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Research Article

User-Centered Usability Evaluation of the DiaCare App for Diabetes Self-Management: A uMARS Analysis

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Abstract

Background: Diabetes mellitus (DM) is a common illness that requires appropriate self-management for the best health outcomes. Mobile health (mHealth) apps, such as DiaCare, can improve management of DM. However, usability issues must be solved to ensure long-term user involvement and effectiveness. ***Objective***: To assess the usability of the DiaCare app for DM management using quantitative and qualitative approaches. ***Methods***: A total of 100 participants took part, including fifty Type 2 diabetes (T2DM) patients and fifty healthy subjects. Data were gathered using the uMARS tool, which evaluated six domains: interaction, performance, visual appeal, information quality, perceived impact, and subjective evaluation. ***Results***: Healthy subjects demonstrated superior ratings in all domains except perceived impact. The qualitative analysis showed the importance of a personalized, interactive app for DM control. ***Conclusions***: While DiaCare provides benefits, more customization is required to suit the demands of T2DM patients, particularly in terms of personalization and navigation. Future research should focus on social interaction aspects to improve user assistance.

Keywords: DiaCare app, Customization, Diabetes management, Mobile health, Usability, User experience.

تقييم قابلية الاستخدام المتمحور حول المستخدم لتطبيق DiaCare للإدارة الذاتية لمرض السكري: تحليل uMARS

الخلاصة

الخلفية: داء السكري (DM) هو مرض شائع يتطلب الإدارة الذاتية المناسبة للحصول على أفضل النتائج الصحية. يمكن لتطبيقات صحة الجوال (mHealth)، مثل DiaCare، تحسين إدارة DM. ومع ذلك ، يجب حل مشكلات قابلية الاستخدام لضمان مشاركة المستخدم وفعاليته على المدى الطويل. **الهدف**: تقييم قابلية استخدام تطبيق DiaCare لإدارة DM باستخدام الأساليب الكمية والنوعية. **الطرائق**: شارك ما مجموعه 100 مشارك ، بما في ذلك خمسون مريضا بمرض السكري من النوع 2 (T2DM) وخمسين شخصا أصحاء. تم جمع البيانات باستخدام أداة uMARS ، التي قيمت ستة مجالات: التفاعل، والأداء، والجاذبية البصرية، وجودة المعلومات، والتأثير المتصور، والتقييم الذاتي. **النتائج**: أظهر الأشخاص الأصحاء تقييمات متفوقة في جميع المجالات باستثناء التأثير المتصور. أظهر التحليل النوعي أهمية وجود تطبيق شخصي وتفاعلي للتحكم في DM. **الاستنتاجات**: بينما يوفر DiaCare مزايا جيدة، هناك حاجة إلى مزيد من التخصيص ليناسب متطلبات مرضى T2DM، لا سيما فيما يتعلق بالتخصيص والتنقل. وينبغي أن تركز البحوث المستقبلية على جوانب التفاعل الاجتماعي لتحسين مساعدة المستعملين.

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INTRODUCTION

Diabetes mellitus affects over 537 million adults globally, with this number projected to reach 643 million by 2045 [1]. Effective diabetes management relies heavily on patients' ability to perform self-management tasks, such as monitoring blood sugar, adhering to medication, maintaining diet, and regular physical activity [2,3]. However, the complexity of these tasks often leads to inconsistent management, resulting in long-term complications [4]. Mobile health (mHealth) apps offer solutions for better condition management by enabling users to track health metrics, set medication reminders, and access educational resources. Research shows mHealth interventions can improve self-care behaviors and health outcomes [3,5]. However, usability issues often hinder long-term engagement and satisfaction, limiting their impact [6]. Many diabetes management apps face usability challenges [7]. which must be addressed to improve patient outcomes. The DiaCare app supports diabetes management with features like blood sugar tracking, medication reminders, exercise monitoring, and educational materials. While initial feedback has been positive, a comprehensive usability evaluation is needed. The User Mobile Application

Rating Scale (uMARS) assesses usability across six domains: interaction, performance, visual appeal, content accuracy, perceived impact, and subjective evaluation [8]. This study aims to evaluate DiaCare using uMARS to identify strengths and areas for improvement, especially in enhancing user engagement.

METHODS

Study Design

This cross-sectional study assessed the usability of the DiaCare app among Type 2 Diabetes (T2D) patients and non-patients, utilizing the User Mobile Application Rating Scale (uMARS) to evaluate six domains: interaction, performance, visual design, content accuracy, perceived impact, and subjective evaluation [8]. Data collection was conducted via structured face-to-face surveys between January and March 2024.

Study participants and data collection

Participants were recruited from health facilities in Tasikmalaya City, Indonesia. Two groups of participants were included: T2DM patients with at least one-year of self-management experience and non-patients using fitness or health-tracking apps. A total of 100 participants (50 per group) were selected through purposive sampling. Each participant used the DiaCare app for four weeks before completing the uMARS survey. Open-ended questions were also included to gather qualitative insights.

Ethical consideration

Informed consent was obtained, and data was anonymized to ensure confidentiality. The study received ethical approval from the Ethics Committee of Bakti Tunas Husada University (No. 290/E.01/KEPK-BTH/XI/2023).

Data management and statistical analysis

The research team processed and stored participant data securely in an encrypted database, ensuring privacy by anonymizing all personal information. Data from uMARS and open-ended responses were verified for accuracy. Quantitative data were analyzed using SPSS version 26, employing summary statistics, Spearman's correlation, and t-test to compare usability ratings between T2DM patients and non-patients, with Cronbach's alpha used to assess internal consistency. Qualitative data were analyzed using thematic analysis to identify patterns and areas for app improvement.

RESULTS

The participant characteristics are summarized in Table 1. A total of 100 participants were included, comprising 50 T2DM patients and 50 non-diabetic healthy individuals. The average age was 42.08±17.19 years.

Table 1: Respondent Characteristics (n=100)

Characteristic	Value
Age (year), mean±SD	42.08±17.196
Age (year), n(%)	
<40	56(56)
40-59	22(22)
60-65	11(11)
≥65	11(11)
Gender, n(%)	
Male	92(92)
Female	8(8)
Educational level, n(%)	
Primary-Secondary education	28(28)
Secondary education	34(34)
Tertiary education	38(38)
Employment type, n(%)	
Public sector employee	39(39)
Private employee	24(24)
Entrepreneur	2(2)
Unemployed	22(22)
Others	13(13)

The age distribution was as follows: 56% were under 40, 22% were between 40-59, 11% were 60-65, and 11% were over 65. Most participants were males (92%), with only 8% females. In terms of education, 28% had elementary to junior high education, 34% were high school graduates, and 38% had a college degree. Regarding employment, 39% were civil servants, 24% worked in private sectors, 2% were entrepreneurs, 22% were unemployed, and 13% were in other sectors. Table 2 presents the mean and standard deviation for each uMARS domain: interaction (3.68±0.86), performance (3.15±1.21), visual appeal (3.47±1.14), content accuracy (3.51±1.04), perceived impact (4.42±0.62), and personal evaluation (3.81±1.09). In Table 2, Spearman's correlation analysis revealed that age was inversely correlated with interaction (r= -0.206, p< 0.05), performance (r= -0.387, p< 0.01), and visual appeal (r= -0.423, p< 0.01), but positively associated with perceived impact (r= 0.561, p< 0.01). Education level was positively correlated with performance (r= 0.554, p< 0.01), visual appeal (r= 0.575, p< 0.01), and content accuracy (r= 0.588, p< 0.01), indicating that participants with higher education rated these aspects more favorably.

Table 2: Descriptive analysis of each domain (n=100)

Domain	Value
Interaction	3.68±0.86
Performance	3.15±1.21
Visual Appeal	3.47±1.14
Content Accuracy	3.51±1.04
Perceived Effect	4.42±0.622
Personal Evaluation	3.81±1.09

Values were expressed as mean±SD.

Occupation was negatively correlated with interaction (r= -0.240, p< 0.05), performance (r= -0.475, p< 0.01), and visual appeal (r= -0.479, p< 0.01), but positively correlated with perceived impact (r= 0.441, p< 0.01). The relationship between uMARS variables, including interaction, performance, visual appeal,

content accuracy, perceived effect, and personal evaluation, and sociodemographic factors was analyzed using Spearman's correlation test. Spearman's rho and *p*-values were determined to evaluate the correlations between mobile app dimensions and sociodemographic factors, such as age, gender, education, and occupation (Table 3).

Table 3: Spearman's correlation between uMARS variables and sociodemographic factors

Sociodemographic Variables	uMARS Domains (*r*)					
	Interaction	Performance	Visual Appeal	Content Accuracy	Perceived Effect	Personal Evaluation
Age group	-0.206*	-0.387**	-0.423**	-0.365**	0.561**	-0.370**
Sex	0.008	-0.021	0.007	-0.009	0.092	-0.175
Education Levels	0.214*	0.554**	0.575**	0.588**	-0.247*	0.145
Employment type	-0.240*	-0.475**	-0.479**	-0.548**	0.441**	-0.198*

*p<0.05, **p<0.01

The results showed a notable inverse relationship between age and several key variables, specifically interaction (r= -0.206, p< 0.05), performance (r= -0.387, p< 0.01), and visual appeal (r= -0.423, p< 0.01). This indicates that older respondents tend to rate these aspects of the application lower. In contrast, age demonstrated a meaningful positive association with perceived benefit (r= 0.561, p< 0.01), suggesting that older users feel a greater benefit or positive effect from the app. Gender did not show a significant correlation with most uMARS variables, except for some small, non-significant correlations, such as with subjective quality. Education level had a significant positive correlation with all uMARS variables, especially with performance (r= 0.554, p< 0.01) and visual appeal (r= 0.575, p< 0.01). This suggests that respondents with more advanced education are likely to give more positive ratings for the app's performance and visual appeal. A significant positive correlation was also observed with information quality (r= 0.588, p< 0.01), suggesting that higher levels of education are associated with better assessments of the content provided by the app. Occupation showed a significant inverse relationship with interaction (r= -0.240, p< 0.05), performance (r= -0.475, p< 0.01), and visual appeal (r= -0.479, p< 0.01), indicating that individuals with certain occupations tend to rate these aspects lower. However, a notable positive association was identified between occupation and perceived benefit (r= 0.441, p< 0.01), showing that respondents with certain occupations perceive a greater positive impact from the app. Table 4 presents the differences in app usability ratings between patients and non-patients. The *t*-test analysis reveals significant differences in the usability ratings of the DiaCare app between individuals with type 2 diabetes (patients) and those without diabetes (healthy subjects) based on uMARS scores.

Table 4: Differences in App usability ratings between T2DM patients and healthy subjects

Domain	Control (n=50)	DM patients (n=50)	*p*-value	Average difference	Effect size (Cohen's d)
Interaction	3.92±0.72	3.44±0.93	0.005	0.48	0.58
Performance	3.64±1.29	2.66±0.89	0.000	0.98	0.87
Visual Appeal	3.98±1.02	2.96±1.03	0.000	1.02	1.00
Content Accuracy	3.04±0.86	3.04±0.86	1.000	0.00	0.00
Perceived Effect	4.08±0.60	4.16±0.37	0.425	-0.08	-0.15
Personal Evaluation	4.28±0.61	3.34±1.26	0.000	0.94	0.93

Healthy subjects rated higher on engagement (3.92 *vs*. 3.44; t= 2.881; p= 0.005), functionality (3.64 *vs*. 2.66; t= 4.415; p< 0.001), and aesthetics (3.98 *vs*. 2.96; t = 4.977; p< 0.001) with medium to large effect sizes. They also provided better ratings on information quality (3.98 *vs*. 3.04; t= 5.050; p< 0.001) and subjective quality (4.28 *vs*. 3.34; t= 4.766; p< 0.001). Conversely, patients reported a greater perceived impact of the app (4.76 *vs*. 4.08; t= -6.502; p< 0.001), indicating that the app provides significant benefits in supporting their health management. No significant differences were found in information quality, with identical mean values between both groups (3.04). Overall, these findings suggest that the app better meets the usability and aesthetic expectations of non-patients, while patients tend to experience a greater positive impact from its use. The validity test using Pearson's correlation indicated that most key variables (engagement, functionality, aesthetics, and information quality) had significant correlations, with correlation values above 0.50, demonstrating good construct validity. Strong associations were identified between performance and visual appeal (r= 0.817, p< 0.01), and between performance and information quality (r= 0.786, p< 0.01). However, the variables perceived impact, and subjective quality did not show significant correlations with other variables, suggesting that these two may not be closely related in this context. For reliability, Cronbach's alpha score of 0.740 reflects an acceptable degree of internal reliability. This value is above the minimum threshold of 0.70, which is generally considered an acceptable indicator of reliability in research. Qualitative analysis employed open-ended questions within the uMARS survey to gain insights into user experiences with the DiaCare application. The data was analyzed using a thematic approach through six steps to discern themes and trends within the qualitative data [9]: 1) Familiarization with the data to understand user context and experiences; 2) Coding based on recurring patterns and keywords; 3) Identifying themes by grouping the codes into broader categories; 4) Verifying themes for correctness; 5) Establishing and labeling final themes; and 6) Reporting the findings.

This analysis resulted in several main themes and sub-themes, as listed in Table 5**.** Users felt that notification features and achievement badges helped them stay motivated in managing their diabetes. Some noted that interactive elements, such as daily health tips, made the app more engaging.

Table 5: Qualitative analysis results

Theme	Sub-them	Description
Interaction	Motivation	Users benefit from notifications and gamification elements.
	Interactivity	Interactive elements enhance engagement, but social features are desired.
Performance	Ease of Use	The app is easy to use, but feature accessibility needs improvement.
Visual Appeal	Design Visual	The design is appreciated, but further customization is expected.
Content Accuracy	Education	The content is considered helpful, but it needs to be simplified and personalized.
Perceived Effect	Empowerment	Users feel more in control and confident in managing their diabetes.
Personal Evaluation	Trust in Information	The information is seen as credible, but personalization is desired.

However, they also expressed a desire for social interaction features to share experiences with other users. "Daily notifications are very helpful in reminding me to check my glucose levels and take medication on time." "I wish there was a community feature so I could share experiences and tips with other users." Most users appreciated the ease of use of the app, though some found certain features, such as the glucose tracker, difficult to access. They desired better accessibility for key features to make the app more practical. "The app is fairly easy to use, but I wish the food logging feature was more visible, as it is often hidden in the menu." The simple and clean visual design was appreciated by users, especially those less familiar with technology. However, there were requests for customization options, such as text size adjustments and color schemes, to make the app more comfortable to use. "The design is simple and appealing, making it easy for someone like me who isn't tech-savvy." "It would be great if I could adjust the text size to make it easier on my eyes." Users valued the educational content provided, but some found the information too technical. They expressed a need for more personalized and relevant advice tailored to their diabetes condition. "The educational content is very helpful, but I would like more specific information tailored to my diabetes condition." Users reported improvements in their health management and noted the positive impact of the app, including behavior changes and increased confidence in managing their diabetes. "The app helps me be more consistent in managing my diabetes, and I feel healthier." "Since using the app, I feel more confident in managing my health condition." While most users trusted the credibility of the app's information, they wanted more personalized information that matched their specific conditions. "I feel the information provided by the app is reliable, but I wish for more personalized recommendations." "The information is good, but I would like features that can tailor recommendations based on my data." Non-diabetic users gave the app a higher score for interaction, performance, visual appeal, and content accuracy in comparison with Type 2 diabetic users. The t-tests showed significant differences, particularly in functionality and aesthetics, suggesting the app aligns more closely with non-diabetic user expectations. Type 2 diabetic users hoped for the app to be more personalized and specific in supporting their diabetes management. They suggested improvements in information personalization, ease of navigation, and access to relevant features. The combined results indicate that while the DiaCare app is beneficial, specific needs of Type 2 diabetic users are not fully met. Developers need to integrate more personalized and interactive features and present content that is relevant and tailored to the specific needs of diabetic users to enhance overall effectiveness and user satisfaction.

DISCUSSION

This study evaluates the usability of the DiaCare app for diabetes management using a combined methodology, integrating both quantitative and qualitative evaluations to offer a thorough perspective of user experiences. Quantitative results indicate that non-diabetic users rated the app higher than diabetic users in domains including interaction, performance, visual appeal, and content accuracy. The results indicate that the application may be more effective for general users than for diabetic patients, consistent with previous literature emphasizing the importance of adapting apps based on users' specific needs [10]. Type 2 diabetic users reported difficulties with navigation and found the given information less relevant, indicating the need for a more personalized and specific app design. These findings align with literature suggesting that health apps should be personalized to enhance user engagement and satisfaction [11,12]. Qualitative analysis revealed that diabetic users requested more tailored content and easier navigation. To optimize the app for both groups, it is crucial to enhance personalization, improve navigation, and integrate diabetes-specific content. This aligns with the literature emphasizing the importance of adaptive and individualized approaches in mHealth app development [13,14]. Functional analysis showed significant differences between diabetic and non-diabetic users, with non-diabetics more satisfied with the app's functionality. This highlights the need to enhance accessibility and feature customization to better serve diabetic patients. The aesthetics domain also showed significant differences, with non-diabetics appreciating the app's visual design more. This suggests that an appealing and functionally relevant visual design is crucial for enhancing user experience, particularly for those with chronic conditions [15]. Although diabetic users reported a slightly more positive impact from the app

compared to non-diabetic users, this difference was not statistically significant, indicating similar effectiveness in supporting health management for both groups. These findings suggest that we can further develop mHealth apps to align the content and features with the specific needs of diabetic users [16]. There were significant differences in the engagement and functionality ratings between diabetic and non-diabetic users, with non-diabetics providing higher ratings. This indicates that the app is more engaging for non-diabetics or easier for them to use. To increase engagement among diabetic patients, interactive features and personalized content that are more relevant to their needs are required. Additionally, although diabetic users rated the app's impact slightly higher than non-users, this difference was not statistically significant. This suggests the app has similar effectiveness in supporting health management for both groups. Literature supports the importance of intuitive and user-preference-based app designs to enhance the effectiveness of mHealth applications [13,16]. Overall, although the DiaCare app shows significant benefits, further adjustments are necessary to meet the specific needs of type 2 diabetic users. This includes enhancing personalization and improving navigation accessibility, aligning with the literature that emphasizes an inclusive and adaptive design approach in digital health applications [17]. The results of the reliability and validity analysis show that most of the main variables, like engagement, functionality, aesthetics, and information quality, have significant correlations above 0.50. This means that the constructed validity is good. A very strong correlation was found between functionality and aesthetics (r= 0.817) and between functionality and information quality (r= 0.786), reinforcing the interconnectedness of these elements within mHealth applications. However, perceived impact and subjective quality variables did not show significant correlations with other variables, suggesting these variables may have a more specific role and are not fully integrated within the overall app framework. In terms of reliability, Cronbach's Alpha score of 0.740 demonstrates strong internal reliability, exceeding the minimum threshold of 0.70 commonly used in research. This result is consistent with Yalin-Ucar *et al*.'s research, which reported that Cronbach's alpha value above 0.70 can be considered an adequate indicator of reliability in scale measurement research [18]. Qualitative analysis revealed that type 2 diabetic users desire more relevant personalization of information and interactivity for managing their condition. Although they reported positive impacts, such as increased health control, they also expressed the need for more intuitive navigation and easier access to key features. Previous studies support the importance of personalization in digital health apps to enhance effectiveness and user engagement [19,20]. Personalized information has proven to enhance engagement and compliance in digital health interventions [21,22]. Therefore, app developers must focus on user-centered design and enhance personalization and interactivity features to effectively support the needs of diabetic users. While the DiaCare app offers benefits, it does not fully meet the specific needs of type 2 diabetic users, according to an integrated interpretation of quantitative and qualitative results. Users emphasize the importance of personalization and interactive features tailored to their needs, aligning with recent literature that suggests designing health apps based on user preferences and needs to improve effectiveness [17,23]. Previous studies also highlight that an inclusive and adaptive approach in health app development can increase user engagement and satisfaction (24). Therefore, developers need to include elements that enable better content customization, and social interaction features to enhance health outcomes and ensure app optimization, as these have proven effective in increasing user engagement and trust in the provided information [25].

Study limitations

This study has several limitations, including a small sample size of 100 participants, which may limit the generalizability of the findings. The data relied on self-reported measures, which could introduce bias. The cross-sectional design provides only a snapshot without examining long-term changes. Additionally, the study only included T2DM patients and non-patients, excluding other groups like type 1 or gestational diabetes patients. Future research should include a larger and more diverse sample for more comprehensive results.

Conclusion

The findings of this study indicate that the DiaCare application is effective in supporting T2DM management, particularly in terms of engagement and positively influencing user behavior changes. However, there are still unmet needs, such as the development of more specific and personalized features, as well as easier access to relevant information. Users also expressed a desire for social interaction features within the application, enabling them to share experiences with other diabetes patients. This suggests that further development should focus on enhancing personalization and interactive features to meet the specific needs of diabetic users better.

Recommendations for future research

Future research is recommended to delve deeper into the personalization aspects of digital health applications, particularly for managing T2DM. Development efforts could focus on features that adjust content based on real-time user health data. Additionally, researchers could explore the integration of social interaction features that allow communication between users with similar conditions to strengthen social support. A deeper exploration of diverse user experiences could also help identify

specific needs across different user groups, making the application more inclusive and effective in supporting diabetes management.

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Conflict of interests

No conflict of interest was declared by the authors.

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Data sharing statement

The datasets used and analyzed during this study are not publicly available due to participant confidentiality and ethical considerations. However, they are available from the corresponding author upon reasonable request. Access will be granted only after obtaining the necessary approvals from the institutional review board and ensuring compliance with ethical guidelines.

REFERENCES

1. International Diabetes Federation. International Diabetes Federation, (10th ed.), Vol. 102, Diabetes Research and Clinical Practice. IDF Diabetes Atlas 2021;2021:147–148.
2. Amerzadeh M, Shafiei Kisomi Z, Senmar M, Khatooni M, Hosseinkhani Z, Bahrami M. Self-care behaviors, medication adherence status, and associated factors among elderly individuals with type 2 diabetes. *Sci Rep*. 2024;14(1):1–9. doi: 10.1038/s41598-024-70000-w.
3. Shrivastava TP, Goswami S, Gupta R, Goyal RK. Mobile App interventions to improve medication adherence among type 2 diabetes mellitus patients: A systematic review of clinical trials. *J Diabetes Sci Technol*. 2023;17(2):458–466. doi: 10.1177/19322968211060060.
4. Yapislar H, Gurler EB. Management of microcomplications of diabetes mellitus: Challenges, current trends, and future perspectives in treatment. *Biomedicines*. 2024;12(9):1958. doi: 10.3390/biomedicines12091958.
5. Liaqat M, Mushtaq M, Jamil A, Mushtaq MM, Ali H, Anwar R, et al. Mobile health interventions: A frontier for mitigating the global burden of cardiovascular disease. *Cureus*. 2024;16(6). doi: 10.7759/cureus.62157.
6. Chen J, Liu Z, Huang X, Wu C, Liu Q, Jiang G, et al. When large language models meet personalization: perspectives of challenges and opportunities. *World Wide Web*. 2024;27(4):1–45. doi: 10.48550/arXiv.2307.16376.
7. Deniz-Garcia A, Fabelo H, Rodriguez-Almeida AJ, Zamora-Zamorano G, Castro-Fernandez M, del Pino Alberiche Ruano M, et al. Quality, usability, and effectiveness of mHealth Apps and the role of artificial intelligence: Current scenario and challenges. *J Med Internet Res*. 2023;25. doi: 10.2196/44030.
8. Stoyanov SR, Hides L, Kavanagh DJ, Wilson H. Development and validation of the user version of the mobile application rating scale (uMARS). *JMIR Mhealth Uhealth*. 2016;4(2):1–5. doi: 10.2196/mhealth.5849.
9. Braun V, Clarke V. Reflecting on reflexive thematic analysis. *Qual Res Sport Exerc Health*. 2019;11(4):589–597. doi: 10.1080/2159676X.2019.1628806
10. Wang W, Grundy J, Khalajzadeh H, Madugalla A, Obie HO. Designing adaptive user interfaces for mHealth applications targeting chronic disease: A User-centric approach. *ACM Trans Softw Eng Methodol*. 2024;1(1). doi: 10.48550/arXiv.2405.08302.
11. Yoon S, Tang H, Tan CM, Phang JK, Heng Y. Acceptability of mobile App-based motivational interviewing and preferences for App features to support self-management in patients with type 2 diabetes: Qualitative study. *JMIR Diabetes*. 2024;9:1-13. doi: 10.2196/48310.
12. Giebelmann K. Customization in eHealth interventions. A possibility for patients with chronic illnesses, overcoming technological barriers and promoting user engagement. Master Thesis, University of Twente, July 2020.
13. Eaton C, Vallejo N, Mcdonald X, Wu J, Rodr R, Muthusamy N, et al. User engagement with mHealth interventions to promote treatment adherence and self-management in people with chronic health conditions: Systematic review. *J Med Internet Res*. 2024;26:1–32. doi: 10.2196/50508.
14. Alruwaili MM, Shaban M, Elsayed Ramadan OM. Digital health interventions for promoting healthy aging: A systematic review of adoption patterns, efficacy, and user experience. *Sustain*. 2023;15(23). doi: 10.3390/su152316503.
15. Kopatich RD, Steciuch CC, Feller DP, Millis K, Siegesmund R. Development and validation of the aesthetic processing preference scale (APPS). *Psychol Aesthetics, Creat Arts*. 2021;17(5):645–659. doi: 10.1037/aca0000449.
16. Fu HNC, Wyman JF, Peden-McAlpine CJ, Draucker CB, Schleyer T, Adam TJ. App design features important for diabetes self-management as determined by the self-determination theory on motivation: Content analysis of survey responses from adults requiring insulin therapy. *JMIR Diabetes*. 2023;8:1–15. doi: 10.2196/38592.
17. Maqbool B, Herold S. Potential effectiveness and efficiency issues in usability evaluation within digital health: A systematic literature review. *J Syst Softw*. 2023;111881. doi: 10.1016/j.jss.2023.111881.
18. Yalın-Uçar M, Bağatarhan T, Yakıt G, Ekici MB, Erol A, Kızılaslan HN. Development of the reasoning ways scale: Validity and reliability study. *Kalem Uluslararasi Egit ve Insa Bilim Derg*. 2024;14(1):129-154. doi: 10.23863/kalem.2023.267
19. Hornstein S, Zantvoort K, Lueken U, Funk B, Hilbert K. Personalization strategies in digital mental health interventions: a systematic review and conceptual framework for depressive symptoms. *Front Digit Heal*. 2023;5:1–14. doi: 10.3389/fdgth.2023.1170002.
20. Korpershoek YJG, Hermsen S, Schoonhoven L, Schuurmans MJ, Trappenburg JCA. User-centered design of a mobile health intervention to enhance exacerbation-related self-management in patients with chronic obstructive pulmonary disease (Copilot): Mixed methods study. *J Med Internet Res*. 2020;22(6):1–19. doi: 10.2196/15449.
21. Asimakopoulos S, Asimakopoulos G, Spillers F. Motivation and user engagement in fitness tracking: Heuristics for mobile healthcare wearables. *Informatics*. 2017;4(1). doi: 10.3390/informatics4010005.
22. Dirin A, Nieminen M, Laine TH. Feelings of Being for Mobile User Experience Design. *Int J Hum Comput Interact*. 2023;39(20):4059–4079. doi: 10.1080/10447318.2022.2108964.
23. Oyebode O, Fowles J, Steeves D, Orji R. Machine learning techniques in adaptive and personalized systems for health and wellness. *Int J Hum Comput Interact*. 2023;39(9):1938–1962. doi: 10.1080/10447318.2022.2089085.
24. Familoni BT, Odetunde Babatunde S. User experience (Ux) design in medical products: Theoretical foundations and development best practices. *Eng Sci Technol J*. 2024;5(3):1125–1148. doi: 10.51594/estj.v5i3.975.
25. Albayrak T, Rosario González-Rodríguez M, Caber M, Karasakal S. The use of mobile applications for travel booking: Impacts of application quality and brand trust. *J Vacat Mark*. 2023;29(1):3–21. doi: 10.1177/13567667211066544.