RESEARCH

Open Access

Designing and evaluating a mobile app to assist patients undergoing coronary angiography and assessing its impact on anxiety, stress levels, and self-care

Milad Safaei[1], Amin Mahdavi[2] and Roghayeh Mehdipour-Rabori[3*]

Abstract

Background Coronary artery disease is one of the leading causes of death and disability worldwide. Coronary angiography is a diagnostic procedure used to detect atherosclerosis. Patients typically experience anxiety and stress before and during the angiography procedure. Furthermore, self-care ability is crucial following angiography.

Aim This study aims to describe the design and evaluation of a mobile application focusing on stress, anxiety, and self-care abilities in patients undergoing coronary angiography.

Method The researchers developed a mobile application for patients undergoing angiography. The application provides information about angiography and tips for enhancing self-care following the procedure. An interventional study was conducted on 70 patients admitted to the angiography ward in hospitals in Kerman, Iran, between 2022 and 2023. The participants were randomly divided into two groups: control and intervention. The interventional group received the intervention application the night before angiography. Two groups completed the Anxiety and Stress Questionnaire (DAS) and Kearney-Flescher Self-Care Survey before the intervention. The researchers used questionnaires that had been prepared and previously utilized in other studies. The two groups completed the anxiety and stress questionnaire within three to six hours and the self-care questionnaire one month after angiography. SPSS 15 software was used for data analysis, with a significance level set at 0.05.

Results The study found that the majority of participants were women. Before the study, there was no significant difference between the two groups in terms of anxiety, stress, and self-care scores. However, after the study, the intervention group showed a significant decrease in average anxiety and stress scores ($p < 0.001$). Additionally, compared to the control group, the intervention group demonstrated significant improvement in average self-care score ($p < 0.001$).

Conclusion According to this study, AP can be effective in influencing the anxiety, stress levels, and self-care ability of patients who undergo coronary angiography. It can help to reduce stress and anxiety while increasing self-care. Instructive software is user-friendly, cost-effective, and can be recommended by nurses and doctors.

*Correspondence:
Roghayeh Mehdipour-Rabori
R_mehdipour@kmu.ac.ir

Full list of author information is available at the end of the article

Background

Cardiovascular diseases stand as a predominant global health concern, accounting for a substantial portion of both mortality and morbidity rates worldwide [1, 2]. With approximately one-third of global deaths attributed to cardiovascular diseases, effective management strategies are crucial [3].

The increase in cardiovascular diseases has resulted in a rise in invasive diagnostic procedures, such as angiography, which is performed more than a million times annually in the US alone [4]. Patients with coronary artery disease (CAD) often experience symptoms such as chest pain that can spread to different parts of the body, as well as breathing difficulties. Angiography is extremely useful for diagnosing the root causes of these symptoms, including issues related to CAD [5].

Research has highlighted the significant mental stress and emotional disturbances that patients undergoing coronary artery interventions, especially anxiety, experience. This anxiety significantly affects both the pre and post-procedural phases [6, 7]. Studies have shown that the level of stress and anxiety before coronary angiography is higher than that before heart surgery [8].

Individuals undergoing coronary angiography often find themselves in unfamiliar environments, with limited knowledge about medical procedures, costs, and potential discomforts. This lack of understanding frequently leads to heightened levels of stress and anxiety, affecting over 80% of coronary angiography candidates [9]. It's crucial to address this anxiety to minimize its physiological impacts on cardiovascular health and overall well-being in clinical settings [4].

Despite global interventional studies on anxiety in angiography patients, including research in Iran [10–12], a thorough literature review reveals a diverse range of studies in this domain. These studies delve into the multifaceted aspects of patient anxiety during the pre-, intra-, and post-angiography phases, shedding light on the psychological challenges faced by individuals undergoing such procedures.

In the context of cardiovascular care, addressing the emotional needs of patients is paramount, as anxiety and stress can significantly influence treatment adherence, recovery outcomes, and overall quality of life. Despite the wealth of research on anxiety in cardiovascular patients, there remains a need for tailored interventions that focus on holistic patient care, encompassing both physical and emotional well-being.

Self-care is crucial in maintaining heart health, including activities that promote physical and emotional well-being. Effective self-care improves cardiovascular outcomes and enhances quality of life and mental health [13]. While angiography serves as a diagnostic tool, it is believed that equipping patients with comprehensive self-care education can enhance their overall well-being, promote informed decision-making, and foster a sense of empowerment in managing their health. The context of managing cardiovascular patients, integrating new technologies, particularly mobile applications, shows promise in delivering health interventions and promoting healthier behaviors, especially in secondary prevention strategies [14, 15]. Research by Beatty et al. (2018) has highlighted the effectiveness of mobile applications in improving physical activity and cardiovascular health, emphasizing their potential to enhance patient outcomes [16].

Considering the significant levels of anxiety and stress experienced by patients before and during angiography, as well as the lack of support for self-care after the procedure, developing software solutions like interactive mobile applications could effectively tackle these challenges. It is crucial to address these issu6y6tt889o0es by creating software solutions. Researchers in Iran conducted a study to fill this gap, recognizing limitations such as the shortage of nursing resources, time, and funds for comprehensive patient education. The study aimed to develop software that integrates scientific and educational information in order to assess its impact on anxiety, stress, and self-care abilities among patients undergoing coronary angiography. The research question addressed the significant importance and made a valuable contribution to the existing body of knowledge in several ways.

Research Gap: Previous studies have overlooked the specific context of patients undergoing coronary angiography and their need for effective stress management, anxiety reduction, and self-care support. This study aims to address this gap by investigating the effectiveness of a mobile app intervention in improving essential aspects of patients' well-being during the coronary angiography process.

Clinical Relevance: Effective stress and anxiety management, along with improved self-care practices, play a vital role in the overall well-being and treatment outcomes of patients undergoing coronary angiography. By exploring the impact of a mobile app intervention on these variables, this research addresses a critical need for interventions that can enhance patients' experiences, promote self-management, and potentially improve treatment outcomes in this specific patient population.

Novelty and Innovation: The utilization of a mobile app intervention in the context of coronary angiography

shows a novel and innovative approach. By incorporating digital health interventions, this study contributes to the expanding field of mobile health applications and their potential to revolutionize patient care. The focus on stress, anxiety, and self-management in patients undergoing coronary angiography adds unique value to the existing body of knowledge as it targets a specific and understudied patient population.

Methodological Advancement: This study employs rigorous quantitative methods, including surveys and statistical analyses, to evaluate the effectiveness of the mobile app intervention. By utilizing these robust research designs, the study aims to establish causal relationships and generate reliable evidence regarding the impact of the app on stress, anxiety, and self-management outcomes. This methodological advancement contributes to the existing literature by providing a robust foundation for evidence-based conclusions.

Practical Implications: The findings of this study have practical implications for healthcare professionals, policymakers, and developers of mobile health applications. The results can inform healthcare providers about the benefits of incorporating mobile app interventions into the care of patients undergoing coronary angiography. This can ultimately lead to improved patient outcomes and enhanced self-management practices. The potential for reducing stress and anxiety levels and promoting self-care behaviors can significantly impact patient well-being and contribute to more efficient healthcare resource utilization.

Methodology

Research philosophy The research philosophy adopted in this study was positivism. In the study, adopting a positivist research philosophy enables the researchers to objectively measure the impact of the mobile app on stress, anxiety, and self-care ability in patients undergoing coronary angiography.

Research approach The research approach employed in this study was quantitative, involving the collection and analysis of numerical data. This approach allows objective and statistical analysis to draw valid and reliable conclusions.

Study design
This interventional study, conducted in Iran from 2022 to 2023, consisted of two phases: the development of a mobile app and the evaluation of its effectiveness.

Designing the mobile app
The mobile App was carefully designed to meet the educational requirements of patients undergoing angiography. The app was created in Persian for Android mobile devices, taking into account their popularity in Iran. The initial stages of the app design process involved:

Literature research A comprehensive literature review was conducted to identify relevant educational topics for patients. Scientific articles and books published between 2013–2023 were scrutinized using keywords such as angiography," "anxiety," "stress," "self-care," "nurses," "patients," "application," "care," and "diet " [17–20].
The education content validation process involved the following steps:

Validation participants The educational content was reviewed by a panel of experts consisting of 10 nurses and 2 physicians who specialize in cardiology. They also have academic backgrounds.

Validation method The content was thoroughly evaluated for accuracy, relevance, and comprehensiveness to ensure that it aligns with current scientific knowledge and best practices in patient care.
After confirming that the topics were suitable, the mobile App was developed. The app can be installed on mobile phones and used offline or online.

Application content
The app has 13 sections that patients can access by clicking on each one. The sections are:
 What is Angiography?
  What is Angioplasty?
  Complications of Angiography.
  Work and Activity.
  Travel.
  Precautions before Angiography.
  Procedures during Angiography.
  Care after Angiography.
  Diet.
  Stress and Anxiety Management.
  Healthy Lifestyle.
  Emergency Visit.
  Contact with a Nurse (Figs. 1 and 2).

These sections were meticulously designed to address various aspects of the patient journey, providing comprehensive support and guidance throughout and after the angiography process.

Interactive features such as quizzes, interactive diagrams, and self-assessment tools were incorporated to engage users and enhance learning outcomes. Multimedia elements such as pictures and audio clips were integrated into the app to enrich the learning experience. These elements help reinforce key concepts related to angiography and self-care practices.

Fig. 1 The first page
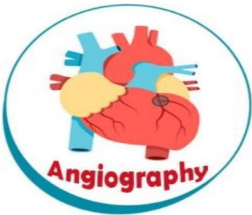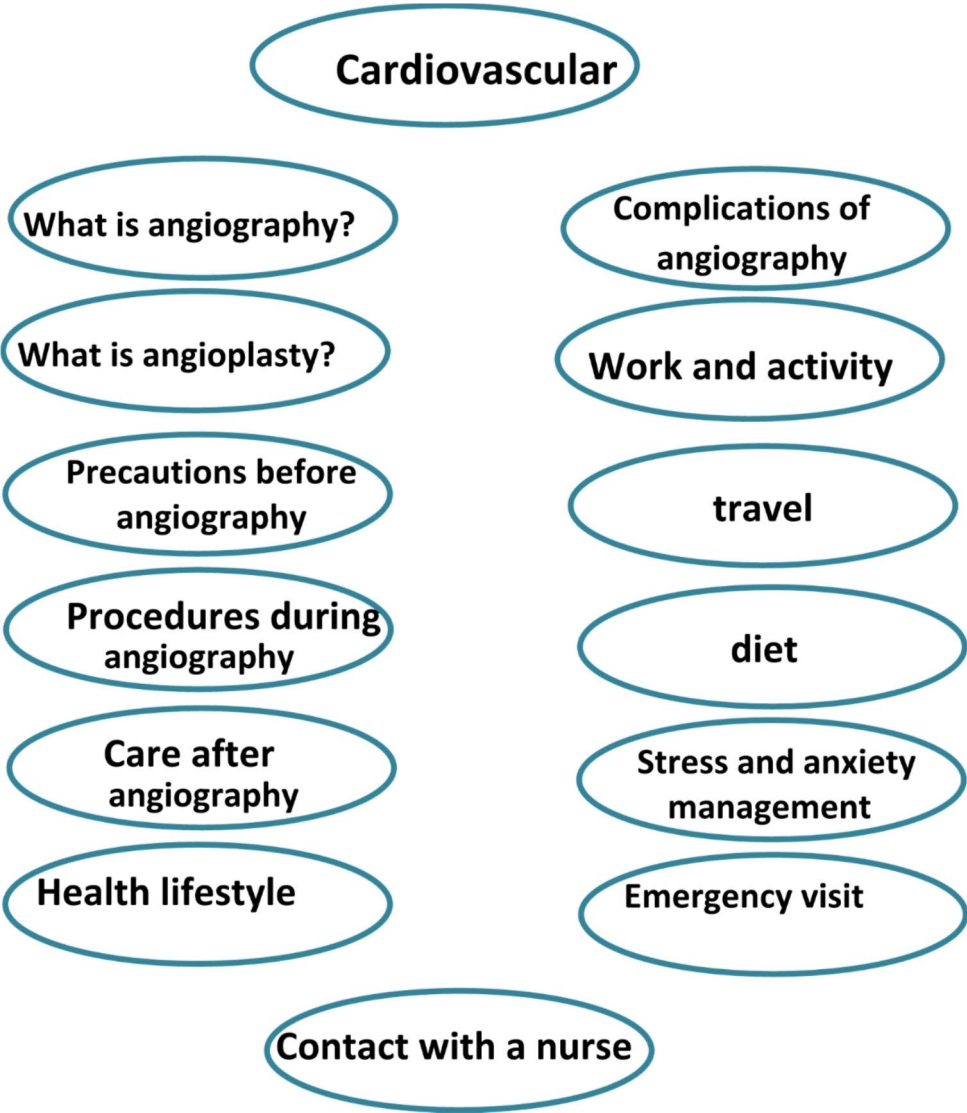
Fig. 2 Searching for medicinal information about Angiography. To search for and access medicinal information just click on each Item

Software development life cycle

The researchers followed a systematic Software Development Life Cycle (SDLC) approach to develop and design the mobile application. In the first phase, requirements were gathered from literature, healthcare professionals, patients, and experts in the field. The researchers ensured that the application addressed the unique requirements of patients undergoing coronary angiography.

The second phase was the design phase. During this phase, the researchers and development team created wireframes and mock-ups to visualize the user interface and functionalities of the application. They collaborated with healthcare professionals to ensure that the application has sufficient usability and effectiveness in the clinical setting.

The third phase involved the actual implementation of the application. This phase includes coding, testing, and iterative refinement. The researchers conducted rigorous testing procedures to identify and resolve any bugs or usability issues.

Validation and evaluation

A comprehensive validation process was undertaken to ensure the accuracy and reliability of the mobile application. The application underwent extensive tests, including functionality, usability, and compatibility testing across various devices and operating systems. They collected feedback from a group of patients and healthcare professionals to assess the user experience and identify areas for improvement.

Evaluating the app

Study Design: The interventional study design was chosen to evaluate the efficacy of the mobile application and its impact on stress, anxiety, and self-care ability in patients undergoing coronary angiography. This design allows for a systematic evaluation of the application's effectiveness by comparing the outcomes of the intervention group with those of the control group.

By implementing an interventional study design, researchers can assess the causal relationship between the benefits of the mobile app and the observed changes in stress, anxiety, and self-care abilities. This design enables researchers to determine whether the mobile app intervention affects these variables, providing valuable insights into its effectiveness in supporting patient well-being and self-care abilities. The study was conducted from 2022 to 2023 for 11 months.

Study setting

This study was conducted in Kerman, Iran. It is the largest province in the country. There are two hospitals affiliated with Kerman Medical University that offer angiography services. Most patients who require angiography are referred to these hospitals.

Study population: The sample size consisted of 70 patients with a confidence level of 95% and a power of 80%. Inclusion criteria included patients aged between 18 and 70 years old (this age range is relevant to the target population undergoing coronary angiography), proficient in the Persian language, owning a smartphone with the ability to operate it, and not diagnosed with nervous or mental disorders based on self-reporting.

The exclusion criteria encompassed patients with chronic diseases, and mental illnesses, individuals who encountered severe cardiovascular complications during angiography like myocardial infarction, those with persistent smartphone malfunctions or utilizing an Apple phone, as well as participants who voluntarily withdrew from the study or deceased during the research.

First, the patients were randomly selected using a checklist that was based on the inclusion and exclusion criteria. The selected patients were informed of the study's objectives. After obtaining informed consent, participants were randomly assigned to two groups: control and intervention. The total number of patients selected based on the sample size formula was 70, with 35 in the control group and 35 in the intervention group.

Intervention procedures

After obtaining the ethics code from the Kerman University of Medical Sciences, the researchers visited the heart hospitals affiliated with Kerman Medical Sciences. Patients who were deemed eligible for angiography by the cardiologist were randomly assigned to two control and intervention groups. During individual interviews, the researcher explained the study's purpose and questionnaire completion to each participant separately.

Two questionnaires were used to collect data. These tools were carefully chosen to capture relevant information about stress, anxiety, and self-care abilities.

The participants read and signed the written consent form. After that, they completed the questionnaires. These questionnaires already existed and were used in various studies [16–19].

The researchers installed the app on the smartphones of the patients in the intervention group and explained its functionality to them and their family members. The patients in the control group only received standard training. The standard training included educational materials and sessions on stress management, anxiety reduction techniques, and self-care practices. The key distinction between the intervention and control groups lies in the utilization of the mobile app.

The patients in the two groups completed the anxiety and stress questionnaire (DAS) and the self-care questionnaire, the "Kearney Fleischer Inventory," before the

intervention. The DAS questionnaire was completed again three hours after the angiography, and the self-care questionnaire was completed one month after the angiography.

Study assessments and measures
Depression anxiety stress scales – DASS 21
Depression Anxiety Stress Scales, first introduced by Lovibond in 1983, can identify and assess symptoms of anxiety, stress, and depression experienced in the past week [21]. The scale was used in some studies [22–24]. This questionnaire contains 21 multiple-choice questions that are completed through self-assessment. Answers vary from "Never" to "Always." Zero (0) is assigned to the "Never" option, one [1] is assigned to the "a little" option, two [2] is assigned to the "Sometimes" option, and three [3] is assigned to the "always" option. The anxiety scale comprises 7 questions [2, 4, 7, 9, 15, 19, 20], while the stress scale consists of 7 questions [1, 6, 8, 11, 12, 14, 18, 25]. The scores for each scale are calculated by summing the responses to the respective questions and then multiplying the total by two. The total score of the scale ranges between 0 and 42 for each dimension separately (depression, anxiety, and stress) [26]. For the anxiety subscale, a score of 0 to 7 indicates normal anxiety, a score of 8–9 indicates mild anxiety, a score of 10–14 indicates moderate anxiety, a score of 15 to 19 indicates severe anxiety and any score greater than 20 specifies very severe anxiety.

For the stress subscale, a score of 0 to 14 indicates normal stress intensity, a score of 15 to 18 indicates mild stress intensity, a score of 19 to 25 indicates moderate stress intensity, a score of 26 to 33 indicates severe stress intensity, and any score over 33 indicates very intense stress [27].

According to the study by Marijanović et al. (2021), the validity and reliability of the scale have been confirmed, making it suitable for assessing anxiety, depression, and stress [27].

Depression data was excluded from this study.

Self-care agency scale
The Self-Care Agency Scale was designed by Kearney and Fleischer (1979) [28]. The scale is reliable and valid for use with heart patients. The scale is reliable and valid for use with heart patients. The scale consists of 64 questions, with 21 items designed to assess self-care ability and 43 items focused on practicing self-care behaviors. The answer to each question is based on a 5-point Likert scale ranging from "always applies to me" (5 points) to "does not apply to me at all" (1 point). The highest score is 320, and the lowest score is 64. The highest score indicates the highest level of self-care [29, 30].

The validity and reliability of the scale have been established in various studies, including those conducted in Turkey and Iran [31, 32]. Abas et al. (2020) reported the efficacy of this instrument for the Iranian community [30].

Data analysis
SPSS 15 was used to analyze the data. Frequencies were used to describe the results. The Kolmogorov-Smirnov test was used to assess the normality of the data distribution.

To analyze the gathered information, one of the statistical tests used was the t-test, which enabled a comparison of mean scores between the intervention group and the control group. Furthermore, repeated measures analyses were conducted to examine changes in stress, anxiety, and self-care over time within each group. A significance level of 0.05 was considered.

Results
Seventy cardiac patients referred for angiography were examined in this study. The mean age of the participants was 53.3±8.17 years. The majority of the participants were female.

Demographic information is presented in Table 1. The results showed that the two groups did not have statistically significant differences in terms of demographic characteristics ($p > 0.05$).

Table 1 Distribution of demographic variables of the studied patients separately from the control and intervention groups

		Intervention Group (n = 35)		Control Group (n = 35)		P value
		%	N	%	N	
sex	Female	42/9	15	57/1	20	0.75*
	male	57/1	20	42/9	15	
Marital status	Single	0	0	5/7	2	0.246**
	Married	100	35	94/3	33	
Education	Diploma & Higher	76/5	36	88/2	30	0.17**
	Under Diploma	23/5	8	11/4	4	

*=Chi-squared test

**= Fisher's exact test

The results of Table 2 indicate that the mean anxiety scores in the patients in the intervention group before the intervention were 22.12±8.32, which decreased to 18.82±9.41 after the intervention. The average stress scores in the patients in the intervention group before the intervention were 32.38±6.39 and decreased to 24.86±5.22 after the intervention (Table 2).

Furthermore, the average self-care score in the patients in the intervention group before the intervention was 15.39±175.63, which increased to 18.92±188.54 after the intervention.

Discussion

The current study was focused on creating and assessing a mobile application that could help patients undergoing coronary angiography manage their stress and anxiety levels better and improve their ability to take care of themselves. The research results showed a notable decrease in anxiety and stress levels among patients using the mobile application, as well as an enhancement in their self-care ability.

To contextualize our findings, it is essential to compare them with relevant previous studies. While our research did not find specific studies demonstrating the impact of mobile applications on anxiety levels in this context, existing literature has shown the effectiveness of various interventions in reducing anxiety levels among patients undergoing medical procedures. For example, Gökçe et al. (2019) and Hu et al. (2020) highlighted the effectiveness of educational interventions in reducing anxiety levels [33, 34].

In the present study, the mobile application effectively reduced stress levels in the intervention group. This highlights the novel contribution of this work, as it is the first study in Iran to develop a mobile application and evaluate its impact on stress, anxiety levels, and self-care abilities in patients undergoing angiography. By addressing the research gap, our study adds to the existing body of knowledge and underscores the potential of mobile app interventions in managing anxiety and stress.

Moreover, our findings are consistent with previous studies that have demonstrated high-stress levels among patients undergoing angiography [35–37]. The success of the mobile application in reducing stress levels indicates that digital interventions can have a positive impact on stress management in these patient populations. Research by Khademian et al. (2021) demonstrated that digital interventions, including mobile applications and online platforms, were effective in reducing stress and anxiety levels [38]. Similarly, a study by Kawadler et al. (2020) highlighted the benefits of smartphone-based interventions in improving psychological well-being and reducing stress among healthy people [39]. Moreover, a meta-analysis by Paalimäki-Paakki et al. (2022) found that digital interventions, such as mobile apps and telemedicine services, were associated with significant reductions in stress levels among patients with chronic conditions [40]. The utilization of digital tools not only provides convenient access to support and resources but also empowers patients to actively manage their psychological health. Our study contributes to this body of evidence by demonstrating the positive impact of a mobile application tailored for patients undergoing angiography, reinforcing the potential of digital interventions in enhancing stress management strategies in healthcare settings.

In terms of self-care, the current study demonstrated that utilizing the mobile application enhanced patients' self-care capabilities. This finding is consistent with previous studies that emphasized the importance of patient participation in treatment and self-care [41]. By providing necessary information, instructions, and adaptation methods, patients can enhance their self-care ability, leading to improved outcomes and reduced anxiety and stress levels. The present study contributes to this body of knowledge by demonstrating the effectiveness of a

Table 2 Comparison of the mean scores of anxiety, stress and self-care before and after the intervention

Variable		Intervention Group (*n*=35)	Control Group (*n*=35)	*P* value
		Mean±SD	Mean±SD	
anxiety score	Pretest	22.12±8.32	21.76±7.94	0.672 *
	Post-test	18.82±9.41	24.12±5.27	0.0001*
P value		0.0001**	0.9**	
stress score	Pretest	32.38±6.39	33.00±4.95	0.471*
	Post-test	24.86±5.22	31.90±5.38	0.001*
P value		0.0001**	0.07**	
self-care score	Pretest	15.39±175.63	18.13±164.74	0/07*
	Post-test	18.92±188.54	18.18±167.82	0.001**
P value		0.0001**	0.1**	

*=independent t test

**= paired t test

mobile app intervention specifically designed for patients undergoing angiography.

One distinguishing factor of the present study is the development of a Persian language app customized for Iranian patients. Most existing apps for patients are in English, which creates a barrier for the majority of Iranian patients who are unable to use English apps. By providing a user-friendly app in Persian, the researchers addressed this gap and ensured that the intervention was accessible and applicable to the target population.

Conclusion

In conclusion, the mobile application designed for patients undergoing angiography proved effective in managing stress and anxiety levels while enhancing self-care abilities. The development of a Persian app tailored for Iranian patients addresses a critical need in the field. Healthcare professionals, particularly nurses, are encouraged to integrate this application into their practice to support patients in managing anxiety and stress and improving their self-efficacy.

The availability of this application, both online and offline, can create a supportive environment for patients undergoing angiography, ultimately enhancing their overall well-being.

Abbreviations
App   Application
DAS   Depression Anxiety Stress Scales
CAD   Coronary artery disease
SPSS   Statistical Package for the Social Sciences

Author contributions
MS and RM wrote the original draft of the manuscript. MS and R M analyzed and interpreted the data. AM performed had a major contributor in writing the manuscript and editing. He helped with Conceptualization. All authors read and approved the final manuscript.

Data availability
The application and data used and analyzed for the study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
The ethics committee of Kerman University of Medical Sciences approved this research with the code of ethics No. IR.KMU.REC.1398.615. The methods followed the relevant guidelines. The participants had the option to join or decline the study without affecting their services and care. They also received information and explanations about the research and the questionnaires, and their confidentiality was guaranteed. All methods were performed in accordance with the relevant guidelines and regulations as stated by the Kerman University of Medical Sciences Ethics Committee. Written informed consent was obtained from all patients.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Author details
[1]Nursing Research Center, Kerman University of Medical Sciences, Kerman, Iran
[2]Kerman Medical University, Kerman University of Medical Sciences, Cardiologist, Kerman, Iran
[3]Department of medical- surgical nursing, Razi Faculty of Nursing and Midwifery, Kerman University of Medical Sciences, Kerman, Iran

References
1. Roth GA, Mensah GA, Johnson CO, Addolorato G, Ammirati E, Baddour LM, et al. Global burden of cardiovascular diseases and risk factors, 1990–2019: update from the GBD 2019 study. J Am Coll Cardiol. 2020;76(25):2982–3021.
2. Khan MA, Hashim MJ, Mustafa H, Baniyas MY, Al Suwaidi SKBM, AlKatheeri R et al. Global epidemiology of ischemic heart disease: results from the global burden of disease study. Cureus. 2020;12(7).
3. Garavand A, Rabiei R, Emami H. Design and Development of a Hospital-Based Coronary Artery Disease (CAD) Registry in Iran. BioMed Research International. 2023;2023.
4. Mobini-Bidgoli M, Taghadosi M, Gilasi H, Farokhian A. The effect of hand reflexology on anxiety in patients undergoing coronary angiography: a single-blind randomized controlled trial. Complement Ther Clin Pract. 2017;27:31–6.
5. Kolkailah AA, Alreshq RS, Muhammed AM, Zahran ME, El-Wegoud MA, Nabhan AF. Transradial versus transfemoral approach for diagnostic coronary angiography and percutaneous coronary intervention in people with coronary artery disease. Cochrane Database Syst Reviews. 2018(4).
6. He CJ, Zhu CY, Han B, Hu HZ, Wang SJ, Zhai CL, et al. Association between anxiety and clinical outcomes in Chinese patients with myocardial infarction in the absence of obstructive coronary artery disease. Clin Cardiol. 2020;43(7):659–65.
7. Lieber AC, Bose J, Zhang X, Seltzberg H, Loewy J, Rossetti A, et al. Effects of music therapy on anxiety and physiologic parameters in angiography: a systematic review and meta-analysis. J Neurointerventional Surg. 2019;11(4):416–23.
8. Chandrababu R, Rathinasamy EL, Suresh C, Ramesh J. Effectiveness of reflexology on anxiety of patients undergoing cardiovascular interventional procedures: a systematic review and meta-analysis of randomized controlled trials. J Adv Nurs. 2019;75(1):43–53.
9. Bidgoli MM, Taghadosi M, Gilasi H, Farokhian A. The effect of sukha pranayama on anxiety in patients undergoing coronary angiography: a single-blind randomized controlled trial. J Cardiovasc Thorac Res. 2016;8(4):170.
10. Barari L, Darabiyan M, Eskandarian R, Ghods A. Anxiety levels in patients candidate for coronary artery angiography. Koomesh. 2024;21(3):437–43.
11. Assari S, Zandi H, Ahmadi K, Saleh DK. Extent of coronary stenosis and anxiety symptoms among patients undergoing coronary angiography. J Tehran Univ Heart Cent. 2017;12(4):155.
12. Keshvari M, Yeganeh MR, Paryad E, Roushan ZA, Pouralizadeh M. The effect of virtual reality distraction on reducing patients' anxiety before coronary angiography: a randomized clinical trial study. Egypt Heart J. 2021;73:1–8.
13. Riegel B, Moser DK, Buck HG, Dickson VV, Dunbar SB, Lee CS, et al. Self-care for the prevention and management of cardiovascular disease and stroke: a scientific statement for healthcare professionals from the American Heart Association. J Am Heart Association. 2017;6(9):e006997.
14. Peiris D, Praveen D, Mogulluru K, Ameer MA, Raghu A, Li Q, et al. SMARThealth India: a stepped-wedge, cluster randomised controlled trial of a community health worker managed mobile health intervention for people assessed at high cardiovascular disease risk in rural India. PLoS ONE. 2019;14(3):e0213708.

15. Coran P, Goldsack JC, Grandinetti CA, Bakker JP, Bolognese M, Dorsey E, et al. Advancing the use of mobile technologies in clinical trials: recommendations from the clinical trials transformation initiative. Digit Biomarkers. 2020;3(3):145–54.

16. Beatty AL, Magnusson SL, Fortney JC, Sayre GG, Whooley MA. VA FitHeart, a mobile app for cardiac rehabilitation: usability study. JMIR Hum Factors. 2018;5(1):e8017.

17. Khodaminasab A, Reisi M, Vahedparast H, Tahmasebi R, Javadzade H. Utilizing a health-promotion model to predict self-care adherence in patients undergoing coronary angioplasty in Bushehr, Iran. Patient preference and adherence. 2019:409–17.

18. Kolahi Z, Zandi M, Esmaeili R, Khoob MK. Effect of Angiography Room Orientation Tour on anxiety of patients awaiting cerebrovascular angiography. Adv Nurs Midwifery. 2020;29(2).

19. Salari A, Ashouri A, Moghtader AJ, Ahmadnia Z, Alizadeh I. The relationship between depression symptoms and severity of coronary artery disease in patients undergoing angiography. Iran J Psychiatry. 2020;15(4):370.

20. Mei Z, Lei K. Angina self-management plan and quality of life, anxiety and depression in Post Coronary Angioplasty patients. Ethiop J Health Dev. 2023;37(1).

21. Lovibond PF, Lovibond SH. The structure of negative emotional states: comparison of the Depression anxiety stress scales (DASS) with the Beck Depression and anxiety inventories. Behav Res Ther. 1995;33(3):335–43.

22. Allabadi H, Alkaiyat A, Alkhayyat A, Hammoudi A, Odeh H, Shtayeh J, et al. Depression and anxiety symptoms in cardiac patients: a cross-sectional hospital-based study in a Palestinian population. BMC Public Health. 2019;19:1–14.

23. Shea TL, Tennant A, Pallant JF. Rasch model analysis of the Depression, anxiety and stress scales (DASS). BMC Psychiatry. 2009;9(1):1–10.

24. Su JJ, Yu DSF. Effectiveness of eHealth cardiac rehabilitation on health outcomes of coronary heart disease patients: a randomized controlled trial protocol. BMC Cardiovasc Disord. 2019;19(1):1–10.

25. Li X, Shek DT, Shek EY. Psychological morbidity among university students in Hong Kong (2014–2018): psychometric properties of the depression anxiety stress scales (DASS) and related correlates. Int J Environ Res Public Health. 2021;18(16):8305.

26. Lovell GP, Huntsman A, Hedley-Ward JJN, Sciences H. Psychological distress, depression, anxiety, stress, and exercise in a ustralian and N ew Z ealand mothers: a cross-sectional survey. 2015;17(1):42–8.

27. Marijanović I, Kraljević M, Buhovac T, Cerić T, Abazović AM, Alidžanović J, et al. Use of the Depression, anxiety and stress scale (DASS-21) questionnaire to assess levels of depression, anxiety, and stress in healthcare and administrative staff in 5 oncology institutions in Bosnia and Herzegovina during the 2020 COVID-19 pandemic. Med Sci Monitor: Int Med J Experimental Clin Res. 2021;27:e930812–1.

28. Kearney BY, Fleischer BJ. Development of an instrument to measure exercise of self-care agency. Res Nurs Health. 1979;2(1):25–34.

29. Yildiz FT, Kaşikçi M. Impact of training based on Orem's theory on self-care agency and quality of life in patients with coronary artery disease. J Nurs Res. 2020;28(6):e125.

30. Tabas EE, Sarani H, Faghihi H, Nezamjoo Z. Comparing the impact of three follow-up methods (telephone, educational booklet, and SMS) on self-care ability of patients with acute coronary syndrome: a quasi-experimental study. Medical-Surgical Nurs J. 2020;9(1).

31. Moradi A, Moeini M, Sanei H. The effect of interactive text message follow-up on health promoting lifestyle of patients with acute coronary syndrome. Iran J Nurs Midwifery Res. 2017;22(4):287.

32. Karakurt P, Kasimoğlu N, Bahçeli A, Başkan SA, Ağdemir B. The effect of activities of daily living on the self-care agency of patients in a cardiovascular surgery clinic. J Vasc Nurs. 2017;35(2):78–85.

33. Gökçe E, Arslan S. Possible effect of video and written education on anxiety of patients undergoing coronary angiography. J PeriAnesthesia Nurs. 2019;34(2):281–8.

34. Hu J, Ren J, Zheng J, Li Z, Xiao XJCN. A quasi-experimental study examining QR code-based video education program on anxiety, adherence, and satisfaction in coronary angiography patients. 2020;56(5–6):428–40.

35. Torabizadeh C, Rousta S, Gholamzadeh S, Kojouri J, Jamali K, Parvizi MM. Efficacy of education delivery through multimedia and text messaging on the psychological parameters of patients scheduled for coronary angiography: a single-blind randomized controlled clinical trial. BMC Cardiovasc Disord. 2021;21(1):1–9.

36. Sajadi SA, Farsi Z. Comparing the effect of peer education and orientation tour on the stress of patients candidate for coronary angiography in selected hospital of Aja University of Medical Sciences. Nurs Midwifery J. 2015;12(12):1119–27.

37. Sayadi L, Varaei S, Faghihzadeh E, Ahmadkhani Z. The effects of multimedia education on anxiety and physiological status among patients with cerebral angiography: a randomized controlled clinical trial. Nurs Pract Today. 2018;5(4):375–84.

38. Khademian F, Aslani A, Bastani P. The effects of mobile apps on stress, anxiety, and depression: overview of systematic reviews. Int J Technol Assess Health Care. 2021;37(1):e4.

39. Kawadler JM, Hemmings NR, Ponzo S, Morelli D, Bird G, Plans D. Effectiveness of a smartphone app (BioBase) for reducing anxiety and increasing mental well-being: pilot feasibility and acceptability study. JMIR Formative Res. 2020;4(11):e18067.

40. Paalimäki-Paakki K, Virtanen M, Henner A, Nieminen MT, Kääriäinen M. Effectiveness of digital counseling environments on anxiety, depression, and adherence to treatment among patients who are chronically ill: systematic review. J Med Internet Res. 2022;24(1):e30077.

41. Shohani M, Amoozadeh MH. The effect of educational program on self-care behaviors of candidates for coronary artery angiography. J Nurs Midwifery Sci. 2021;8(3):171.

Publisher's note