, resulting in increased use of these technologies in the prevention and treatment of mental health conditions such as anxiety. Despite the fact that ICTs can potentially improve access to care and enhance intervention outcomes,⁴¹ many mHealth

technologies lack a solid foundation based on current scientific evidence, and only a small percentage of them have undergone rigorous evaluation in randomized controlled trials.^{14,42} A main strength of the prevANS intervention is that a group of experts with clinical experience designed it after reviewing the current scientific literature and choosing the components based on the evidence for the prevention of anxiety disorders. Furthermore, since ICT-based interventions offer the advantage of being accessible at any time, location, and intensity, ensuring user engagement is essential. For this reason, a user-centered approach using the World Café method was adopted to develop the intervention. This involved testing the beta version of the prevANS intervention with a group of potential users and health professionals who provided feedback and contributed to improving the perceived utility of content, usability, attractiveness, and engagement, which are critical factors of mHealth that have been linked to intervention outcomes.^{43,44} Finally, the prevANS intervention will be tested in a full-powered randomized controlled trial,³² contributing to the limited research on digital preventive interventions targeting anxiety disorders.

Overall, most participants in the World Café agreed on the importance of the intervention being visually pleasing, with dynamic and edited videos, plain language, and a reduced amount of written information. Regarding “facilitators,” different aspects of usability, such as being easy to use and intuitive, the organization of the activities or the visual design, were identified as relevant aspects of the

Table 2. Changes made in the final version of the intervention after the World Café meeting.

| Barriers/suggested changes | Changes and improvements | |
|---|--------------------------|---|
| | Yes/ No | Updates made |
| Usability | | |
| Long initial questionnaires. | No | The app design was adapted, including smaller icons that do not interfere with the rest of the information on the screen. |
| Lack of an app tutorial/video about app use. | Yes | |
| Improving the mobile version to facilitate reading. | Yes | |
| Content utility | | |
| Risk associated with knowing one's anxiety risk probability. | Yes | Every 3 months, a message with the option of a free text response is sent in order to detect undesirable effects of the prevANS intervention. The contents were revised, and some words that could be considered more technical were clarified. In the quiz format activities, more feedback was added when the user selected either the correct or the incorrect answer. |
| Use of technical language. | Yes | |
| Too general/basic content. | Yes | |
| Lack of feedback in some activities. | Yes | |
| Attractiveness | | |
| Lack of dark mode. | No | More illustrations and GIFs were incorporated. The videos were edited, showing some important information on the screen at the same time it is mentioned in the video. Some of the information presented in the modules was converted into a dropdown system. |
| Not enough images. | Yes | |
| Too much text in some sections. | Yes | |
| Videos are not attention-grabbing. | Yes | |
| Lack of dynamism when providing the information. | Yes | |
| Adding more customization options. | No | |
| Engagement | | |
| The intervention does not really encourage its use. | Yes | A notification system was incorporated, so the app will send a notification to the user's phone whenever new material is available. |
| Knowing the risk level may cause people to lose interest in the intervention. | No | |
| Risk of addiction to the reward system. | No | |
| Adding the possibility of introducing one's daily achievements. | No | |

intervention, which aligns with previous literature.^{45,46} Concerning the “barriers,” some participants pointed out that knowing the risk level of having an anxiety disorder in the next 12 months could cause anxiety. According to

this concern raised by the participants, we incorporated the detection of undesirable effects of the prevANS intervention through a message with the option of free text response sent periodically every 3 months. It should be

noted that providing personalized and tailored information about individuals' risk has shown to have a positive impact on preventing depression and anxiety.^{47,48} Lastly, the proposed "changes" were mainly related to the lack of information about navigating the web/app, content, engagement or technological aspects, which are common issues reported in other studies.^{39,49} Following this approach allowed us to introduce changes in the web/app considering the experiences, preferences, and opinions of potential users to increase usability and engagement. By designing a preventive intervention delivered through ICTs with feedback from potential users and health professionals, we expect to increase the likelihood that prevANS will be well-received and utilized and potentially increase its effectiveness, as suggested by previous research.³¹

The present study has some limitations. First, a convenience sampling strategy was used for the qualitative research, which was geographically constrained to the region of Málaga, limiting the generalization of the results obtained. Secondly, the qualitative methodology has inherent potential bias related to coding and data interpretation. Future research is needed combining qualitative and quantitative data. Thirdly, some changes suggested by potential users were not implemented due to budget/time limitations, among other reasons. For instance, the dark mode was not added because the costs outweighed the potential benefits. Additionally, the length of the questionnaires could not be modified since the predictA risk algorithm is based on these questionnaires.^{29,30} Finally, the predictA algorithm has been only validated in primary care attendees without anxiety disorders at baseline but not in a general population sample. However, we assume that the participants interested in the prevANS intervention will have some reason for being interested in the prevention of anxiety disorders, which itself involves a higher risk of having an anxiety disorder than random individuals in the general population.

Despite these limitations, the present research has strengths, such as using a validated and reliable risk algorithm to calculate the probability of suffering from anxiety disorders that allows personalizing the intervention to the individual's risk level and profile. In addition, therapeutic components included were those supported by the scientific literature. Finally, a user-centered approach was adopted to develop the prevANS intervention, which involved engaging potential users and health professionals in refining the intervention. This approach helped identify potential users' specific needs, which were incorporated into the intervention to increase the likelihood of being effective.

Conclusion

Overall, prevANS is a personalized intervention designed considering the opinions and feedback of potential users

and health professionals that includes components that have been shown to be effective. To date, limited research has been conducted on eHealth and mHealth interventions for the universal prevention of anxiety disorders. Therefore, it is crucial to conduct further research assessing the effectiveness of ICT technologies in delivering mental health preventive interventions in randomized controlled trials, with particular consideration of the individual needs and preferences of users in its design. Such an approach may enhance adherence and the effectiveness of the intervention. Finally, if the intervention proves to be effective, it could be implemented in healthcare services and educational settings.

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