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Smartphone-based application for cognitive behavioral therapy of panic disorder: a feasibility study with volunteers reporting past panic attacks

Emre Cem Esen^{1*} and Hayriye Baykan²

Abstract

Background Panic disorder affects up to 5% of people. It is often treated with cognitive behavioral therapy (CBT) and antidepressants. However, access to CBT remains limited because of psychiatrist and psychologist shortages and long wait times. Digital health solutions have emerged to address this gap. Still, many applications lack personalization and professional oversight. Against this background, this study evaluated the feasibility of a smartphone-based application delivering structured CBT sessions for panic symptoms among Turkish-speaking adults with a history of panic attacks.

Methods Twenty healthy volunteers participated. Each had at least one lifetime panic attack and no current psychiatric disorder. They completed five CBT-based sessions using the application. The sessions included psychoeducation, panic diaries, cognitive restructuring, and interoceptive exposure. Motivational interviewing strategies supported the sessions. To assess feasibility, we examined acceptability, demand, and practicality. Key outcomes were session completion rates, time on task, requests for assistance, perceived comprehension, willingness to continue, and likelihood of recommending the app.

Results All 20 participants finished the five sessions. Session completion times differed by education level ($F(2,17) = 5.561, p = 0.02$). High school graduates required more time than university or postgraduate participants. Assistance requests were rare, occurring less than 0.5 times per session. Requests increased with age ($p = 0.46, p = 0.04$). Perceived understanding peaked at Session 3 (75%). Willingness to continue declined modestly at that session. Ultimately, 95% would “definitely recommend” the application. All respondents stated they would use it if they experienced panic attacks.

Conclusions The structured CBT-based mobile application was found to be feasible, acceptable, and practical. It achieved high completion and recommendation rates. Our findings suggest it is essential to tailor psychoeducational content to each person’s educational level. Older users may need additional support. This application may be among the first structured CBT mobile interventions for panic disorder developed in Türkiye. It could serve as a pioneering digital mental health tool internationally.

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Clinical trial number Not applicable.

Keywords Panic disorder, Mobile application, Cognitive behavioral therapy, Feasibility study, E-mental health

Introduction

Panic disorder affects approximately one in 20 people and causes significant problems [1, 2]. The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), is a standard text for mental health diagnoses. DSM-5 defines panic disorder as having recurrent panic attacks and having a fear of further attacks and/or their consequences. Panic disorder is characterized by avoidance, such as avoiding places or situations believed to trigger panic attacks, and safety-seeking behaviors, such as frequently checking their blood pressure or pulse, or making regular visits to the hospital. These behaviors disrupt daily functioning [3].

Internationally accepted guidelines for panic disorder emphasise CBT as the initial treatment of choice and recommend antidepressants, particularly when symptoms are long-standing or when patients decline or do not benefit from psychological interventions [4–8]. Studies show that CBT works alone or with medication and has lasting benefits [9]. However, shortages of psychiatrists and psychologists create critical gaps in access. The number of in-person visits dropped during the COVID-19 pandemic [10]. In many places, wait times for psychiatrist visits are several months [11, 12]. Delayed treatment increases the burden on healthcare. These barriers highlight the value of digital solutions and encourage the development of our mobile application.

E-health and telemedicine offer new ways to address barriers in psychiatry. Telepsychiatry is a service given remotely by audio or video. E-mental health covers many digital methods. These include telepsychiatry, websites, videos, virtual reality, chatbots, mobile applications, and wearable devices [13]. These tools help with access issues and move psychiatry forward [14]. Yet, many solutions lack close monitoring. Some may offer outdated information, little personalization, or no professional supervision [15]. Tackling these challenges is crucial for the field.

Given these challenges, this study aims to develop a mobile application for patients with panic disorder that uses cognitive behavioral therapy at Balıkesir University through an interdisciplinary collaboration between psychiatrists and software developers, supported by an institutional research grant. The first phase focused on creating the application content. We believe this is the first mobile app in Türkiye to offer structured CBT sessions for panic disorder.

This preliminary study aimed to evaluate whether a CBT-based algorithm for panic symptoms is feasible and acceptable for Turkish-speaking adults with a history of panic attacks under supervised conditions. We examined

feasibility across the domains of acceptability, demand, and practicality. Outcomes included session completion rate, time-on-task, willingness to continue, perceived understandability, perceived fit, and requests for assistance. Due to the small sample size, the use of healthy volunteers, and the absence of a control condition and standardized symptom outcome measures, this first-phase study was not designed to draw conclusions about treatment efficacy.

Methods

Preparation of application content

The content was developed based on key texts on anxiety and CBT for panic disorder [16–24]. The application delivers core CBT components, including psychoeducation about panic attacks and panic disorder, monitoring of panic attacks and associated thoughts, correction of catastrophic cognitive distortions, interoceptive exposure exercises, and motivational interviewing techniques to enhance engagement and adherence. Content was designed to be flexible, with the level of detail and repetition adjusted according to users' needs and responses.

The application is not AI-driven and does not use machine learning. It follows pre-defined branching rules based on user responses. Sessions consist of brief text segments with simple graphics, as needed.

A “one size fits all” approach was avoided in content design. Content was personalised to users' physical sensations and catastrophic thoughts during panic attacks, and adjusted according to their level of motivation, need for detail, and need for repetition.

Figure 1 presents screenshots from the app and an architectural design of a session. Figure 1.A shows a screenshot of a session step in the app. The step text appears in the image. After completing the step, if a response is required, the user clicks the proceed button to continue. After this study is finalized and necessary changes are made, the app's steps in later versions will not only be delivered in writing but also delivered verbally to the user. In Fig. 1.B, a basic form of the panic attack diary is shown. The user enters information about their panic attack in this diary. Figure 1.C presents the architectural design of the fourth session of the app. The design shows which step users proceed to based on their answers. If the user's responses suggest a medical condition (for example, if the user reports chest pain that has persisted for a significant period), the application ends. The user is then advised to visit the emergency room or an appropriate medical institution, based on their complaint.

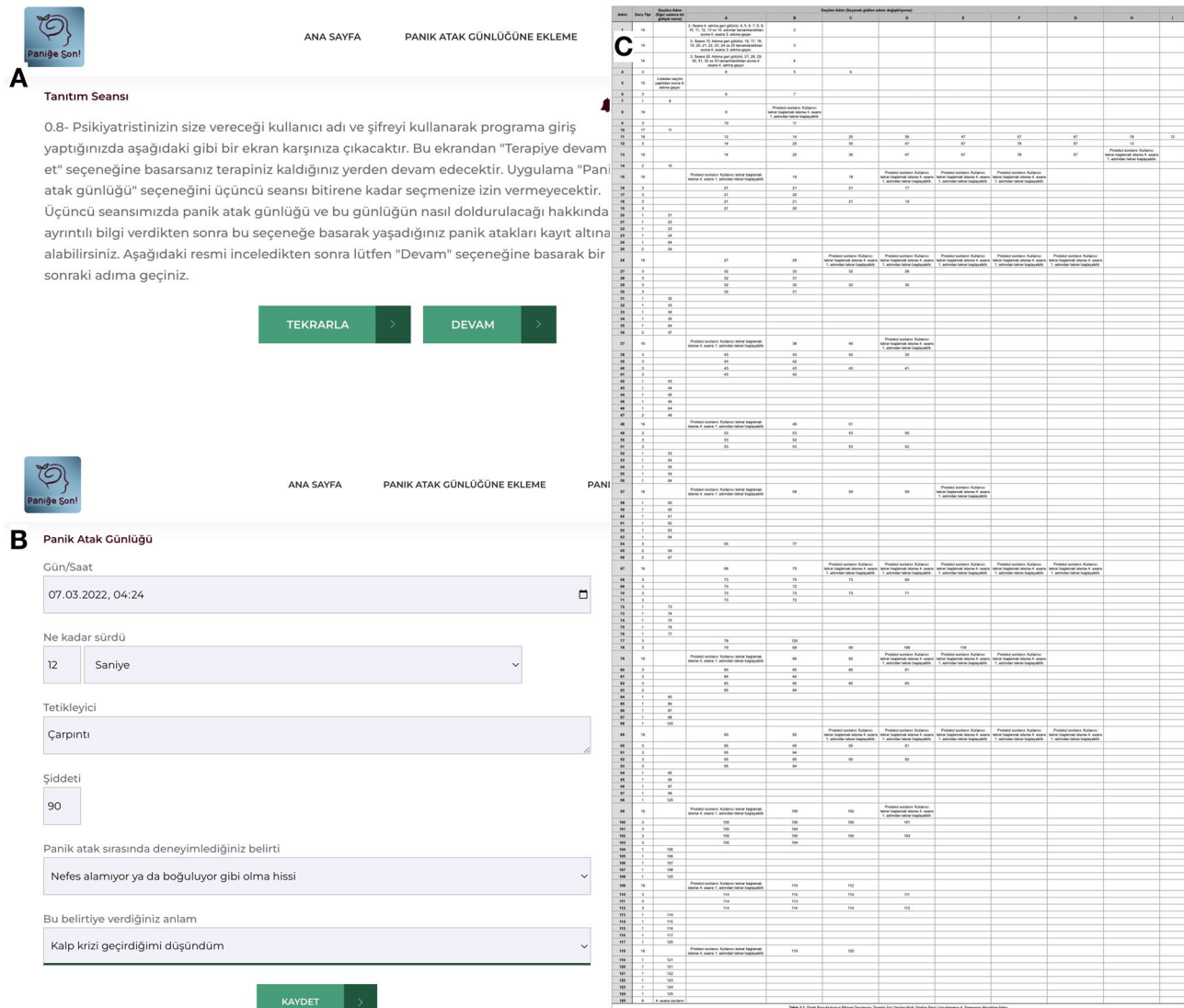


Fig. 1 App Design. (A) Screenshot from the app (B) Screenshot from the “basic” panic attack diary from the app (C) An example architectural design from a session of the app

The first session began by presenting symptoms of panic attacks and panic disorder through an imaginary patient, clarifying these concepts for the user. Next, the user responded to questions about their motivation for using the application. If their responses showed low motivation, the app used motivational interviewing techniques. We then explained the available treatments for panic disorder and described the role of CBT, offering additional resources for those interested.

The second session begins with a review of panic attack symptoms. Users are asked to list which symptoms they experience and rank those that distress them most. Next, we provide an explanation of the sympathetic nervous system and the neuroendocrine response, tailoring details to specific symptoms identified by users. We then assess users’ beliefs in catastrophic thoughts, introduce

an alternative explanation, and reassess their beliefs. To foster motivation, we collaboratively explore the positive and negative impacts of panic attacks on users’ lives. The session concludes with a summary, preparing users for the next stage.

In the third session, the algorithm explains that the cognitive-behavioral model of panic attacks shows how avoidance and safety-seeking behaviors sustain panic attacks. The algorithm then provides clear, step-by-step instructions on how to fill out a panic attack diary. At the end of the session, participants practiced by writing a diary entry about either a real or hypothetical panic attack.

The fourth session starts with a brief review of newly covered topics from the first three sessions. Users can revisit any topic they want. Next, using the panic attack

diary, we ask about the most distressing symptoms and catastrophic thoughts. We examine evidence for and against these thoughts. Based on this evidence, we develop an alternative explanation and evaluate it. If the evidence indicates another health issue, we prompt the user to stop and seek medical attention. In this preliminary study with healthy volunteers, users did not need this option. We also ask about fears of “dying” or “going crazy.” If users have such thoughts, we examine the evidence and develop alternative explanations.

In the fifth session, we conduct two in-session behavioral experiments: running in place for 30 s and breathing through a straw for 60 s. Before each experiment, we provide detailed instructions on how to perform the task. We then explore the user’s expectations and the meanings they attribute to these expectations. The user performs the behavioral experiment. We evaluate the evidence obtained from the experiment and compare it with the user’s expectations. At the end of the session, we review the conclusions drawn from the behavioral experiments and the evidence once again. Interventions throughout the sessions have been summarized in Table 1.

Sample

The feasibility of the algorithm was investigated in healthy volunteers who had experienced at least one panic attack. Eligible volunteers were native Turkish speakers aged 18–65 years who had completed at least a high school education. Individuals with a current diagnosis of panic disorder or any active psychiatric or substance use disorder according to DSM-5 were excluded to avoid the confounding effects of ongoing mental health conditions on the feasibility assessment.

Participants were recruited using snowball sampling among community contacts. First, individuals employed at the Balıkesir University Department of Psychiatry (healthcare professionals, support staff, and medical

students) were informed about the study. They were asked to identify acquaintances who might meet the eligibility criteria. These acquaintances, the initial “seed” participants, were then contacted by the research team, screened, and invited to participate in the study. Enrolled participants referred additional individuals who met the eligibility criteria. Those directly employed at the Balıkesir University Department of Psychiatry were excluded from the study.

This first-phase study aimed to evaluate the application’s technical feasibility, usability, and acceptability, not its therapeutic efficacy. For ethical and safety reasons, we excluded individuals with a current diagnosis of panic disorder. The application had not yet been evaluated as a treatment tool, and such patients require established evidence-based interventions. We instead enrolled volunteers with a history of at least one panic attack but no current panic disorder. This approach reduced potential confounding from comorbid psychiatric conditions and ongoing treatments.

This study was approved by the Balıkesir University Health Sciences Non-Interventional Research Ethics Committee (Approval No: 022161). All procedures involving human participants adhered to the ethical standards of institutional and national research committees. These procedures also adhered to the 1964 Declaration of Helsinki and its subsequent amendments. Written informed consent was obtained from all participants for their participation in the study and for the publication of anonymized data and images. The study assessed the feasibility of the application content, rather than its clinical effectiveness, and did not involve an intervention. As a result, it does not meet the criteria for a clinical trial; thus, clinical trial registration is not applicable.

Table 1 Overview of CBT-based intervention components included in the five-session mobile application

Session	Aim	Key components	Example prompts/exercises	Safety notes
1	Orientation & motivation	Psychoeducation (panic symptoms; PD overview; CBT rationale); brief MI for engagement	Motivation check; optional “learn more” branch	N/A
2	Symptom identification & beliefs, biological psychoeducation	Identify personal symptoms; sympathetic/neuroendocrine overview; assess catastrophic beliefs; develop initial alternative explanations; motivation pros/cons	Symptom list; belief rating pre/post alternative explanation	Remind users to seek medical care if non-panic red flags
3	Cognitive model psychoeducation & panic attack diary	CBT model of panic (avoidance/safety behaviors); diary training and first entry (remembered or hypothetical attack)	Walkthrough: date, triggers, symptoms, meaning, ending, alternative explanation	N/A
4	Cognitive restructuring	Review S1-3; select most distressing symptom & belief; examine evidence for/against; craft alternative explanation; evaluate both	Structured Socratic prompts; require evidence for/against both beliefs	Abort option if data suggest non-panic medical issue
5	Interoceptive exposure & learning	Two in-session experiments: running in place (30 s); straw breathing (60 s); compare expected vs. observed outcomes; consolidate learning	Expectancy rating → exercise → outcome rating → summary	No adverse events observed

Implementation

First, participants received detailed information about panic attacks and panic disorder. They were also informed about the application content and its development. After obtaining informed consent, the researcher collected a volunteer information form. This form included name and surname, gender, age, education level, native language, history of panic attacks, previous psychiatric treatment, evaluation for a diagnosis of panic disorder, and substance use. Before starting the first session, participants rated their willingness to use the application during a panic attack on a five-point Likert scale. After each session, participants evaluated the clarity of the session, the application's understanding of their complaints, its usefulness, their willingness to continue, and their likelihood of recommending the application. All evaluations used the same five-point Likert scale.

All sessions took place in person at the outpatient psychiatry clinic. Each participant completed the application individually in a quiet, private room. The study's first author was present for every session, staying with the participant throughout. The first author recorded the number and content of questions, any difficulties encountered, session completion times, and all feedback. No audio or video recordings were made during the sessions.

Statistical analysis

Parametric data were expressed as mean (standard deviation) and non-parametric data as median (minimum-maximum). Normality was checked with the Shapiro-Wilk test. Student's *t*-test or the Mann-Whitney *U* test was used for gender, while ANOVA or the Kruskal-Wallis test was used for education level, the Spearman test for age, and Fisher's Exact test for categorical variables. Statistical significance was set at 0.05, so *p*-values below this threshold were considered significant.

Results

The sample consisted of 20 participants with a mean age of 37.25 (SD = 13.63, 95% CI = 29.87–42.63), of whom 16 (80%) were female. Regarding education, five participants (25%) had a high school degree, four (20%) had a university degree, and eleven (55%) had completed a master's or doctoral degree.

All volunteers completed all five sessions of the application. All interoceptive exercises were conducted in person, and notably, no adverse events occurred.

Neither gender nor age had a significant impact on program completion times ($t(18) = -0.591, p > 0.05$ and $\rho = 0.449, p > 0.05$, respectively). Table 2 provides the mean completion times for each session.

High school graduates, university graduates, and master's/doctoral graduates completed the entire application content in an average of 47 min and 9 s, 32 min and 4 s, and 34 min and 30 s, respectively. High school graduates completed the application in a statistically longer time than both university graduates and those with master's and doctoral degrees ($F(2, 17) = 5.561, p = 0.02$). No significant difference was found between university graduates and master's and doctoral graduates in terms of total completion time ($p > 0.05$). Only in the completion time of the fifth session was there no statistically significant difference found according to education level ($F(2, 17) = 0.588, p > 0.05$). Please refer to Table 2 for further details.

Throughout the study, participants' requests for assistance were evaluated quantitatively. On average, participants requested assistance less than once every two sessions. The number of assistance requests was not significantly affected by educational level or gender ($\chi^2(2) = 0.797, p > 0.05$; $U = 46, p > 0.05$, respectively). However, it was found to increase with age ($\rho = 0.464, p < 0.05$).

Figure 2 presents the percentages of healthy volunteers who, after each session, responded "I think the application understood me and my complaints very well" to the question of how well they thought the application understood them and their complaints. The percentage of participants giving this response was highest in the third session (75%) and lowest in the fourth session (55%). No statistically significant association was found between the perceived comprehensibility of the application content and the educational level of the healthy volunteers ($\chi^2 = 2.640, p > 0.05$).

Figure 3 shows the percentages of healthy volunteers who, after each session, responded "I would definitely recommend it" when asked whether they would recommend the application to an acquaintance with panic disorder or recurrent panic attacks. No statistically

Table 2 Session completion times by educational level and overall (mean and SD, in minutes / seconds)

	High School Graduate (n=5)	University Graduate (n=4)	Master's/Doctoral Degree (n=11)	Overall (n=20)
1st Session	7 min 35 s, 1 min 45 s	5 min 27 s, 1 min 3 s	5 min 17 s, 1 min 31 s	5 min 53 s, 1 min 45 s
2nd Session	14 min 26 s, 2 min 6 s	9 min 34 s, 2 min 27 s	10 min 31 s, 2 min 17 s	11 min 18 s, 2 min 52 s
3rd Session	8 min 23 s, 1 min 45 s	5 min 17 s, 1 min 38 s	5 min 52 s, 1 min 54 s	6 min 23 s, 2 min 6 s
4th Session	9 min 18 s, 2 min 39 s	6 min 2 s, 1 min 30 s	5 min 56 s, 1 min 36 s	6 min 48 s, 2 min 19 s
5th Session	7 min 27 s, 1 min 54 s	5 min 45 s, 2 min 1 s	6 min 55 s, 2 min 40 s	6 min 49 s, 2 min 21 s
Overall	47 min 9 s, 6 min 57 s	32 min 4 s, 7 min 42 s	34 min 30 s, 8 min 10 s	37 min 11 s, 9 min 31 s

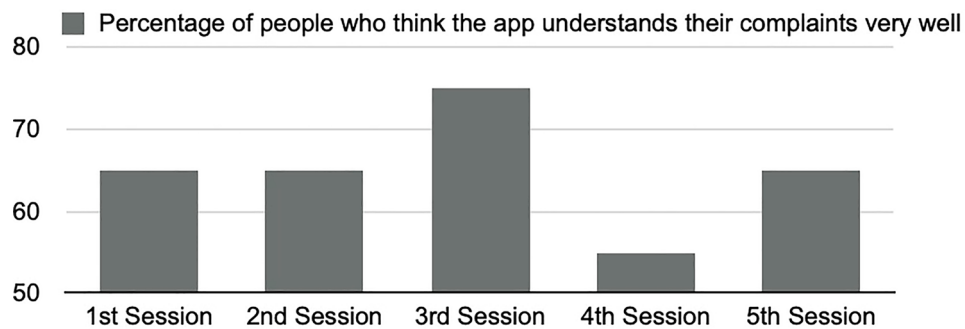


Fig. 2 Percentage of participants endorsing that the application ‘understood me and my complaints very well’ after each session ($n = 20$)

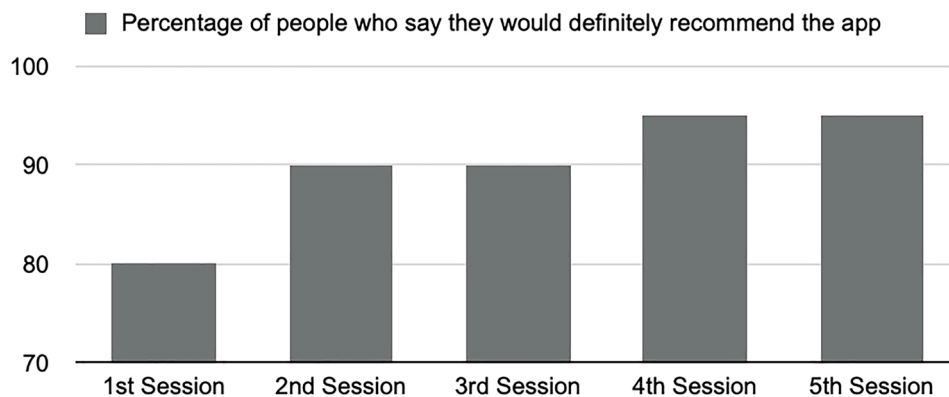


Fig. 3 Percentage of participants indicating that they would ‘definitely recommend’ the application after each session ($n = 20$)

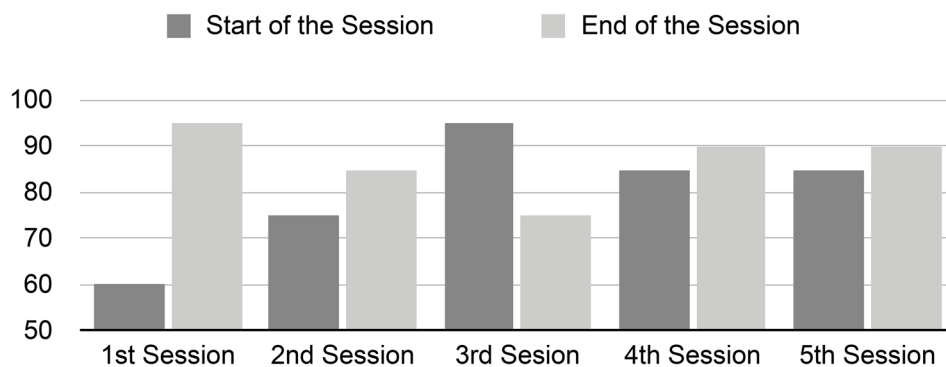


Fig. 4 Willingness to begin and to continue sessions across the five-session program ($n = 20$)

significant association was found between participants’ willingness to recommend the application and their educational level ($\chi^2 = 1.216, p > 0.05$).

Figure 4 presents the percentages of participants who, prior to each session, responded “I would be very willing” to the question regarding their willingness to begin the session, and who, after each session, responded “I would definitely want to continue” to the question regarding their willingness to proceed to the next session.

At the end of the study, participants were asked to provide feedback by considering all sessions together. Among the participants, 95% reported that they would “definitely recommend” the application to an acquaintance

experiencing panic disorder; all participants indicated that if they were continuing to experience panic attacks, they would be “willing” or “very willing” to use the application; all stated that the application “understood” or “understood very well” themselves and their complaints; and 95% reported that the application was “understandable” or “highly understandable.”

Feasibility was evaluated across three domains—acceptability, demand, and practicality—using multiple indicators (e.g., completion rates, willingness to use, time-on-task, and assistance requests). A summary of feasibility indicators, their operational definitions, and observed values is presented in Table 3. Participants

Table 3 Summary of feasibility domains, measures, and observed values

Feasibility Domain	Definition	Timing of Evaluation	Measure / scale	Observed value
Acceptability	Proportion of participants who completed all 5 application sessions	End of study	% of participants completing all 5 sessions	20/20 (100%)
Acceptability	Participants' rating of how understandable they found the application content	After each session and once at the end to evaluate all sessions	5-point Likert scale (1= not at all, 5= completely)	Mean= 4,81, SD= 0,45
Acceptability	Participants' rating of how well they felt the application "understood" their problems	After each session and once at the end to evaluate all sessions	5-point Likert scale (1= not at all, 5= completely)	Mean= 4,62, SD= 0,57
Demand	Participants' rating of how useful they perceived the app to be	After each session and once at the end to evaluate all sessions	5-point Likert scale (1= not at all, 5= completely)	Mean= 4,65, SD= 0,56
Demand	Participants' rating of how enthusiastic they felt about beginning the session	Before each session	5-point Likert scale (1= not at all, 5= completely)	Mean= 4,77, SD= 0,49
Demand	Participants' rating of how enthusiastic they felt about proceeding to the next session	After each session	5-point Likert scale (1= not at all, 5= completely)	Mean= 4,87, SD= 0,34
Demand	Participants' rating of how enthusiastic they felt about using the app if their panic attacks were to recur	End of study	5-point Likert scale (1= not at all, 5= completely)	Mean= 4,80, SD= 0,41
Demand	Participants' rating of how willing they would be to recommend the app to others with similar problems	After each session and once at the end to evaluate all sessions	5-point Likert scale (1= not at all, 5= completely)	Mean= 4,90, SD= 0,33
Practicality	Time required to complete all 5 sessions	Recorded throughout the 5-session program	Total minutes (mean \pm SD)	Mean= 37 minutes 10 s, SD= 9 min 30 s
Practicality	Number of times participants asked for help in using the app	Recorded throughout the 5-session program	Total count of help being asked per participant during the all 5 sessions	Mean = 2,05 (SD: 2,37)

generally described the interoceptive exercises as challenging but acceptable, noting that step-by-step guidance made them feel safer. Some preferred shorter, more frequent psychoeducational segments, while others liked the concise five-session format. Overall, they found the content understandable and would recommend the application to others with similar problems.

Participants provided qualitative feedback about the application. Many said the psychoeducation from the first and second sessions (panic attack symptoms, panic disorder, the sympathetic and neuroendocrine systems) was familiar and easier to follow. In contrast, several participants found the cognitive-behavioral model presented in the third session—addressing avoidance and safety-seeking behaviors in panic—to be new and demanding. They indicated that they still felt understood by the application, but that the amount and complexity of information made this session tiring and reduced their willingness to continue at the same pace.

Discussion and conclusions

Most existing mobile applications for treating panic disorder primarily consist of video recordings and relaxation exercises, and their effectiveness is limited by the absence of personalized adjustments and feedback. Breathing-only apps have limited long-term effectiveness for panic symptoms, highlighting the need for comprehensive

solutions that include psychoeducation and cognitive restructuring developed in conjunction with mental health professionals, administered under the supervision of a psychiatrist or psychologist, and functioning as a complementary and supportive adjunct to face-to-face therapy processes [15, 25]. To our knowledge, comparatively fewer apps offer a structured CBT program that combines psychoeducation, systematic interoceptive and in vivo exposure, and cognitive restructuring, particularly in Turkish and with an explicit focus on integration into psychiatrist-led care.

A key feature of the application we developed is its interactive algorithm, which delivers structured CBT for panic disorder, tailoring the user's experience based on their responses and recorded data. This personalized approach addresses a key limitation of many existing e-mental health applications, which often lack adaptation to individual user needs. Our Turkish-language application functions as a structured CBT tool for panic attacks and panic disorder, specifically designed to augment routine psychiatric care.

Our observations revealed that educational level has a significant impact on session completion times. As shown in the Results, high school graduates required more time to complete the application than university and post-graduate graduates, which was especially true during the psychoeducation-heavy second and third sessions. These

findings suggest that dense psychoeducational content may be more demanding for users with lower educational attainment. To address these differences, future versions of the application will incorporate features designed to enhance comprehension for users with varied educational backgrounds. For example, optional audio summaries will be provided to help participants with lower educational attainment, facilitating their understanding. Furthermore, the user interface will be optimized for simplicity and clarity. Sections involving dense psychoeducational content will be divided into shorter modules, and more simplified explanations will be provided and repeated more frequently, thereby ensuring accessibility and ease of use for all educational levels.

On average, participants required assistance less than once every two sessions, and the number of assistance requests was not affected by educational level, indicating that the application was overall comprehensible and usable independently. Although age did not significantly affect total completion time, it showed a moderate positive association with the number of assistance requests. This suggests that older users are not hindered in completing the application but may require greater user support. It is anticipated that this effect might be more pronounced when the application is used independently in a digital setting. These findings imply that in future effectiveness trials and clinical use, older patients—particularly during initial sessions—should be monitored more closely and, if necessary, seen more frequently by the therapist. For this reason, in future versions of the program, a brief introductory session of approximately five minutes is planned, delivered in the therapist's presence, to support motivation and familiarize patients with the application.

Interestingly, feasibility data showed a divergence between perceived “understanding” and motivation in the third session: participants gave the highest feedback scores regarding how well the application understood them at the end of this session, yet willingness to proceed decreased compared with earlier sessions. Taken together with participants' qualitative feedback, this pattern suggests that while the cognitive–behavioural model is perceived as meaningful and personally relevant, presenting a large volume of novel and complex material in a single session may reduce motivation. These findings support the redistribution of this content across multiple shorter sessions and the gradual reintroduction of key elements in future versions of the program.

Overall, feasibility findings demonstrated that participants required little assistance, found the content understandable, felt the application recognized their complaints, and nearly all reported that they would “definitely recommend” the application to someone experiencing panic attacks. These results suggest that the

developed intervention is broadly acceptable, useful, and worth implementing. Importantly, willingness to use the application increased as sessions progressed, suggesting that the structured nature of the intervention successfully maintained user motivation. However, the relatively low willingness to use the application prior to the first session—even among an educated, self-selected sample—indicates the need for improved initial introduction of the program. These findings suggest that motivational interviewing techniques should be integrated not only within the sessions themselves, but also during the orientation phase when the application is first presented.

The need for e-mental health applications developed in collaboration with mental health professionals, implemented under psychiatric supervision, and designed to complement face-to-face therapy is clear [15]. Unfortunately, opportunities for psychiatrists, psychologists, engineers, software developers, and user-interface designers to collaborate in multidisciplinary teams remain scarce in both academia and the private sector. One of the main barriers is that it is often not feasible for clinicians to dedicate themselves full-time to application development alongside their traditional professional roles. In addition, funders, software developers, and engineers are often quite distant from the clinician's perspective; consequently, parameters such as time spent on the app or the number of downloads are often prioritized over therapeutic benefit, creating further obstacles for meaningful clinical contributions. A pragmatic approach could involve implementing a ‘clinician-in-the-loop’ sprint cycle, which enables continuous feedback from clinicians throughout the development process. In our opinion, this model would foster an iterative workflow, allowing psychiatrists and psychologists to provide insights and make adjustments in real-time, potentially bridging the existing disconnect. We recommend implementing this approach to demonstrate to all stakeholders that multidisciplinary input is both feasible and valuable, ultimately leading to more effective and clinically relevant e-mental health applications.

E-mental health has been evolving rapidly in recent years; applications have shifted from human-designed algorithms to AI-based therapeutic bots. However, when developing AI-driven e-mental health applications, it is impossible to predict every potential user interaction or response in advance. We believe that e-mental health should not be treated as an untested, high-risk technological venture, but rather as an area of scientific progress that must proceed gradually and carefully, as in all fields of medical science.

A significant limitation of this study is that we did not utilize standardized, psychometrically validated instruments to assess usability and app quality. Instead, feasibility and acceptability were evaluated using brief,

study-specific items developed for this pilot to reduce participant burden and focus on initial testing of the algorithm and CBT content. This approach limits the comparability of our findings with the broader digital mental health literature and may reduce the reliability of our estimates of usability and acceptability.

This pilot involved volunteers with prior panic attacks but without current panic disorder, with sessions completed under the researcher's observation, which limits generalisability to clinical populations and may inflate usability ratings. All sessions were conducted under direct supervision in the clinic, with the first author present in the room. Although this arrangement was chosen to ensure safety during interoceptive exercises and to resolve possible technical problems, it may have increased participants' sense of support and made it easier to complete the program than would be the case in fully self-guided home use. In addition, post-session and end-of-study feasibility ratings were obtained face-to-face with the researcher, which may have introduced follow-up and social desirability bias and contributed to more positive acceptability ratings. Future studies should therefore evaluate the application under less supervised conditions and, where possible, employ blinded or independent outcome assessments.

This feasibility study is the initial step in developing a CBT-based mobile intervention. Future work will include testing the app in larger clinical samples with patients diagnosed with panic disorder. Based on the findings from this preliminary feasibility study, we plan to expand the intervention to 12–15 sessions in future versions. Specifically, psychoeducational content from the second and third sessions will be redistributed across three or four shorter sessions, with simplified explanations and more repetition. Beliefs in catastrophic thoughts and alternative explanations, recorded in session two, will be tracked session by session to monitor changes over time.

In clinical implementation, patients will be asked to complete one to two sessions per week, with psychiatric follow-up every four weeks. Psychiatrists will assess the appropriateness of patients for referral to the application and confirm the diagnosis of panic disorder before its use. During follow-up, the therapist will evaluate patient progress and adherence using clinical interviews and brief reports generated by the application, which will graphically display changes in belief levels regarding catastrophic and alternative thoughts across sessions.

In the longer term, digital interventions for panic disorder should be systematically built on established CBT protocols. These protocols should be adapted to local cultural and service contexts, and then evaluated across countries. This helps assess generalizability and identify context-specific modifications. Once feasibility and effectiveness are established, further development may

include AI-based personalization, such as adaptive tailoring of content and feedback. Incorporating VR-assisted exposure exercises is another possibility, aligning with emerging trends in digital mental health.

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Author contributions

First author Asst. Prof. Emre Cem Esen, M.D., Ph.D, was responsible for conceptualization, methodology, and writing the original draft. Prof. Hayriye Baykan, M.D., was responsible for supervising and revising the original draft.

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Data availability

The datasets generated for this study are available on reasonable request from the corresponding author.

Declarations

Ethics approval and consent to participate

This study was reviewed and approved by the Balıkesir University Health Sciences Non-Interventional Research Ethics Committee (Approval No: 022161). All procedures performed involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments. Written informed consent was obtained from all individual participants included in the study for their participation and for the publication of anonymized data and images. Since the study tests the feasibility of the application content, rather than its effectiveness, and is not an intervention study, the current research cannot be classified as a clinical study; therefore, a clinical trial number is not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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