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The Role of Modern Technologies in the Treatment of Migraine.

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Abstract

The article aims to study the effectiveness of using a mobile application as a control diary in the treatment of migraine. The aim of the research is to improve migraine behavioral skills and knowledge in patients who use the mobile application, control medication intake, and achieve the effectiveness of treatment without other additional drugs by monitoring the elimination of migraine triggers on a daily basis. During the study, 80 (100%) patients diagnosed with migraine were examined. Standard pharmacological drugs for the treatment of migraine were recommended to all patients: antidepressants, nonsteroidal anti-inflammatory drugs, triptan, and general stimulants. For the purpose of preventive treatment, 40 patients were recommended a paper control diary, and the remaining 40 patients were recommended a mobile application called "MIGREN PRO". Patients were re-examined after 3 months. The number, duration, and level of depression of patients who used the mobile application decreased, and their quality of life improved.

1. Introduction

Today, we live in an era of digital technology and mobile applications. The use of digital technologies and smartphones was 35% in 2011 and 85% by 2021 [1]. Telemedicine and electronic health (eHealth) means services in the field of health. Types of electronic health care; include mobile health (mHealth), mobile devices used for medical purposes, and wearable devices [2].

mHealth software is used to collect and present health information to patients, remotely monitor patients, make accurate diagnoses, and assist in disease control and management [3]. Such applications include medical education applications, general public health applications, telemedicine, and telehealth applications [1].

In the last decade, several researchers have found eHealth and mHealth applications to be highly effective in treatment [4]. These programs are a new tool for the timely delivery of medical information to doctors, from migraine treatment, control, and preventive measures; include cognitive-behavioral skills, biofeedback (BQA), and proper relaxation training [5].

Patients used a paper diary or calendar to record details of their migraine treatment. Usually, when paper diaries are used, information is entered by handwriting, which causes several inconveniences and leads to distrust in patients during treatment [6,7]. Several studies have found mobile applications to be more convenient, reliable, and effective treatment methods than paper diaries for documenting and storing migraine data [8]. Studies have shown that apps have helped manage patients by controlling the number, duration, and medication use of headaches. In addition, electronic headache diaries are a reliable method for documenting and storing migraine-related information, and their use has been found by patients to be a more effective treatment option than paper diaries[9]. **Purpose:** Studying the effectiveness of daily migraine control and treatment using the "MIGREN PRO" mobile application.

2. Methods

The research was conducted in the city of Tashkent, Republic of Uzbekistan. 80 patients diagnosed with migraine were included in the study. During the study, the diagnosis of migraine was based on the 2013 diagnostic criteria of the International Headache Society (ICHD-3). Magnetic resonance imaging (MRT) of the brain, and electroencephalography (EEG) were performed in all patients. Standard migraine treatment regimens were recommended to all

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patients. Patients were divided into two groups. The first 40 patients were recommended a paper migraine diary, and the second group was recommended a control diary in the form of the "MIGREN PRO" mobile application. All patients were followed up. After 3 months, the patients were re-examined neurologically.

Subject Recruitments

During the study, patients diagnosed with migraine aged 18 to 55 years were examined. 61 patients were women, and 19 were men. Patients were divided into two groups.

Group 1: 40 patients who were recommended to use a paper migraine diary.

Group 2: 40 patients who were recommended a migraine diary in the form of an electronic mobile application.

Factors that cause migraine attacks in patients:

1. Environmental factors (hot air temperature, computer, TV, noisy places, sharp smells, gas, mental and physical stress, sleep disorders).
2. Limiting the consumption of food products that cause migraine attacks (oily fish, garlic onions, canned goods, semi-finished products, leguminous products, fruits, dried fruits, nuts, pistachios, almonds, yeast products, cocoa products, chocolate, coconut oil).
3. Avoiding psychogenic factors (stress, depression).
4. Do not take drugs that expand blood vessels in migraine (cavinton, trental, nicotinic acid, etc.). The above-mentioned factors causing migraine attacks were recommended to both groups, i.e., in group I, a control diary, notes in paper form, and in group II, a control diary in the form of a "MIGREN PRO" mobile application.

"MIGREN PRO" mobile application is in Uzbek language and consists of the following components:

1.Patient general information.

2.Educational part.

3."My Headache" page - where patients are monitored monthly, 3-month headache status by answering set questions.

4. Control of drugs recommended by the doctor in the "Control of drugs" section.

5."Questionnaire" - on this page, patients are presented with the MIDAS scale for assessing daily functioning, and the PhQ-9 scale for determining the level of depression. Patients fill out questionnaires before and after treatment, and the effectiveness of treatment is evaluated.

6.The "Notes" page provides notes on migraine triggers (sleep mode, foods, medications, etc.).

7. The application has two download options (for Android and Apple (iOS). Pregnant and lactating women, and patients with severe somatic diseases, epilepsy, mental illness, alcoholism, drug addiction, toxicomania, and organic brain diseases were not included in the examination.

Standardized Instruments

During the diagnosis of migraine, all patients were recommended to undergo brain MRI in order to exclude other brain organic diseases during acute pain. According to the results of the MRI examination: 1) mild atrophy in the brain - 42%, small subcortical ischemic foci - 25%, single ischemic foci - 8% and no change in the brain was detected in 25% of patients. In order to study the bioelectric activity of the brain, all patients underwent an EEG examination. According to the results of EEG: 1) general changes in the brain - 54%, dysrhythmic changes - 21%, sharp waves - 15%, epileptiform pathological wave - 10%.

Assessment of headache level using VASh (Visual Analog Scale) numbers. It is asked to rate the level of pain from 0 to 10 points on the VASh scale. The patient should rate the pain by choosing a numerical value that corresponds to the level of pain. 0 points - no pain, 1-3 points - mild pain, 4-6 points - moderate pain, 7-9 points - severe pain, and 10 points - excruciating headache.

PhQ-9 (Patient health Questionnaire) scale was used to determine the level of depression. In the PhQ-9 scale, patients are asked to answer questions about depression during the last two weeks and 9 questions: none (0 points), few days (1 point), almost half of all days (2 points), almost every day determined by answers such as day (3 points). The results are interpreted as follows: 1-4 points minimal depression, 5-9 points mild depression, 10-14 points moderate depression, 15-19 points severe depression, and 20-27 points severe depression.

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The MIDAS (Migraine Disability Assessment) scale was used to assess the impact of migraine on patients' daily work activities. The MIDAS scale asks about the impact of headaches on daily work activities over a period of 3 months. For example, 5 questions are asked, such as: "During the last 3 months, how many days in a row did you miss family, social, or leisure time because of a headache?" The overall assessment is on a scale from 0 to 21 points and above and is graded from I to IV. 0-5 points I degree – the headache of low intensity, reduction of daily work. 6-10 points II degree - moderate headache, slight restriction of daily activities. 11-20 points III degrees severe pain, serious limitation of daily activities. A score of 21 and above is IV degree severe pain, a significant reduction in daily activities.

Statistical Analysis

Statistical analysis was performed using GraphPad Prism 7 software. The collected data were analyzed using Microsoft Excel. The obtained data were presented in average values, standard deviation, and percentages. Statistical threshold is considered significant at * $r < 0.05$, ** $r < 0.01$, *** $r < 0.001$ and *** $r < 0.0001$.

3. Result

According to the statistical results of the study, women were more than men. Distribution of patients by gender and age is given in Table 1.

Table 1 Demographic data of patients

	Migraine N (%)
Women	61 (76%)
Men	19 (24%)
Average age	36,8± 10,9

The degree of headache was determined using the VASh scale. During the initial examination, severe and unbearable headaches were found in the patients. The average score on the VASH scale was 10±0. At follow-up after 3 months, the pain was reduced compared to the initial examination, but the headache level was significantly reduced in the second group (mobile app) than in the first group (paper method) 5.3± 0.19. At follow-up, patients who used the paper method had mild to moderate pain. Severe headache was significantly reduced in patients who used the mobile application, and no unbearable headache was observed p<0.001. The level of headache according to the VASH scale is given in Table 1.

Table 1 Evaluation of the degree of headache using numbers on the VASh scale.

VASh scale	Before treatment (n-80)	After treatment		P
		1 group of patients who used the paper method (n-40)	2 groups of patients who used the mobile application (n-40)	
No pain	-	52%	75%	

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Mild pain	-	25%	10%	
Moderate pain	10%	10%	8%	
Severe pain	34%	8%	7%	
Excruciating headache	56%	5%	-	
Average level	10±0 score	6,4±0,4 score	5,3±0,19 score	p<0,001

The level of depression in all patients was calculated based on the results obtained using the PhQ-9 scale. Before the treatment, a high level of depression was detected in both groups, the average level was 10.45±0.3. The level of depression was significantly lower in group 2 compared to group 1 after treatment P<0.0001. Table 2 shows the level of depression in migraine patients before and after treatment.

Table 2 Results of the PhQ-9 scale to determine the level of depression

PhQ-9 scale	Before treatment (n-80)	After treatment	
		1 group of patients who used the paper method (n-40)	2 groups of patients who used the mobile application (n-40)
Minimal depression	28 (35%)	9 (23%)	-
Mild depression	19 (24%)	12 (30%)	-
Moderate depression	16 (20%)	8 (20%)	9 (23%)
Severe depression	11 (13%)	7 (17%)	7 (18%)
Most serious depression	6 (8%)	4 (10%)	3 (8%)
Average level	10,45±0,3	3,3±0,9	17,9±5,7
P	P<0,0001		

The patients' daily activities were determined on the MIDAS scale. Before the treatment, we can see a significant decrease of 22.7±1.5 in the daily functioning of patients in both groups. After the treatment, compared to the patients in the first group, daily work activities were significantly restored in the second group 9.1±0.9. As shown in Table 3, patients who used the mobile application for migraine control had a higher efficacy of treatment compared to the paper-based method (P<0.0001).

Table 3 Assessment of daily functioning on the MIDAS scale

MIDAS scale	Before treatment (n-80)	After treatment		P
		1 group of patients who used the paper method (n-40)	2 groups of patients who used the mobile application (n-40)	
Level 1 - decrease in daily activities	-	40 (50%)	60 (75%)	
Level 2 - mild limitation of daily activities	-	28 (35 %)	12 (15%)	
Level 3 - serious limitation of daily activities	28 (35%)	12 (15%)	8 (10%)	
Level 4 – significant decrease in daily functioning	52 (65%)	-	-	
Average indicator	22,7±1,5	9,8±2,2	9,1±0,9	P<0,0001

The results of the research showed that the level of headache and depression decreased without any additional drugs, and daily work activities were significantly restored due to the formation of behavioral skills and knowledge in patients, as well as the control of medication intake.

4. Discussion

Our study found that patients who used a mobile app for migraine headache control had significantly lower headache levels, duration, and frequency due to direct dietary reminders, sleep patterns, and medication management than using a paper-based method. caused a significant decrease and a significant improvement in the quality of life. At the same time, the level of depression also decreased significantly (p<0.0001).

Many mobile apps are not scientifically based because they are commercially produced without the involvement of medical professionals. In Hundert's

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experiments, only 18% of 38 applications had clinical experience, but these applications did not report the psychometric properties of headaches. The Headache Diary Pro mobile application developed by Froggyware, despite being the most used application by patients, proved to be less comfortable to use than other competing applications[10].

A meta-analysis conducted by Mosadegi-Nick et al. found that the evidence base for the efficacy and clinical safety of mobile applications for the treatment of headache disorders is limited [11].

For example, the results of 1,287 patients who used 31 behavioral therapy applications for the treatment of depression from scientists' experiments showed that the application was easy to use, convenient, and therapeutically effective [12]. Jürgens and Christiansen compared the observed changes in headache attacks with non-pharmacological methods of headache prevention in their experiment. Studies of headache patients using cognitive behavioral therapy, relaxation training, or aerobic exercise have found a reduction in "monthly headache days" after 6 months of treatment. It should be noted that they achieved the effectiveness of treatment without using other special additional pharmacological and non-pharmacological methods [13].

5. Conclusion

According to our results, in the preventive treatment of migraine, the use of a mobile application and a regular regime (sleeping on time, organizing rest properly, eating on time) and following dietary rules (oily fish, vinegar, garlic, onions, legumes) as a result of regularly reminding patients to limit the consumption of products, not to eat bitter, salty, salted, canned products in excess of the norm), the level and number of migraine headaches significantly decreased. At the same time, it significantly reduced the level of depression. The quality of life improved after treatment in the second group of patients. For this reason, we recommend using a mobile app diary to monitor your migraines.

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