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RESEARCH ARTICLE

DEVELOPING SMARTPHONE MOBILE APPLICATION FOR MUSCULOSKELETAL HEALTH: THE DEVELOPMENT AND INITIAL EVALUATION OF FIZYOID

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ABSTRACT

Purpose: This study developed the Turkish application "Fizyoid" to manage chronic musculoskeletal disorders through personalized exercise programs and evaluated user experience and initial health outcomes.

Material and Methods: The study had four stages: (1) application development, (2) feedback on exercises, (3) user experience evaluation, and (4) application performance measurement. Data from the first six months after launch were analyzed.

Results: Of 149 users who downloaded Fizyoid, 21 used it for four weeks and completed a pre- and post-use Personal Test. Nine users contacted a physiotherapist, 31 notifications were accessed, two users completed a Satisfaction Survey, and nine reviewed the app on Google Play with a 4.7-star rating. Physical improvements were modest, suggesting longer-term use may yield better results.

Conclusions: Fizyoid shows potential as a user-friendly tool for musculoskeletal health. While satisfaction and engagement are high, the short evaluation period limits conclusions on physical outcomes, indicating a need for further research on long-term effectiveness and integration with healthcare services.

Keywords: Digitalization; Mobile health application; Musculoskeletal health; Physical therapy; Self-management

INTRODUCTION

Smartphones have revolutionized daily life, integrating seamlessly into our routines and reshaping how we interact with the world. These devices have become an essential part of our daily routines, offering a vast array of capabilities that extend far beyond mere communication (11). Beyond communication, smartphones have become essential in healthcare, offering innovative ways to monitor, manage, and improve health outcomes (24). The number of mobile health applications increased exponentially, with over 350,000 health-related applications available as of 2021 (2), reflecting their expanding role in personal healthcare management. These applications have facilitated individuals' access to health information and enabled them to monitor and guide their health behaviours (12). Among the diverse range of mobile health applications, those specifically targeting musculoskeletal health stand out for their potential to address a major public health challenge through practical and personalized solutions (19). These applications provide a comprehensive toolkit for managing musculoskeletal health by offering pain relief strategies, guided exercises to improve strength and flexibility, posture correction techniques, and tools to monitor physical activity, thereby empowering users to take control of their health (22).

Musculoskeletal disorders affect over 1.7 billion people worldwide representing a significant public health challenge (4) by leading to chronic pain, disability, and reduced productivity (13). The effective management of musculoskeletal disorders increasingly relies on patient participation in self-care practices, which are essential for maintaining mobility, reducing pain, and preventing further injury alongside traditional treatments (9). While traditional care is typically provided in clinical settings, digital health solutions offer the advantage of continuous, real-time support that enhances self-management skills and promotes better health outcomes even outside of the clinical environment (1). Smartphone applications hold significant potential to deliver personalized, easily accessible, and engaging tools, transforming how individuals manage musculoskeletal health by integrating care into their daily lives (22). Despite the abundance of mobile health applications, those tailored to the Turkish-speaking population are limited, resulting in a significant deficit in readily accessible healthcare resources. Furthermore, a notable proportion of the Turkish-language applications were developed in foreign countries and subsequently translated. This study aims to develop a Turkish-language smartphone application designed for musculoskeletal health and to ascertain user engagement and, the effectiveness of the application on the musculoskeletal system

MATERIALS AND METHODS

The study was conducted at the Faculty of Physiotherapy and Rehabilitation between September 2018 and June 2019. The study was approved by the Non-Interventional Clinical Research and Ethics Committee of the Pamukkale University (Date: 01.08.2017, Number: 60116787-020/49864).

Participants

The inclusion criteria were as follows: being over 18 years of age, having an Android smartphone. The exclusion criteria were as follows: having an orthopedic, neurological or musculoskeletal disorder that may prevent participation in exercise training, having severe musculoskeletal pain.

Procedure

The study was carried out in four stages: Application development (Stage 1), Gathering feedback on the effect of the exercises on the musculoskeletal system (Stage 2), Collection of feedback from users regarding their experience with the application (Stage 3), Measurement of application performance (Stage 4). The data obtained during the 6-month period following the release of the application constituted the study results.

Application development (Stage 1): The application was called *Fizyoid*. The content was created by researchers, videos, GIFs, or images of the exercises and measurements in the application were prepared and the application was developed using mobile application builder (Mobiroller). The application was paired with Google and uploaded to the Google console by subscribing to the Google Play store. The prototype of the application was presented to five physiotherapists and five potential users. The application was updated according to the user's suggestions and was released on 27 December 2018.

At the initial launch of the mobile application, all users were presented with a digital form that combined informed consent and a privacy policy, including compliance with the Turkish Personal Data Protection Law (KVKK – Law No. 6698). This form explained the purpose of data collection, the voluntary nature of participation, and how personal and health-related data would be used for scientific research purposes. Users were required to explicitly accept the form via a checkbox; otherwise, the application would not proceed. This process ensured that informed consent was obtained digitally and in full compliance with ethical and legal standards.

The application was only available on the Android platform through the Google Play Store. All data collected through the application were anonymized before analysis and stored locally, with no access granted to third parties. Users' personal identities could not be linked to the data, ensuring participant confidentiality throughout the study.

The content of the application includes About Us, Personal Test, Exercise List, Recommendations and Usage, Ask the Physiotherapist, My Exercises, Exercise Diary, Share the Application, and Satisfaction Survey, which are described in more detail below.

The *About Us* page contains information about the application, musculoskeletal disorders, exercise and postural issues.

The *Personal Test* page allows users to self-assess their musculoskeletal system and a personalized exercise programme. It consists of two parts: Personal Information and Evaluations. Personal Information includes demographic (age, gender, weight, height) and clinical (medical conditions, presence, severity and location of pain, fall history, exercise habits) data. The Evaluations page contains measurements that are commonly used in physiotherapy and rehabilitation practices and provide clues about musculoskeletal conditions. Measurement procedures are explained with photos and videos for users to self-assessment.

Measurements included in the application are posture (photos with three different postural alignments), range of motion (cervical flexion and lateral flexion), flexibility (Apley's scratch test-bilateral, sit and reach test), balance (single leg stance test), muscle strength and endurance (plank test, 30 second sit to stand test). On the Evaluations page, the participant was asked to choose between photographs of three different postures: Round back posture, Kypholordotic posture, Healthy posture. They were asked to tick one of the options: presence or absence of tension during cervical flexion and lateral flexion. In Apley's scratch test, participants were instructed to mark "negative" if they could grasp their fingers and "positive" if they could not. In the sit-and-reach test, they were asked to tick "positive" if they could reach their toes and "negative" if they could not. For the one-leg standing test, participants who were able to stand on one leg for 45 seconds continuously were asked to tick "positive", and "negative" if they were unable to do so. Those who could stand on the plank position for 30 seconds were asked to tick ''positive'' and those who could not were asked to tick ''negative''. Finally, the total number of full sit-ups for 30 seconds was questioned.

User responses on the personal test page are accessed via Google Forms. Personal information was used to determine whether the user met the exclusion criteria, and users who met the exclusion criteria were emailed to advise them to consult a doctor before exercising.

Exercise List page contains a series of exercises designed to protect and improve the musculoskeletal health of adults who are inactive and do not have a diagnosed musculoskeletal condition. The exercise series are designed to start a warm up and end with stretch. The list of exercises includes How should I choose an exercise?, Full Body Workouts, Neck Exercises, Shoulder Exercises, Wrist Exercises, Waist Exercises, Hip Exercises, Knee Exercises, Ankle Exercises, Balance Exercises, Posture Exercises, and each exercise includes written explanations, videos, GIFs or pictures.

The application allows two types of exercise program planning: a personalized exercise programme planned by the physiotherapist or user-created custom exercise programme. The results of the personal test were used to create a personalized exercise programme planned by the physiotherapist. Based on these results, the researchers created an exercise programme specific to each user and sent it to them by e-mail. If the user wants to create their own exercise programme, information on how to choose the exercise series is included in the 'How should I choose exercises?

Recommendations and Usage contains information for users on how to use the application and what to consider when creating an exercise programme, such as tips on how to avoid injury during exercise or how to perform the exercise correctly.

Ask the Physiotherapist allows users to ask questions directly to the physiotherapist via email.

My Exercises allows the user to create a personal exercise list. The user can add favourite exercises and view exercise history.

Exercise Diary is designed to motivate the user to exercise and to establish exercise habits. The application sends daily notifications to the user.

The notification is defined as "Did you exercise today?" with "yes" and "no" answers (Figure 1).
Share the Application is designed to promote Fizyoid to a wider audience via social media or email.
The *Satisfaction Survey* includes a 5-point Likert type survey to measure users' satisfaction with the application, as well as open-ended questions for users to write suggestions (Figure 2).

Gathering feedback on the effect of the exercises on the musculoskeletal system (Stage 2): Users' "*Personal Test*" data was examined to collect feedback on the effect of the exercises on the musculoskeletal system.

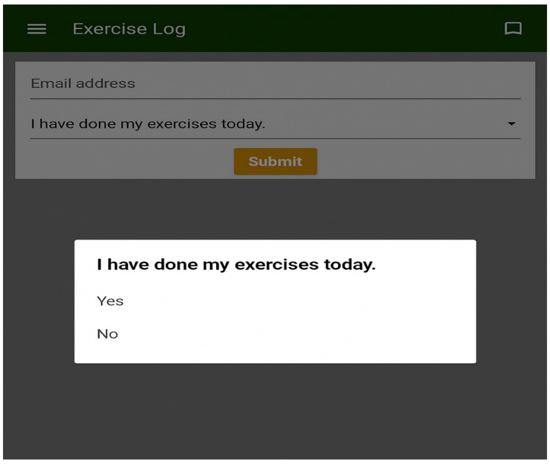

Figure 1. Exercise diary page screenshot

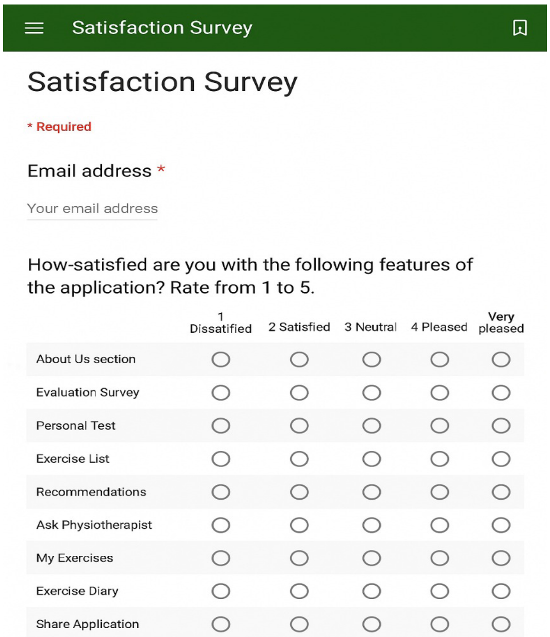

Figure 2. SatisfactionsSurvey page screenshot.

Data were analyzed from users who performed the exercises for four weeks and completed the *Personal Test* at the beginning and end were analyzed.

Collecting feedback from users on their experience of the application (Stage 3): Feedback was collected in order to update and improve the application based on the feedback and ratings from the application users with the *Satisfaction Survey*.

Measurement of application performance (Stage 4): The number of application downloads and content click rates during the 6-month period were determined using Mobiroller data and Google statistics.

Statistical Analysis

The Statistical Package for Social Sciences (version 21; SPSS Inc., Chicago, IL) was used to analyze the data. Continuous variables were presented as mean±standard deviation (minimum and maximum), median and categorical variables are presented as absolute numbers (n) and percentages (%). Categorical data were compared using the Chi-square ($\chi 2$) test. The Wilcoxon Signed Rank Test was used for within group comparisons. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

Application Performance

A total of 149 users downloaded the Fizyoid application between 28/12/2018 and 30/06/2019, logging in 723 times and viewed various screens 4,546 times. 49 users completed the *Personal Test*, 21 users used the application for four weeks and completed the *Personal Test* before and after. 9 users contacted the physiotherapist by e-mail. The *Exercise Diary* daily notifications were accessed by users 31 times. 2 users completed the *Satisfaction Survey*, and the application was reviewed by 9 users on Google Play and received a customer satisfaction rating of 4.7 stars.

Personal Test Outcomes

The Personal Test page was completed by 49 participants (21 male, 28 female) with an average age of 39.34±10.24 years (range: 19-57). Body weight was 73.67±13.49 kg (range: 46-105), height was 166±9.56 cm (range: 150-193) and the mean BMI was 26.63±3.81 (range: 18.87-36.51). 18 (36.7%) participants had medical conditions, 32 (65.3%) participants had the presence of pain. The body parts where participants reported pain were low back (n=8), back (n=9), neck (n=8), knees (n=4), feet (n=2), shoulders (n=1), elbows (n=1) and hands (n=1). 32 (65.3%) of the participants reported no exercise habits. None of the participants had a history of falls.

The self-assessment outcomes for posture, range of motion, flexibility, balance, muscle strength and endurance are presented in Table 1.

Table 1. Evaluations page outcomes.

	n (%)
Posture	
Round back posture	6 (12.2)
Kypholordotic posture	19 (38.8)
Healthy posture	24 (49)
Tension during cervical flexion	
Yes	14 (28.6)
No	35 (71.4)
Tension during cervical lateral flexion (right)	
Yes	30 (61.2)
No	19 (38.8)
Tension during cervical lateral flexion (left)	
Yes	29 (59.2)
No	20 (40.8)
Apley's scratch test (right)	
Positive	29 (59.2)
Negative	20 (40.8)
Apley's scratch test (left)	
Positive	37 (75.5)
Negative	12 (24.5)
Sit-and-reach test	
Positive	31 (63.3)
Negative	18 (36.7)
Single leg stance test (right)	
Positive	44 (89.8)
Negative	5 (10.2)
Single leg stance test (left)	
Positive	44 (89.8)
Negative	5 (10.2)
Plank	
Positive	36 (73.5)
Negative	13 (26.5)
	X±SD
30 second sit to stand test	15,18±5,18

The Effectiveness of the Application on the Musculoskeletal System

The Personal Test page was completed by 21 participants (9 male, 12 female) before and after 4 weeks of using the application. The mean age of the participants was 40.23±9.40 years (range: 27-57), body weight 74.42±12.87 kg (range: 53-100), height 166.61±9.93 cm (range: 150-193) and the mean BMI 26.78±4.01 (range: 20.70-36.51). 6 (28.6%) participants had medical conditions, 10 (47.6%) participants had the presence of pain. The body parts where participants reported pain were back (n=6), low back (n=1) neck (n=1), feet (n=1) and shoulders (n=1). 16 (76.2%) of the participants reported no exercise habits. None of the participants had a history of falls.

No significant differences were observed in the results of the posture, range of motion, flexibility, balance, muscle strength, and endurance tests at the four-week (Table 2).

DISCUSSION

The objective of this study was to develop a smartphone application for musculoskeletal health and to evaluate its acceptance, usage, and perceived benefits among users. The principal findings were as follows: the application was downloaded by 149 users, 49 of whom completed the personal test, 21 used the application for a period of four weeks, and 9 contacted the physiotherapist. The application was evaluated favourably, with an average rating of 4.7 out of 5 stars on Google Play. The self-assessment data from the Personal Test indicated that the majority of users reported some degree of musculoskeletal issues, with low back, back, and neck problems being the most prevalent. Among the 21 users who utilized the application for four weeks, no notable improvements were observed in the physical tests, which may be attributed to the limited duration of the study period. As of 2023, over 6 billion people worldwide use smartphones, which have become a powerful platform for health interventions (16). In light of the growing reliance on digital health tools, the development of a mobile application with a particular emphasis on musculoskeletal health presents a distinctive opportunity to leverage technology for improved health outcomes (6). The findings indicate that there is considerable interest and demand among users for a smartphone application designed to address musculoskeletal health concerns.

Table 2. Comparison of the results of the participants at baseline and week four.

	Baseline n (%)	Week 4 n (%)	p
Posture			
Round back posture	3 (14.3)	1 (4.8)	0.55
Kypholordotic posture	7 (33.3)	7 (33.3)	
Healthy posture	11 (52.4)	13 (61.9)	
Tension during cervical flexion			
Yes	5 (23.8)	4 (19)	0.500
No	16 (76.2)	17 (81)	
Tension during cervical lateral flexion (right)			
Yes	9 (42.9)	6 (28.6)	0.260
No	12 (57.1)	15 (71.4)	
Tension during cervical lateral flexion (left)			
Yes	10 (47.6)	5 (23.8)	0.099
No	11 (52.4)	16 (76.2)	
Apley's scratch test (right)			
Positive	11 (57.4)	10 (47.6)	0.500
Negative	10 (47.6)	11 (57.4)	
Apley's scratch test (left)			
Positive	16 (76.2)	17 (81)	0.500
Negative	5 (23.8)	4 (19)	
Sit-and-reach test			
Positive	15 (71.4)	15 (71.4)	0.633
Negative	6 (28.6)	6 (28.6)	
Single leg stance test (right)			
Positive	19 (90.5)	19 (90.5)	0.697
Negative	2 (9.5)	2 (9.5)	
Single leg stance test (left)			
Positive	20 (95.2)	20 (95.2)	0.756
Negative	1 (4.8)	1 (4.8)	
Plank			
Positive	17 (81)	18 (85.7)	0.500
Negative	4 (19)	3 (14.3)	
	X±SD	**X±SD**	
30 second sit to stand test	16±1.02	17.71±1.26	0.12

The favourable reviews and user engagement demonstrate that the application was well-received. However, the study also demonstrates the inherent difficulty in maintaining consistent engagement over time, which is a known challenge for digital health tools. Only 21 users completed both the pre- and post-test assessments, which highlights a major limitation in sustained user engagement and data completeness. The limited completion rate may be attributed to several factors, such as insufficient external motivation or accountability mechanisms, possible technical difficulties, low digital health literacy, or a lack of interactive and feedback features within the application. Potential solutions to enhance future engagement may include the integration of gamification elements, personalized progress tracking, push notifications, in-application reminders, and opportunities for direct feedback or interaction with healthcare professionals. These strategies could help reinforce user motivation and increase long-term adherence. The lack of any significant physical improvements among the twenty-one participants in this study during the relatively short four-week study period highlights the inherent challenge of achieving meaningful and sustainable improvements in musculoskeletal health within a short time frame. This finding is consistent with existing literature, which suggests that meaningful improvements in chronic musculoskeletal conditions typically require prolonged and consistent engagement, often extending beyond the duration of this study. For instance, it is recommended that the intensity and duration of the treatment should be moderate, with a duration of 60–120 minutes for a period of 7–15 weeks, to provide the greatest benefit in chronic musculoskeletal pain (5). This indicates that a longer-term usage and evaluation period may be necessary to fully assess the application's capacity to produce tangible physical benefits for users. It is anticipated that regular utilisation of the application will facilitate enhanced self-management abilities and among users and improvement in musculoskeletal problems. To build on these insights, future research should examine the long-term impact of using the application over a more extended period.

Musculoskeletal conditions represent the leading cause of disability worldwide and constitute a significant burden on global healthcare resources (21). The prevalence of musculoskeletal diseases is expected to rise in conjunction with the growth of the ageing population and the prevalence of individuals who fail to prioritize diet, lifestyle, health, and physical activity (10). The application was downloaded by 149 users, with a substantial number engaging with its content and features, including the personal test and exercise programmes. The average user rating of 4.7 stars on Google Play indicates a significant level of satisfaction with the functionality and content of the application. However, only two users completed the Satisfaction Survey, and nine users contacted the physiotherapist, indicating that although the application was well-received, there may be potential for enhancing user engagement. The application was not designed with the specific intention of appealing to the Turkish population. The creation of a Turkish application specifically designed for musculoskeletal health may have contributed to its favourable reception within the cultural and linguistic context of its users. Further research could examine the influence of cultural appropriateness on user engagement and health outcomes, potentially through comparative studies with non-Turkish applications. Furthermore, additional features could be incorporated into future developments of the application to enhance user feedback. These could include in-application messaging, more regular prompts, or gamification elements that reward active engagement (20). Integration of the mobile application with other interventions, such as face-to-face physiotherapy, may result in more pronounced benefits for musculoskeletal health. This could be achieved by combining the convenience and personalization of the digital platform with the expertise and hands-on guidance of healthcare professionals. A multimodal approach could leverage the strengths of both digital and traditional methods, enabling more comprehensive and effective solutions for the management of musculoskeletal conditions (7).

Exercise programmes for chronic musculoskeletal pain should be designed on an individual basis, considering the specific needs of each patient and in accordance with clinical guideline recommendations for the management of such conditions (5). One of the key advantages of the developed application is its capacity to generate personalized exercise programmes based on user input from the Personal Test. Personalization is of critical importance in the management of musculoskeletal health, given the significant inter-individual variability in needs and conditions. Although the study did not observe significant physical improvements within the short duration, the application's capacity to deliver tailored exercise regimens positions it as a valuable tool for long-term self-management. Furthermore, incorporating user feedback is a crucial step in enhancing the application and guaranteeing its alignment with the needs of the target population. By addressing the limitations identified in this preliminary study, the smartphone application can be further developed to serve as an effective tool for managing musculoskeletal health.

Mobile health tools have the potential to reduce the burden on healthcare systems by enabling patients with musculoskeletal conditions to manage their conditions independently (17). Widespread adoption of such applications can help to reduce the burden on healthcare resources by reducing the need for frequent face-to-face consultations and enabling patients to take a more active role in their health management. This could lead to cost savings and improved health outcomes on a larger scale (8). One of the main advantages of our mobile rehabilitation application is its ability to conduct assessments without the need for external electronic devices. Unlike previous studies that relied on tools such as iPod accelerometers to evaluate physical performance (18), our approach simplifies the user experience by eliminating the need for additional hardware. This enhances accessibility, particularly for users with limited resources or technological familiarity. Another strength of the application is the integration of real-time reminders, educational content, and feedback mechanisms, which were designed to support user motivation and promote consistent exercise habits. Prior research has shown that such features—including automated messaging and communication with healthcare professionals—can positively influence long-term health behaviors (23, 14, 3). In line with the findings of a research, our use of scheduled notifications also aimed to reinforce adherence, especially during the early stages of engagement (15). However, the study had several limitations, including a small sample size and short follow-up period, which may have limited the ability to detect significant physical changes. In addition, maintaining user engagement over time is a known challenge for digital health interventions, and this study is no exception. Furthermore, the application was created using a free application creation platform. Therefore, the application was limited to the services offered by the service provider and only for the Android operating system. The low completion rate of the satisfaction survey and minimal contact with the physiotherapist suggest that users could benefit from more robust engagement strategies. Enhancing the user experience through social features, regular motivational content, or community support within the application may help to maintain user interest and engagement over time.

CONCLUSION

In conclusion, this initial study demonstrates the potential for a smartphone application to engage users and address an important public health issue related to musculoskeletal disorders. Positive user feedback and interest suggest that such an application will be well received by its target audience. Nonetheless, the short duration of this study, combined with limited sustained engagement, restricts the ability to draw definitive conclusions about its effectiveness. Addressing these limitations in future iterations may unlock the full potential of such digital tools in improving musculoskeletal health outcomes.

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Conflict of interest: All authors declare that they have no conflicts of interest.

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