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Design and Evaluation of Mobile-Based Self-Care Application to Prevent Lumbar Disc Hernia for Nurses

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Abstract

Background: One of the most common musculoskeletal disorders in the spine is considered to be lumbar disc hernia. It is believed that nurses commonly encounter this disorder owing to the severe working environment. The present survey aims to design and evaluate mobile-based self-care application to prevent lumbar disc hernia in nurses.

Methods: The method of this research, consists of three parts: needs assessment, designing and evaluation. 20 nurses participated in pre- and post-test evaluations. The "Information Needs Assessment" questionnaire was completed by 10 experts and was assessed with Cronbach's alpha coefficient (Alpha=0.930), "Self-assessmenttest" with Cronbach's alpha coefficient (Alpah=0.820) and "Knowledge Assessment" test with Cronbach's alpha coefficient (Alpah=0.944). An application with Kathleen's programming language was created under the Android operating system and was evaluated by 5 experts based on the "Nelson Usability" questionnaire. Data analysis was performed with SPSS software version 22.

Results: This designed application capabilities are as follows: 1. Providing educational content in four areas of lumbar disc hernia, ergonomics, stress management and exercise, 2. Recording information in health record and announce warnings about clinical features, 3. Recording Body Mass Index (BMI) and announce the necessary warning to observe weight balance, 4.Giving the chance to nurses to test themselves both, before and after using the self-care-application. The t-test value of 0.613, in connenction with a highly significant ($p<0.001$) indicates that the observed improvement in nurses' knowledge after using the application is statistically significant (the mean pre-test score was 11.05, while the post-test score increased to 15.55). This demonstrates that the intervention had a measurable effect beyond what might be expected by chance.

Conclusion: This study reveals the fact that the use of the above-mentioned self-care application leads to the improvement of knowledge. Therefore, it is highly recommended that a mobile-based self-care application including knowledge, insight, and educational contents of lumbar disc hernia, ergonomics, stress management and exercise can help nurses acquire self-care skills in the prevention of lumbar disc hernia. This app has the potential to reduce workplace injuries to lower healthcare costs and improve nurse retention by fostering self-care practices.

Keywords: Lumbar disc hernia, Mobile applications, Nurses, Self care, Knowledge assessment

Introduction

The World Health Organization (WHO), among occupational diseases, ranks occupational musculoskeletal disorders second after respiratory-occupational diseases and enumerates it as the second leading cause of physical disability worldwide (1,2). Musculoskeletal disorders are a major occupational health issue, causing economic burdens, disability, and reduced quality of life worldwide (1-3). In particular, health care professionals are at risk for musculoskeletal disorders (4). This disorder is one of the serious and costly problems of the high-risk group of the nursing profession and is also common among Iranian nurses. Nurses, the largest professional group in the health care system, have a high rate of musculoskeletal disorders (4,5).

Musculoskeletal disorders are a major workplace challenge for nurses, caused by intense physical activities and psychological-organizational factors (1,2,4). The highest prevalence of musculoskeletal disorders in the working population is related to the lower back, which shows a prevalence of low back pain between 51 to 90% during life (4). Also, in nurses, the most common symptoms of these disorders are in the lower back (6). Nurses face a high risk of low back pain due to prolonged physical activities, heavy lifting, and repetitive movements that strain the lumbar region (4,7). Among occupations, nurses rank third in the prevalence of low back pain (7,8). According to the above-mentioned issues, studies show that nurses can enhance the principles of self-care as much as possible by increasing knowledge on self-care behaviors and improving their working conditions, which is one of the main pillars of patient education in various fields. Otherwise, nurses will not be able to take care of themselves and their patients if they are not in good general health, and this may increase the risk of disc hernia as well as occupational problems (9). Nurses in developing countries face greater occupational health risks due to limited monitoring programs.

Applying ergonomic principles and regular health assessments can reduce musculoskeletal disorders like low back pain. Smart tools enhance self-care, knowledge, and nursing skills, aiding disease management effectively (7,10,11). Smart mobile health tools and applications are essential for nurses' self-care in the workplace. Advances in mobile technology have expanded its role beyond communication, enabling its integration into healthcare. Mobile-based self-care apps help manage health, prevent side effects, and support effective disease management (12). Studies show that educational programs are effective in improving knowledge to prevent lumbar hernias (13). Studies show that many mobile health software and applications focus on self-monitoring and self-care (14) and have greatly enhanced self-care capabilities in a range of health care activities (15). The ubiquity of mobile phones creates a new way to face or deal with various obstacles to adapt and maintain self-care behaviors (16).

Nurses are especially vulnerable because of their continuous exposure to intense physical activities—such as bending, lifting, and prolonged standing—which are known as risk factors for low back pain. Studies report that up to 90% of nurses experience low back pain during their lifetime, and lumbar disc herniation is among the most common and debilitating conditions in this high-risk group.

Despite the existence of numerous mobile health applications focused on self-monitoring, few have been tailored specifically to address the multidimensional nature of self-care in nursing. Our application distinguishes itself by integrating evidence-based content with interactive features that focus on three critical aspects: ergonomics, stress management, and exercise education. By enhancing nurses' knowledge and self-care behaviors, the app aims to reduce the incidence of lumbar disc herniation while improving overall workplace safety.

Furthermore, recent literature underscores the potential of digital tools to support preventive health measures among healthcare professionals. Nonetheless, there is limited research on targeted interventions for nurses. Thus, the primary objectives of this study are to design and evaluate a mobile-based self-care application that:

1. delivers tailored educational content on ergonomics, stress management, and exercise; 2. improves self-assessment and knowledge regarding lumbar disc herniation prevention; and 3. demonstrates high usability and potential for broader implementation in healthcare settings.

Materials and Methods

The present study is applied research in the field of health with the aim of designing, implementing and evaluating a mobile-based self-care application to prevent nurses from developing lumbar disc hernia in Ayatollah Rouhani Hospital in Babol. This hospital provides health service in general, specialized and sub-specialized wards in Mazandaran. This research has five steps namely identifying the required information elements and technical components, program design, self-assessment, knowledge assessment and evaluation of self-care program. The process of identifying, implementation and evaluation is presented:

Step 1: identifying the required information elements and technical components

Sample size (n=20) was determined based on feasibility during COVID-19 and pilot study conventions. Statistical analyses (paired t-tests) were selected to compare pre/post-test scores due to the small, paired sample. This includes a clear justification for the sample size based on preliminary reliability tests (Cronbach's alpha) and an expanded description of the statistical analyses performed (*e.g.*, t-test for pre-test and post-test comparisons, descriptive statistics, and frequency distribution analyses) to enhance transparency and replicability.

The study enrolled nurses working at Ayatollah Rouhani Hospital who voluntarily consented to participate. Inclusion criteria included being a full-time nurse at the hospital and willingness to use an Android smartphone. Exclusion criteria were a history of severe spinal disorders (*e.g.*, prior back surgery or diagnosed chronic musculoskeletal diseases), current treatment for spinal conditions, or unwillingness to participate in the self-care training program.

By conducting a comprehensive review of studies and guidelines in scientific sources, scientific databases and similar applications, data elements and capabilities required by the application were extracted and identified. By collecting, integrating and prioritizing the extracted requirements, also consultation with specialists which are divided in the following subgroups: 6 physiotherapists, 3 medical informatics and 1 health information management.

A questionnaire containing 87 questions on a scale of 5 Likert options (from completely I agree to strongly disagree) was designed. The questionnaire consisted of 3 main parts:

1- Demographic data requirements including (three components of demographic information with 6 questions, clinical information with 3 questions and lifestyle with 7 questions), 2- Information related to education including (four components of lumbar disc hernia with 12 questions, ergonomics with 12 questions, stress management with 6 questions and sports with 2 questions) and 3- Technical capabilities with 41 questions. The questionnaire was initially pilot-tested with 10 experts to assess its reliability and validity. The pilot results provided a Cronbach's alpha of 0.930 for the Information Needs Assessment questionnaire, ensuring that the instrument was robust for use in the study. The questionnaire was given to the members of the research community and was collected after completion. The results of the survey were analyzed using descriptive statistics and frequency distribution report. Based on the scores given by the experts participating in the research, the frequency and average scores for each data element were calculated. Then, considering that the highest possible score for each data element was 5, half of this number, *i.e.* 2.5, was considered as the average score for each element. As a result, each part of the questionnaire having an average of at least 2.5 and more was calculated as a necessary part and placed in the questionnaire.

Step 2: designing a self-care application

In order to determine the necessary infrastructure for the design, development and implementation of self-care application with Kathleen programming language in the Android programming environment, meetings were held in order to use the expertise of a programmer. With reviewing the documentation of the first part of the work, hardware, software and database details are provided for the anticipated self-care application.

Kathleen programming language was selected due to its robust support for multimedia integration, efficient database management, and proven compatibility with the Android operating system. These features facilitated the development of a highly interactive, user-friendly interface essential for delivering

educational content and self-assessment tools. Reduced code size, high readability, cross-platform development, and security are some of the features of Kotlin programming.

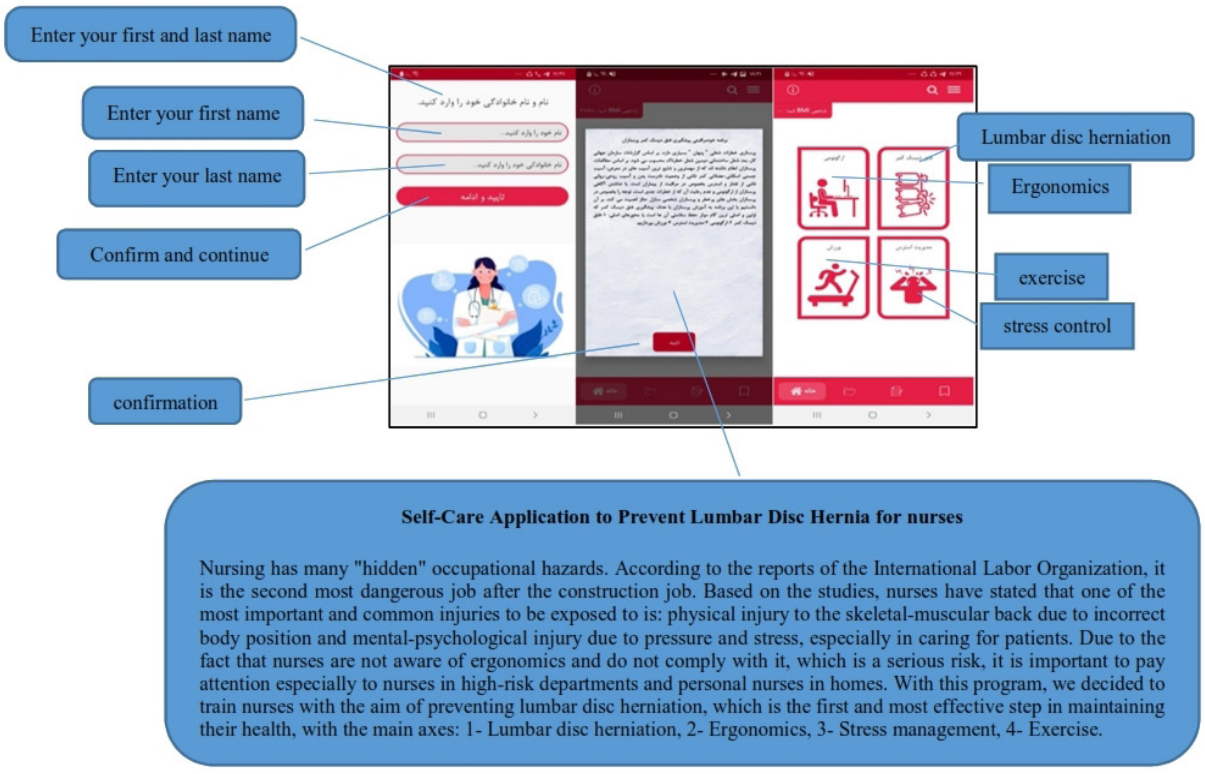
To further enhance the reader's understanding of the application design, additional screenshots (Figures 1-5) have been included. These images illustrate the main user interfaces, including the login, dashboard, educational content, and self-assessment pages. The interface design emphasizes an intuitive layout, ease of navigation, and accessibility, ensuring a user-friendly experience for busy nursing professionals.

The application features a minimalist design with intuitive navigation, categorized into four main sections (lumbar disc hernia, ergonomics, stress management, exercise). Each section includes interactive modules, instructional videos, and self-assessment checklists. The dashboard provides real-time feedback *via* progress charts and personalized warnings [*e.g.*, Body Mass Index (BMI) alerts]. In designing the application, criteria such as simplicity, ease of access, flexibility according to the level of knowledge and skills of nurses and creating a database were considered.

Step 3: nurses' self-assessment

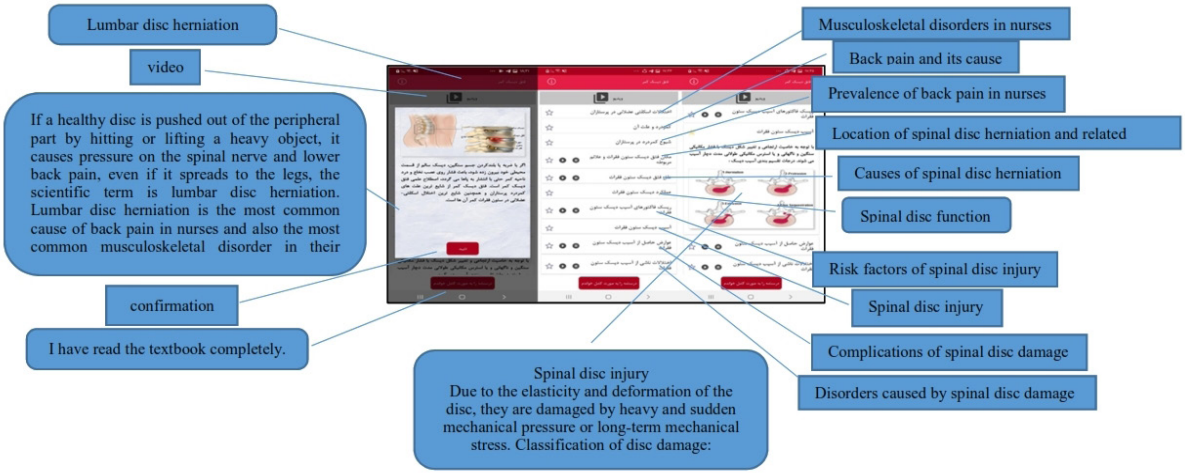
In designing the nurses' self-assessment test, a comprehensive review of specialized nursing education texts was performed and then similar tests were analyzed. The researcher was present in the research field and reviewed the working conditions and activities of the nurses, such as: how to transport the patient, sudden rotation, sitting and getting up, with a checklist. After designing the test using the textbooks and educational content of nurses, to determine the validity of the test four reviewers specialized in: 1- Design and production of content and curriculum planning, 2- Nursing education and development of medical education, 3- Physiotherapist and 4-Educational Management, respectively were asked to evaluate and finalize the questions.

To determine the reliability of the test, 20 nurses participated in a pilot study which was after the preliminary test. Cronbach's alpha coefficient of the



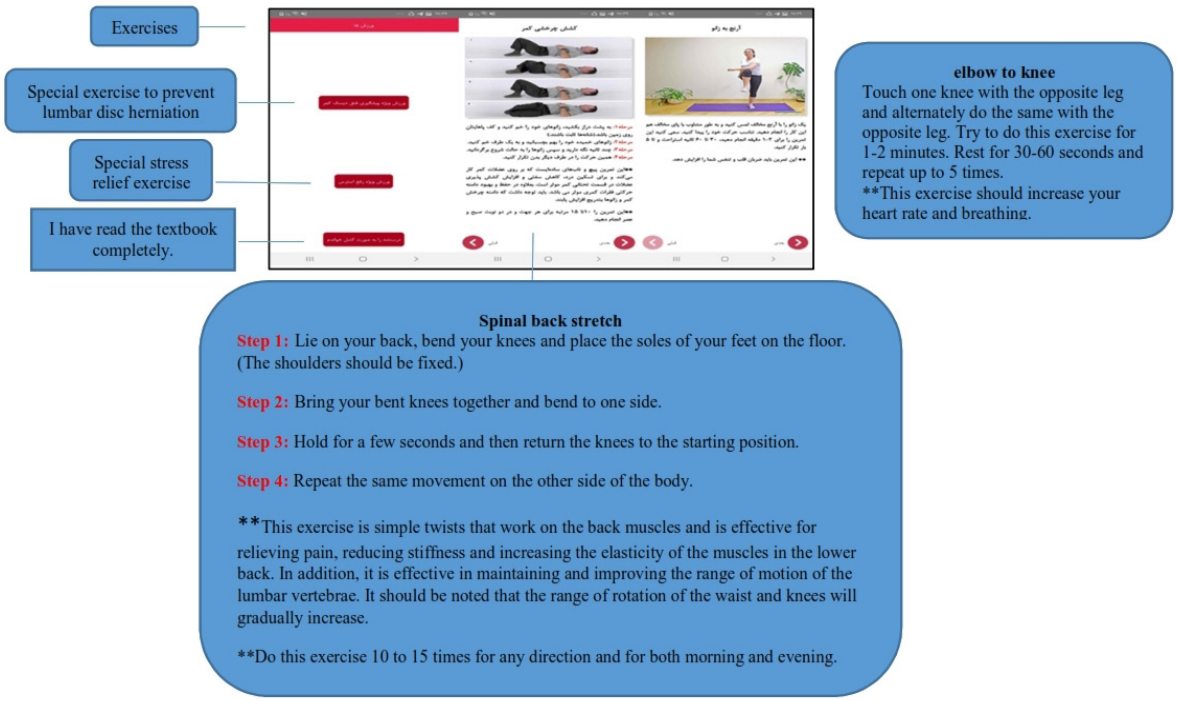
Source: Kisner, Carolyn, Lynn Allen Colby, and John Borstad. Therapeutic exercise: foundations and techniques. Fa Davis, 2017.

Figure 1. Homepage layout with menu icons and user profile access.



Source: Kisner, Carolyn, Lynn Allen Colby, and John Borstad. Therapeutic exercise: foundations and techniques. Fa Davis, 2017.

Figure 2. View of a textbook.



Source: Kisner, Carolyn, Lynn Allen Colby, and John Borstad. Therapeutic exercise: foundations and techniques. Fa Davis, 2017.

Figure 3. View of the sports textbook.

test was estimated to be (Alpha=0.84). Taxonomy questions are also on three levels; 25% knowledge with 5 questions, 50% understanding with 10 questions and 25% application with 5 questions were identified.

As it shows in table 1, to test the nurses' self-assessment, after estimating Cronbach's alpha coefficient and determining the taxonomy and difficulty coefficient of the questions in the pilot study, 20 nurses were selected by simple random sampling method; then, they participated in a pre-test and a post-test in two stages. At first, the self-assessment test was prepared based on the self-assessment components in the form of a paper and pencil. Then, the order of test questions was based on the educational content and sequence of self-care software sections. At this stage, 20 nurses

Table 1. Difficulty coefficient of self-assessment test questions

Components	Number of questions	Difficulty coefficient		
		Difficult 0.40-0	Medium 0.70-41	Easy 1-0.71
Lumbar disc hernia	10	-	3	7
Ergonomics	6	-	6	-
stress management	3	-	1	2
Sport	1	-	1	-

who expressed their readiness and satisfaction to participate in the self-assessment test were asked to install an application containing the content of the self-assessment test on an Android-enabled mobile phone and answer the test sections.

Step 4: assess the level of knowledge of nurses

In designing the nurses' knowledge assessment test, a comprehensive review of specialized nursing education texts was performed and then similar tests were analyzed. The researcher was present in the research field and reviewed the working conditions and activities of the nurses, such as: how to transport the patient, sudden rotation, sitting and getting up, with a checklist.

After designing the test by using textbooks and educational contents of nurses, to determine the validity of the test, four judges with special fields as following: 1- production of contents and curriculum planning, 2- Nursing education and development of medical education, 3- Physiotherapist and 4- Educational Management, were asked to evaluate the questions and finalize them. To determine the reliability of the test, 20 nurses participated in the pilot study, and after the preliminary test, Cronbach's alpha coefficient of the test was estimated to be Alpha=0.94. The taxonomy of the questions was also identified in three levels of knowledge: 5% with one question, understanding 55% with 11 questions and application of 40% with 8 questions.

As it shows in table 2, to assess the level of knowledge of nurses, after estimating the Cronbach's alpha coefficient and determining the taxonomy and difficulty coefficient of the questions in the pilot study, 20 nurses were selected by simple random sampling and participated in two stages, pre-test and post-test. In the first stage, 20 nurses were pre-tested with paper and pencils and the scores were recorded. After one month of training, the same 20 nurses, participated again in the post-test which was uploaded electronically in the application. And the mean scores of pre-test and post-test were compared.

Step 5: evaluate the usability of the self-care program

The standard "Nelson Usability Assessment Principles" questionnaire was used to assess

Table 2. Comparison of difficulty coefficient of pre-test and post-test knowledge test questions

Components	Number of questions	Pre-test difficulty coefficient			Post-test difficulty coefficient		
		Difficult 0.40-0	Medium 0.70-41	Easy 1-0.71	Difficult 0.40-0	Medium 0.70-41	Easy 1-0.71
Lumbar disc hernia	5	-	5	-	-	1	4
Ergonomics	10	-	9	-	-	1	9
Stress management	4	-	2	-	-	-	2
Sport	1	-	1	-	1	-	-

the applicability of the self-care program. The effectiveness of mobile-based self-care application for the prevention of lumbar disc hernia in nurses was evaluated by experts in the subgroups as follows: 3 persons of information technology engineering, and 2 persons of software engineering. After proving the normality of the Nelson usability assessment principles questionnaire based on the scores of the experts participating in the study, the results of the survey were analyzed using descriptive statistics and frequency and mean distribution reports as follows: in all technical sections of the self-care application, the average scores are higher than medium which confirms the high quality of the self-care application. A report comparing the median and mean usability components is presented in table 3.

As shown in table 3, after comparing the median and the mean, in all the components of the self-care application, we see that the means outperform the medians. Therefore, it can be claimed that this self-care program has a high quality.

This study primarily presented analyses through frequency and percentage distributions. However, when evaluating nurses' knowledge before and after the intervention, a pre-post test was conducted utilizing SPSS software and a t-test. All other analyses were carried out using the developed application.

Results

According to the purpose of the research, in the needs assessment section, a score of 2.5 was considered as the base medium for each element. The program was designed to allow the user to record their functional activities step by step and receive the necessary care alerts while working. In the section of nurses' self-assessment test, the test shows that before using the software, they were not in a good condition considering the mentioned components. In the section of nurses 'knowledge assessment test, the results of the study indicated that the average pre-test scores of nurses' knowledge were not desirable, but after one month of training, their abilities in the post-test significantly increased. In the survey of technical capability and technical efficiency of the program, five IT and software engineering experts participated, whose average scores were higher than their medium, which indicates the high quality of this program.

Table 3: Comparison report of average and average usability components of self-care program

Applicability components	Number responsive	Number Items	At least score	Maximum score	Medium	Average
Visibility of System Status	5	29	39	49	24.5	45
Match Between System and the Real World	5	24	30	42	21	37.60
User Control and Freedom	5	23	33	44	22	38.60
Consistency and Standards	5	51	49	32	16	56.60
Help Users Recognize, Diagnose, and Recover from Errors	5	21	29	32	16	29.80
Error Prevention	5	15	15	36	18	28.60
Recognition Rather Than Recall	5	40	61	83	16	71.20
Flexibility and Minimalist Design	5	16	25	32	26	29.60
Aesthetic and Minimalist Design	5	12	42	52	26	46.80
Help and Documentation	5	22	29	36	18	32.40
Skills	5	21	25	74	37	42.40
Pleasurable and Respectful Interaction with the User	5	14	26	34	17	31
Privacy	5	3	3	8	4	5.40
Total		291				

Table 4. Needs assessment components of self –care App

Components and sub-components of the needs assessment		Number responsive	Number Items	At least score	Maximum score	Average	Medium
Demographic data requirements	Identity information	10	6	11	30	20.80	20.5
	Clinical information	10	3	3	15	11.60	9
	life style	10	7	8	34	26.70	21
Training information	Lumbar disc hernia	10	12	16	60	46	38
	Ergonomics	10	12	13	58	45.80	35.5
	stress management	10	6	6	30	23.60	18
	Sport	10	2	2	10	8.10	6
Technical capability	Technical	10	41	74	217	189.50	145.5
Total	-	10	89	-	-	-	-

Findings regarding the first goal of the research: Identifying the required information elements and technical components

As table 4 shows, the lowest average in the component of demographic data requirements is related to the clinical information sub-component (11.60), and in the education component it is related to the sports sub-component (8.10). The highest averages are related to the technical part equal to 189.50, the lumbar disc hernia sub-component of the education part equal to 46 and the lifestyle information sub-component of the demographic data requirements equal to 26.70, respectively. Considering that the highest possible score for each data element was 5, half of this number, *i.e.* 2.5, was considered as the average score for each element. As a result, each part of the questionnaire that had an average of at least 2.5 and more was calculated as the required part.

Findings regarding the second goal of the research: Designing a self-care application

The results of designing a mobile-based self-care application with the following technical capabilities are:

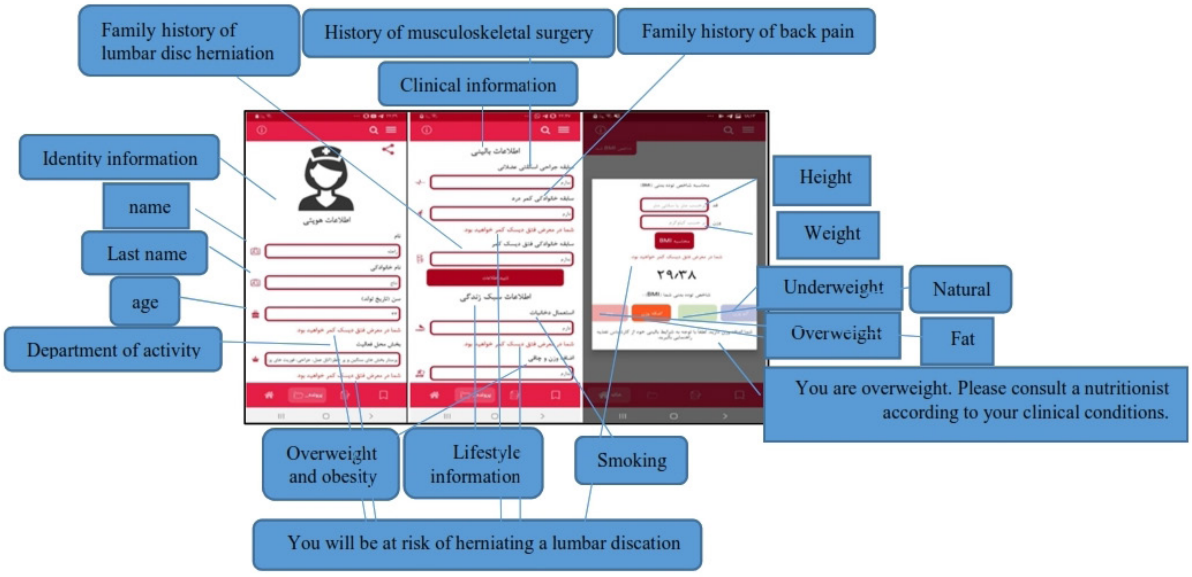
1. Requesting and receiving user information and permission to enter the software. An overview of application pages is shown in figure 1.
2. Providing educational content to nurses to observe the principles of ergonomics in the workplace and home, stress management and performing sports without risk and gaining knowledge and ability to identify the causes and areas of lumbar disc hernia and how to prevent it. View of a textbook is shown in figure 2.
3. Nurses participation in the examination of the four sections (lumbar disc hernia, ergonomics, stress management and exercise), with the ability to correct mistakes and issue warnings to guide nurses in choosing the right options. View of the sports textbook is shown in figure 3.
4. The ability to record BMI and announce the necessary warnings to nurses who are obese and overweight. View of the test and profile section is shown in figure 4.
5. The possibility of registering information in the health file by nurses and announcing warnings to them about identity, clinical and lifestyle characteristics when they have lost their balance. View of personal health record and BMI are shown in figure 5.

Findings regarding the third goal of the research: Nurses' self-assessment test

Descriptive statistics of nurses' self-assessment scores: As shown in table 5, in the self-assessment test of nurses, the lowest mean is related to exercise subcomponent (9), and the highest mean is related to lumbar disc hernia subcomponent (14.8). The average components of the nurses'

Source: Kisner, Carolyn, Lynn Allen Colby, and John Borstad. Therapeutic exercise: foundations and techniques. Fa Davis, 2017.

Figure 4. View of the test and profile section.



Source: Kisner, Carolyn, Lynn Allen Colby, and John Borstad. Therapeutic exercise: foundations and techniques. Fa Davis, 2017.

Figure 5. View of personal health record and BMI.

Table 5. Statistical description of self-assessment test of nursing in application

Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Overall score	14	14	15	16	17	14	14	12	14	12	12	13	13	12	13	16	15	12	16	13
Average	13.85																			
Components of nurses' self-assessment test	Lumbar disc hernia								Ergonomics				Stress management					Sport		
Average	14.8								11.85				14					9		
Total average	12.41																			

self-assessment test (in the components of lumbar disc hernia, ergonomics, stress management and exercise) (12.41), is out of 20 self-assessment test scores. Figures show that nurses were not in a good

Table 6. Statistical description of pre-test and post-test of nurses' knowledge

Variables	Number	At least	Maximum	Average	Standard deviation
Pre-exam	20	54	70	65.05	5.29
Post-test	20	34	98	83.95	17.98

condition before using self-care software.

Findings regarding the fourth goal of the research: Assessing the level of knowledge of nurses

Descriptive statistics of pre-test and post-test of nurses' knowledge: Table 6 shows that training nurses in four areas (lumbar disc hernia, ergonomics, stress management and exercise) has enhanced their knowledge, awareness and ability to deal with and prevent lumbar disc hernia. Therefore, nurses have acquired the necessary knowledge to prevent lumbar disc hernia.

Comparison of mean pre-test and post-test scores of nurses' knowledge in application

As shown in table 7, statistical studies indicate that the pre-test scores averaged 11.05 (SD=4.77), while the post-test scores reached an average of 15.55 (SD=2.54). The t-test yielded a value of 0.613 with a significance level of $p<0.001$. Furthermore, the effect size was computed using Cohen's d, which was approximately 1.18—indicating a large effect—and the 95% confidence interval for the mean difference

Table 7. Test results of two dependent samples regarding pre-test and post-test scores of nurses' knowledge

Nurses' scores	Number	Average	Standard deviation	Mean standard error	Test
Pre-test score	20	11.05	4.77	1.067	t=0.613
Post-test score	20	15.55	2.54	0.568	p<0.001

Table 8. Score of usability components

Applicability components	Number responsive	Number items	At least score	Maximum score	Average	Standard deviation
Visible system status	-	29	39	49	45	4.63
Matching between the system and the real world	-	24	30	42	37.60	5.17
User freedom and control	-	23	33	44	38.60	4.21
Compatibility and standards	-	51	32	49	56.60	6.10
Assist the user in identifying, detecting and recovering errors	-	21	29	32	29.80	1.30
Error prevention	-	15	15	36	28.60	8.73
Cognition instead of recollection	-	40	61	83	71.20	8.89
Design flexibility and simplicity	-	16	25	32	29.60	2.70
Beauty and simplicity of design	-	12	42	52	46.80	4.76
Help and documentation	-	22	29	36	32.40	2.88
Skills	-	21	25	74	42.40	20.05
Enjoyable interaction and respect in communication with the user	-	14	26	34	31	3.16
Privacy	-	3	3	8	5.40	2.30
Total	5	291	-	-	-	-

ranged from 2.5 to 6.3.

Findings regarding the fifth goal of the research: Assessing the technical capability of a self-care application

After scoring the Nelson usability assessment principles questionnaire by 5 experts participating in the research from the subgroups of Information Technology Engineering and Software Engineering, the results of the survey were analyzed as follows. Table 8 was illustrated score of usability components. The usability assessment, based on the Nelson Usability Evaluation Principles, revealed that the application performed strongly in several domains. Notably, 'Compatibility and Standards' (average score=56.60) and 'Cognition instead of Recollection' (average score=71.20) were rated highly, reflecting the app's intuitive design and user-friendly information retrieval. However, the 'Privacy' component received a lower average score of 5.40, indicating an area for further enhancement. These results suggest that the application offers excellent usability in most respects. Therefore, it can be claimed that this self-care program has a high quality.

Discussion

In this study, an evidence-based self-care application was designed and developed for the prevention of lumbar disc herniation in nurses. The educational content of the software was in four areas: lumbar disc herniation, ergonomics, stress management, and exercise. In addition, in this study, the knowledge of the nurses in the software itself was measured.

How to design and use a mobile-based self-care application

Educational, technical and operational parts of the program are included: Requesting and receiving nurse information, four educational contents of lumbar disc hernia, ergonomics, stress and exercise management, test (self-assessment and knowledge assessment), BMI and announcing the necessary warnings to nurses, health record. This software was written in Android programming environment and in Kathleen language and can be installed on phones supporting Android operating system. This self-care program assesses nurses' abilities after providing educational content to them in the following areas:

Lumbar disc hernia educational contents include: musculoskeletal disorders, prevalence of low back pain, spinal disc function, causes of disc hernia, risk factors for disc injury and complications of spinal disc injury in nurses.

Ergonomics training contents include: the need for ergonomics in nurses and workstations, the need to use helping devices during patient transfer, ergonomic recommendations during nursing patients using methods such as the Scott method (flat back and knees bent) and no sudden rotation and twisting lumbar to the sides, ergonomics of nurses while working with computer system and ergonomics during daily activities.

Stress management training contents include: the need for stress prevention for nurses, techniques to control and reduce stress during their work and techniques to control and reduce stress at home.

Exercise educational contents include: special exercise for the prevention of lumbar disc hernia and special exercise for relieving stress. Nurses who are exposed to educational training can greatly prevent lumbar disc hernia.

The study of Granfar *et al* entitled "Designing and creating a mobile-based self-care application for osteoporosis" evaluated the effectiveness and performance of the program by physicians and emphasized that self-care has a special role in the care of chronic diseases. Success in the management of these diseases can be achieved when the patient can play a role in self-care activities such as proper medication, monitoring of health fluctuations and maintaining a lifestyle. Health technology, along with the possibility of continuous monitoring of the health status of people, empowers the elderly and prevents their chronic diseases. Finally, mobile applications can reduce costs, improve the quality of health care, change health behavior by strengthening prevention and improve health in the long time (17).

A study by Pinheiro and Machado entitled "Back Pain Program: An Exercise Program for Low Back Pain Management" examined one of 61 applications that were systematically reviewed. In this study, one of the 61 applications that had the highest quality score (average 3.94 and range 5) was selected for review and it was considered as an application

Table 9. Benefits and limitations of the low back pain program: an exercise program for low back pain management (18)

limitations	Advantages
1. The app lacks evidence-based educational content	1. Monitoring of pain intensity throughout the exercise program
2. The app has not been tested for effectiveness in reducing the symptoms of low back pain	2. Minimal equipment required to perform the exercises
3. It is unknown whether researchers, app users or people with low back pain were involved in the development of this app	3. Easy-to-use interface, low cost to download and no subscription costs
4. The app lacks engaging features that could promote greater adherence to the program	4. No advertisements and no internet access is required
5. The exercises cannot be individualized to the patients' needs or ability	5. Text description and high-resolution instructional videos explaining the exercises

evaluated according to the ranking scale. Benefits and Limitations of the "Low Back Pain Program was illustrated in table 9.

The above studies are also consistent with the present study, but to overcome the limitations and barriers of the study has:

1. Evidence-based educational content
2. High quality evaluation of the effectiveness of the self-care program
3. Easy-to-use interface and good user experience
4. Clear program developers (Software and Information Technology Specialists)
5. Personalized exercises

Nurses' self-assessment evaluation (with test)

In the nurses' self-assessment test, the average components of lumbar disc hernia, ergonomics, stress management and exercise are equal to 12.41 out of 20 points. Self-assessment test shows that nurses were not in a good condition before using self-care software.

In the study of Selter *et al* entitled "Mobile health program for chronic low back pain self-management (Limber): a pilot study" was conducted. Eligible patients enrolled in the 3-month physiotherapy program and received the Limber mobile app for iOS or Android. Linear hierarchical modeling analysis showed that daily activity evaluation scores were a significant predictor of Oswestry Disability Index (ODI) scores during the study (p=0.01). Therefore, they concluded that the cooperation of participants who completed the Lumber program was high and the program, which was rated by most respondents, was positive. Daily activity was significantly associated with ODI scores and supported the validity of this new tool (19).

The study of Zakerian *et al* entitled "The relationship between ergonomic knowledge and workplace conditions with musculoskeletal disorders" has been done among nurses as well. 335 nurses were selected for this study. Nurses' knowledge of ergonomics, working conditions (including lighting, ventilation, *etc*.) and work-related injuries and problems scored 0.58±2.93, 0.54±2.23 and 0.76±2.66, respectively, out of 5. According to the researchers, nurses' knowledge of the principles of moderate ergonomics and their level of knowledge on working conditions and work-related injuries were assessed as low and weak, respectively. The study suggests nurses need to be trained in safe work practices and stress management techniques to increase knowledge of the ergonomic principles of the workplace and reduce related problems and injuries. In addition, ergonomic interventions should be performed with regard to high-risk areas of the body in order to improve workplace conditions and reduce physical stress (20).

The researcher's study in the self-assessment section showed that the overall mean scores of the nurses' test (from the components of lumbar disc hernia, ergonomics, stress management and exercise) were not favorable. But after a month of training in self-assessment test and recording of functional activities, in the form of checklists and graphs in the application,

which were displayed in each of the above four components with each user visit, the nurses reached the desired level.

Furthermore, establishing a long-term evaluation framework is crucial to assess the enduring benefits of the application. The authors recommend designing prospective longitudinal studies to monitor outcomes beyond the initial training period.

Assessing the level of knowledge of nurses (with pre-test and post-test)

In the first stage, 20 nurses were pre-tested with paper and pencils and the scores were recorded. After one month of training, the same 20 nurses, participated in the post-test uploaded to them electronically in the application, the mean scores of pre-test and post-test were compared and the study revealed that the average score of pre-test knowledge of nurses was equal to 11.05, while the average score of their post-test after one month of training was equal to 15.55. Also, the value of t-test was equal to 0.613 and the level of significance obtained was acceptable (s=0.000). Therefore, the scores of the studied nurses increased significantly after training. Of course, it should be noted that training the above four areas to nurses to prevent lumbar disc hernia is necessary, but it is not enough. Therefore, to prevent lumbar disc hernia, it is necessary to use an application in the practical work environment and daily life and ergonomic interventions. The difference in the mean scores of the nurses participating in the tests showed that training them was able to greatly improve the level of nurses' knowledge in the field of prevention of their disc hernia.

A sample size of 20 nurses was selected based on preliminary feasibility considerations and pilot study results that indicated a measurable difference between pre-test and post-test scores. Although a formal power analysis was not conducted, this sample size was deemed sufficient for an initial evaluation of the application's efficacy. Future studies with larger, multi-center samples are recommended to further validate these findings.

The findings of the study conducted by Al-Azmani Nodeh and Taziki Balajlini entitled "A Review of the Use of Smartphone Applications in Nursing Education" which aimed to examine the application of smartphone applications in nursing education, showed that studies in independence, knowledge transfer, skills, theoretical and practical communication, competence, self-efficacy, clinical skills, motivation, learning satisfaction, problem solving, quality of care, stress management, in the areas of safety, injections, obstetrics, basic concepts, practical and applied, palliative care, cardiopulmonary resuscitation, surgical care, psychiatry, pediatrics, special, vital signs, gastric gavage, endotracheal suction, urinary catheter implantation, drug calculations, pressure ulcer was done. Studies have shown that areas under study have improved the participants' conditions through smartphone training. Therefore, they concluded that smart education has a positive effect on increasing knowledge, awareness, motivation, self-confidence and can be used as a complementary method in nursing skills training due to its ease of use and effectiveness (21).

The results of the study conducted by Zakerian *et al* entitled "The relationship between ergonomic knowledge and workplace conditions with musculoskeletal disorders among nurses: a questionnaire" indicated that nurses need to be trained in the safe work and stress management techniques to increase knowledge of the ergonomic principles of the workplace and reduce related problems and injuries. In addition, ergonomic interventions should be performed with regard to high-risk areas of the body in order to improve workplace conditions and reduce physical stress (20).

The results of another similar study done by Al-Azmani Nodeh and Taziki Balajlini with the subject of "an overview of the use of smartphone applications in nursing education" showed that intelligent education has a positive effect on increasing knowledge, awareness, motivation, self-confidence and can be used as a complementary method in nursing skills training due to its ease of use and effectiveness (21). In another study conducted by Safdari *et al* on "Designing and creating a pre-eclampsia self-care application", the results showed that the use of mobile-based applications is a useful way to increase knowledge and improve the health of pregnant mothers and helps pregnant mothers with pre-eclampsia to control their disease by following proper nutrition and treatment principles to minimize

the complications of their disease (22). In the study of Arabian *et al* on the subject of "Study of the effect of ergonomic intervention on musculoskeletal disorders in the staff of Alimoradian Nahavand Hospital", the results of their study showed that education alone has little effect on reducing musculoskeletal disorders in medical settings and only in some areas where there is no need to do things quickly and immediately and there is enough opportunity to benefit from a lot of training, it can reduce the incidence of these disorders. This study also investigated some of the causes that lead to a decrease in the impact of education in such environments, which indicates that the present health care environments need ergonomic intervention in the design of the environment, tools and equipment simultaneously with the educational intervention due to increasing the level of health care applications (23). The above studies confirm the findings related to the education and assessment of nurses' knowledge. The present study showed that nurses need training and updating in the areas of lumbar disc hernia, principles of ergonomics, stress management methods and exercise. But these trainings alone are not enough to prevent lumbar disc hernia and along with the training, ergonomic interventions are needed.

Assessing the technical capability of a health-related self-care application

The Nelson checklist is a standard checklist for evaluating software usability from an expert perspective. In this study, five IT and software engineering experts evaluated the capability and technical usability of a mobile-based self-care application and determined the severity of problems using Nelson's ten principles. In all technical components and sub-components of the program, which were scored by five technical experts, the average scores were higher than their average, and this is a testament and justification to the high quality of the self-care application. Accordingly, by operating and implementing the above program, nurses can be helped to identify the needs of their work and work environment better and more accurately and improve their knowledge and awareness in this field, to avoid risky movements and as a result prevent lumbar disc hernia.

A study by Khajouee *et al* entitled "Usability Evaluation of an Emergency Information System: A Heuristic Evaluation" has been conducted in Mashhad University of Medical Sciences. In this research study, three trained assessors independently assessed the relevant subsystem using Nielsen's ten principles and assessed the severity of the problems. Finally, from the combination of problems found by independent evaluators, a single list was prepared and their average severity was calculated. The results of the study revealed a total of 163 usability problems. The lowest level of observance of exploratory evaluation principles was related to the feature of "error prevention" by 3% and the highest rate was related to the feature of "similarity and standards" by 27%. The average severity of the problems ranged from 3.2 (minor issue) to "system resolution" to 9.2 (major issue) to "help users identify and correct errors". The results showed that the exploratory evaluation method can be used to identify a large number of usability problems in health software applications. These types of problems, if not solved, will cause a waste of time for users and patients, increase errors, reduce the quality of information and generally threaten the health of patients (24). The researcher's study also showed that the mobile-based self-care application after implementation and evaluation; Along with the training, after comparing the mean and the medium, in all the components of the self-care application based on the ten principles of the Nielsen questionnaire, it was observed that the means exceed the medium of the components. Therefore, it can be claimed that this self-care program has a high quality. Accordingly, by operating and implementing the above program, nurses can be provided with help to better and more accurately identify the needs of their work and work environment and improve their knowledge and awareness in this field; they can also avoid risky movements and thus avoid developing lumbar disc hernia.

For broader real-world implementation, it is recommended that the application be integrated into existing hospital training programs and continuous professional development initiatives. Collaboration with healthcare administrators and IT departments will be essential to adapt the platform to specific clinical settings, ensuring seamless integration with routine practice and patient care protocols.

Looking ahead, further studies should examine the app's impact among diverse nursing populations, particularly in underserved and rural areas. Such investigations would help to generalize and validate the effectiveness of the mobile-based self-care application across varied healthcare settings.

Although the application demonstrated high usability in several domains, certain areas, such as privacy features, require further refinement. Future interactions will focus on enhancing data security measures, incorporating user feedback on interface design, and optimizing content delivery to further improve usability and clinical outcomes.

Conclusion

In conclusion, this study demonstrates that the mobile-based self-care application is an effective tool for improving nurses' knowledge of lumbar disc herniation prevention through evidence-based content and a user-centered design. The application's high usability ratings and significant improvements in post-test scores underline its potential as a valuable resource in clinical practice. Although the study was limited by a small sample size and short-term evaluation, these limitations provide important directions for future research, including larger, multi-center studies and longer follow-up periods.

Beyond the immediate findings, the study has broader implications for integrating mobile-based self-care applications into routine nursing practice. Such applications can potentially enhance patient care outcomes, reduce occupational injuries, and improve overall healthcare quality. Future research should focus on these broader impacts to further inform policy and practice in nursing and health informatics.

Limitations and recommendation

One limitation of this study was the constrained recruitment due to COVID-19 protocols, which limited access to a broader range of participants. Although measures such as remote data collection and adjusted scheduling were implemented to mitigate these barriers, we acknowledge that this may have introduced a selection bias. Future work should aim to incorporate more diverse settings on normal operational resume. However, in a contextual and qualitative study, there are limitations in measuring and establishing the reliability and accuracy of the study. Notably, the small sample size of 20 nurses and the short-term evaluation period may limit the generalizability of the findings and the assessment of long-term efficacy. Future research should address these constraints by employing larger, multi-center samples and extending the evaluation period. The seminars and posters that are open to the public and that are free of charge and that are not limited to the design or appearance of the window. This is a virtual machine which can be used to extract data from a mouse and a mobile device. It is unable to get content from the browser to the server with the default settings, which can be used on the screen. The contents of the application are stored in the text of the application, which is displayed in the browser window.

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Ethics approval and consent to participate

The study was approved by the ethics committee of Tabriz University of Medical Sciences (IR.TBZMED.REC.1398.815). Written informed consent was obtained from all the participants involved in our study. All methods were carried out in accordance with relevant guidelines and regulations. All experimental protocols were approved by a named institutional and/or licensing committee. Informed consent was obtained from all subjects involved in this study.

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Conflict of Interest

The authors declare that they have no competing interests.

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