revista interfaces
V. 11, N. 2 (2023) | ISSN 2317-434X
ARTIGOS ORIGINAIS

SELF-MANAGEMENT OF LOW BACK PAIN USING THE M-HEALTH EXERCISE PROGRAM

AUTOGERENCIAMENTO DA LOMBALGIA USANDO UM PROGRAMA DE EXERCÍCIOS VIA M-HEALTH

DOI: https://doi.org/10.16891/2317-434X.v11.e2.a2023.pp1899-1906 *Recebido em: 30.01.2023 | Aceito em: 24.06.2023*

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ABSTRACT

Objective: To evaluate the effects of an exercise program (mHealth) delivered using a mobile application (APP) on pain, function, and quality of life in patients with low back pain. **Methods:** This was an interventional study that included 51 patients with low back pain. The participants were divided into a control group (n = 24) that did not undergo any type of intervention, and intervention group (n = 27) which completed a protocol of exercises and educational videos via APP for two months. The participants in both groups were assessed at baseline and two months later using a visual analog scale (VAS), Oswestry Disability Index (ODI), and EQ-5D questionnaire. **Results:** The participants in the intervention group had a significant reduction in pain with mean difference for VAS was 1.82 (95% CI: 0.96, 2.66; p = 0.0002), improved function with 5.41 for ODI (95% CI: 1.32, 9.50; p = 0.012), and quality of life with EQ-5D equal to -0.14 (95%: -0.20, -0.08; p = 0.0001) compared to the control group, which had no significant changes. **Conclusion:** The mHealth exercise program was effective in reducing pain and improving the function and quality of life in patients with low back pain.

Keywords: Mobile Applications; Low Back Pain; Exercise Therapy; m-Health; Self-Management.

RESUMO

Objetivos: avaliar a influência de um programa de exercícios via APP na funcionalidade, no quadro de dor e na qualidade de vida de pacientes com lombalgia. **Métodos:** Trata-se de um estudo intervencional com a participação de 51 pacientes com lombalgia. Os participantes foram divididos em grupo controle (n=24) que não sofreu nenhum tipo de intervenção, e grupo intervenção (n=27) que completou um protocolo de exercícios e vídeos educativos via APP durante dois meses. Os participantes de ambos os grupos foram avaliados no início e dois meses depois usando a escala visual analógica (EVA), Índice de Incapacidade de Oswestry (ODI) e o questionário EQ-5D. **Resultados:** Os participantes do grupo intervenção apresentaram redução significativa da dor com diferença média para EVA de 1,82 (IC 95%: 0.96, 2.66; p = 0,0002), melhora da funcionalidade com 5,41 para ODI (IC 95%: 1.32, 9.50; p = 0,012) e na qualidade de vida com EQ-5D igual a -0,14 (95%: -0.20, -0.08; p = 0,0001) em relação ao grupo controle, que não apresentou alterações significativas. **Conclusão:** O programa de exercícios via mHealth foi eficaz na redução da dor, na melhora da função e qualidade de vida em pacientes com lombalgia.

Palavras-chave: Aplicativos Móveis; Dor Lombar; Terapia por Exercício; Telemedicina; Autogestão.

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V. 11, N. 2 (2023) | ISSN 2317-434X
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INTRODUCTION

Low back pain is a public health problem characterized as a painful condition that usually presents as non-specific with prevalence varying according to ethnicity, sex, age, and occupation (KNEZEVIC et al, 2021; QASEEM; WILT; MCLEAN; FORCIEA, 2017). Musculoskeletal disorders were one of the health problems that grew the most in the last years; with low back pain being the most prevalent in 134 of 204 countries analysed (CIEZA et al, 2017). The chronic low back pain can lead to functional impairment, work absence, decreased productivity, and reduced quality of life. Most cases of low back pain have a multifactorial origin; involving genetic factors, age, overweight, working conditions and other factors (KNEZEVIC et al, 2021; QASEEM; WILT; MCLEAN; FORCIEA, 2017). Exercises to strengthen and stabilize the spinal musculature are a good conservative treatment for low back pain (ZHANG et al, 2021; CAREY; FREBURGER, 2016). However, due to difficulties in accessing the health system (pre-existing and exacerbated due to the COVID-19 pandemic) and non-adherence to treatment programs, alternate methods of exercise program delivery are needed. Remote interventions are emerging using telehealth and mobile applications (APP) along with the internet (e-health) for the care and self-management of patients with low back pain and other conditions (LEWKOWICZ et al, 2021).

The use of mobile technology and APPs has increased significantly in recent years (LEWKOWICZ et al, 2021). The term “mHealth” (Mobile Health) can be defined as health practices performed through mobile devices like smartphones, tablets, and wireless devices. The smartphones brought possibilities in the development of innovative APPs, and these became tools used to support diagnosis, information delivery, and treatment (CHATZIPAVLOU; CHRISTOFORIDOU; VLACHOPOULOU, 2016). Thus, mHealth can be used for self-management of chronic conditions such as low back pain (CAREY; FREBURGER, 2016). Mobile APPs are constantly accessible and adjustable to the users' needs eliminating physical barriers and facilitating the approach according to the user's needs (EDWARDS et al, 2016). The advantages of using technology are to facilitate the individual's interaction and participation with exercise practices generally limited by financial or temporal issues (KAIRY; LEHOUX; VINCENT; VISINTIN, 2009).

Mobile application programs and the using mHealth strategies have been identified as useful tools to improve the efficiency of patient self-care with chronic diseases (LEE et al, 2018). However, systematics reviews identified limited, heterogeneous, and varied qualitative studies about digital health interventions to support low back pain self-management. The authors suggests that further primary research of long-term investigating the implementation of digital health interventions and user’s experiences is required (SVENDSEN et al, 2020). Thus, despite the wide coverage of the subject, strategies for the treatment of low back pain using exercises and technology (mHealth) still need further testing and evaluation (MATHEVE; BRUMAGNE; TIMMERMANS, 2017; DU; LIU; CAI; HU; DONG, 2020). Therefore, the aim of this study was to evaluate the effects of an mHealth exercise program and educational videos delivered via APP on pain, function, and quality of life in patients with low back pain.

METHODS

mHeath exercise APP

The APP was developed at the University’s Department of Physical Therapy to assist people with low back pain and who did not have immediate access to the health care (wait list patients). The APP supports the use for the Android and IOS system with two access types - administrator and user. In the administrator interface it is possible to monitor the user data and check if the exercises were completed. In the user interface it is necessary to enter personal information to register generating a login and password. During the registration the StartBack questionnaire is completed to assesses the severity of low back pain and classifying it as: low, medium, or high severity “red flag” (PILZ et al, 2014). Users who are classified as red flag are automatically instructed to seek medical care. The user area consists of videos with guidance on performing exercises. The videos were developed according to the National Institute for Health and Care Excellence (NICE) Guideline and previous studies (QASEEM; WILT; MCLEAN; FORCIEA, 2017; SARAGIOTTO et al, 2016; CORP et al, 2021).

Registered users receive a “push” alert on their smartphone to remind them to perform the exercises. After clicking on the alert, the APP opens the screen with a series of five videos. The exercises include stretching and strengthening with guidance on posture, repetitions and how many sets should be performed. As soon as the user completes the exercises for the day, the user completes a check-out confirming the completion and receives an automated message with an incentive medal. At the end of each week, an educational video is sent with information on spinal physiology, spinal pathologies, posture, sleep care, weightlifting, computer sitting position and workplace guidelines.

Study design and participants

This was an interventional study by matched allocation that included 51 patients with chronic low back pain (n = 51). The study was conducted remotely, and responses were obtained through an online questionnaire. The questions were digitized in Google Forms, and a link that was forwarded to the subject who accepted to participate. The study included patients with low back pain; aged between 18 and 70 years; BMI (body mass index) between 18-35 kg/m^2; both sex; having an Android or IOS smartphone and internet at home. Subjects with restrictions to exercise, undergoing physical therapy treatment, using walking aids, and those who had spinal surgery in the last 12 months were not eligible to participate.

Procedures and instruments

The instruments used in this study were: a sociodemographic questionnaire about age, sex, weight, height, BMI, a Visual Analog Scale (VAS), the Oswestry Disability Index (ODI) and the EQ-5D questionnaire.

Pain assessment

A Visual Analogue Scale (VAS) was used to assess pain intensity. It is a continuous scale from 0 to10) with “no pain” (0) and “maximum pain” (10) anchors. The patient indicates the point on the line that represents the pain intensity at the moment or in the last 24 hours. The higher the score, the worse the pain. The scale has good test-retest reliability (r = 0.94; p <0.001) (FERRAZ et al, 1990).

Function assessment

The Oswestry Disability Index (ODI) questionnaire was used to assess the degree of functional impairment during daily activities due to low back pain. The ODI was created in 1980 and the Portuguese version was validated in 2007 (VIGATTO; ALEXANDRE; CORREIA FILHO, 2007). The instrument has ten questions with six options and scores between 0 and 5. The ten sections in which the questionnaire is divided are: pain intensity, personal care, lifting objects, walking, sitting, standing, sleeping, sex life, social life, and locomotion. These domains were selected as the patients describe and measure deficiencies with subjects with low back pain. The loss of functional mobility leads to the patient's loss of independence. The score obtained was divided by 50 if the questionnaire was fully answered and by 45 if any item was not answered. The result was multiplied by 100. The score ranged from 0% – no disability to 100% – maximum disability. The degrees of disability are: minimal disability (0 to 20%), moderate disability (21 to 40%), severe disability (41 to 60%), disabled (61 to 80%) and bedridden or exaggerating its symptoms (81 to 100%).

Quality of life assessment

The EQ-5D questionnaire was applied to assess the quality of life. The instrument was developed by the EuroQol group and published in 1990. The Portuguese version was validated in 2013 and showed good acceptability in measuring health status with an ICC of 0.86. The EQ-5D is a health-related quality of life measurement instrument based on a classification system that describes health in five dimensions: mobility, personal care, usual activities, pain/malaise and anxiety/depression. Each of these dimensions has three associated severity levels which correspond: no problems (level 1), some problems (level 2) and extreme problems (level 3). Each health status is represented by a five-digit code. The results are transformed into an index from -0.59 to 1.00. The closer to 1.00, the better the health status (FERREIRA; FERREIRA; PEREIRA, 2013).

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V. 11, N. 2 (2023) | ISSN 2317-434X
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Data collection and intervention

Contact with patients on the waiting list for Physical Therapy services at the university clinic by the researchers via smartphone and via social networks and media. The researcher explained the objectives of the study and checked whether the potential participant was eligible the study. For those who agreed to participate and were eligible, a link with the online questionnaires was sent. The data collection process took place by videocall, and the researcher was available at the time to resolve any doubts regarding the research and the questionnaires. Sociodemographic information, the VAS, the ODI and the EQ-5D questionnaire were collected at baseline and two months later for both groups.

Study participants were divided into a control group (n = 24) and an intervention group (n = 27) by matched allocation based on the baseline responses considering sex and ODI scores. Control group participants did not undergo any intervention or treatment during the two-month period. The intervention group participants had the APP installed and the educational videos and exercises were available in the APP including five stretching, strengthening and balance exercises that were performed three times a week for two months. After the end of each session educational videos on pain were sent to the intervention group participants. All exercises were performed at the participant's home. The study was approved by the university ethics committee (CAAE: 02673118.4.0000.0062) and written informed consent form was obtained from all volunteers who participated of the study. The study was registered in REBEC (Brazilian Registry of Clinical Trials – number# RBR-7fpjgmj).

Data analysis

G*Power 3.1 was used to check the power of the study with post hoc test for an effect size of d = 0.95; α err. prob = 0.05, and a power (1-β err prob) of 0.95 was achieved with 51 participants.

Descriptive data were tabulated in an Excel® spreadsheet; mean, standard deviation, absolute and relative values were calculated. To verify the normality of the sample distribution the Klmogorov-Smirnov teste was used. Homogeneity of the control and interventional groups was tested using a paired t-test for age, BMI and ODI scores, and Fischer's exact test for sex. The paired t-test was used to compare the values at baseline and two months later withing and between groups in *Statistica* (version 7.0 - *StatSoft*, *Inc*.). A significance level of 5% was adopted for all tests.

RESULTS

The sociodemographics and the ODI scores were similar between groups. The results show that no statistical difference was observed between the control and intervention groups for age (p=0.926), sex (p=0.402), BMI (p=0.341) and ODI (p=0.654) as shown table 1.

Table 1. Comparison between Control and Intervention groups for age, BMI, ODI scores and sex.

	Control (n = 24)	**Intervention (n = 27)**	**Between-group difference**	
	Mean ± SD	**Mean ± SD**	**Mean (95% CI)[a]**	**p value**
Age	34.8 ± 15.40	34.4 ± 14.98	0.46 (-9.02, 8.09)	0.926
BMI	25.62 (4.56)	27.01 (5.63)	1.38 (-1.52, 4.29)	0.341
ODI	19.9 (13.39)	18.4 (10.29)	1.47 (-8.15, 5.21)	0.654
Sex	**n (%)**	**n (%)**	**Difference between fractions (95% CI)[b]**	**p value**
Female	13 (54.2)	18 (66.7)		
Male	11 (45.8)	9 (33.3)	12.5 (-14.4, 39.4)	0.402

a paired t-test; b Fischer's exact test;
SD = Standard Deviation; ODI = Oswestry Disability Index; BMI = Body Mass Index.

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V. 11, N. 2 (2023) | ISSN 2317-434X
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The results of the control group before and after the intervention period showed no statistically significant changes after two months (Table 2). The comparative results of the intervention group before and after the use of the exercise protocol by mHealth were significantly positive with a reduction in the painful condition (p = 0.0002), improvement in functionality (p = 0.012) and quality of life (0.0001) as shown table 2.

Table 2. Comparison of the baseline and two-month data on pain, function, and quality of life for the Control and Intervention group.

		Pre	Post	Between-group difference in change scores	
	n	**Mean ± SD**	**Mean ± SD**	**Mean (95% CI)**	**p value**
VAS Control	24	5.46 ± 2.70	5.04 ± 2.63	0.42 (95%: -0.61, 1.44)	0.410
VAS Intervention	27	5.33 ± 2.80	3.52 ± 2.05	1.82 (95%: 0.96, 2.66)	0.0002
ODI Control	24	19.92 ± 13.39	17.38 ±11.46	2.54 (95%: -2.80, 7.88)	0.335
ODI Intervention	27	18.44 ± 10.29	13.04 ± 7.32	5.41 (95%: 1.32, 9.50)	0.012
EQ-5D Control	24	0.63 ± 0.20	0.70 ± 0.18	-0.06 (95%: -0.13, 0.002)	0.058
EQ-5D Intervention	27	0.68 ± 0.19	0.82 ± 0.18	-0.14 (95%: -0.20, -0.08)	0.0001

SD = Standard Deviation; CI = Confidence Interval; VAS = Visual Analogue Scale; ODI = Oswestry Disability Index; EQ-5D = Quality of life.

DISCUSSION

The findings of the APP-based exercise program were effective in reducing low back pain from 5.33 points to 3.52 points. This result is similar to those reported by Hlaing et al. (2021) that found that core stabilization and strengthening exercises were effective in reducing low back pain. A longitudinal cohort study that evaluated digital care program in a large population of patients with back pain found that high completion and engagement rates and a significant positive relationship between engagement and pain reduction (BAILEY et al, 2020). However, in a different study, the use of e-health strategies, including smartphones, were not effective for the improvement of patients with low back pain; the authors highlighted that the APPs interface and participants preferences are important to be considered on the design of such applications (SUMAN et al, 2019).

Our results indicated improvements in function to intervention group. These findings are corroborated by Chhabra et al. (2018) in which subjects with low back pain also completed an APP-based exercise program and also had significant decline in disability. Exercises increase muscle strength, improve muscle function and range of motion, which improves function, accelerating recovery from low back pain (HAYDEN; ELLIS; OGILVIE; MALMIVAARA; VAN TULDER, 2021). A possible explanation for the improvement in the function is segmental stabilization. Strong and resilient muscles on the spine can withstand ischemic and fatigue, help maintain postures. Thus, core stability exercises have strong theoretical basis for prevention of spinal disorders (RODRÍGUEZ-ROMERO; BELLO; VIVAS COSTA; CARBALLO-COSTA, 2019; KOLBER; BEEKHUIZEN, 2007).

Low back pain is a challenge for health systems being a recurring problem. Patients with low back pain present limitations in activities of daily living, reduced quality of life, as well as working disability, and is often accompanied by emotional changes (SELTER et al, 2018;

MASIERO et al, 2021). Our results showed that exercise program and educational videos delivered via m-Health resulted in improvements in quality of life. A study that used virtual reality to deliver an exercise program also found significant improvements in quality of life and improvements in cognitive function in subjects with low back pain (ALEMANNO et al, 2019).

Self-management is a fundamental component in chronic care due to the active participation of the affected individual in their care. mHealth help mitigate care disparities, optimize treatment delivery, are cost-effective, safe, easy to administer, improve adherence, and facilitate accessibility, minimizing distance and time barriers to care (SLATER; CAMPBELL; STINSON; BURLEY; BRIGGS, 2017).

Although the exercise APP used allow the therapist to see if the user used the application and opened the videos, it is not possible to track if the study participants performed the exercises, which is the main limitation of the present study. Future studies could pair the APP with activity monitors or smartwatches to track activity levels.

CONCLUSION

The exercise program delivered using mHealth reduced low back pain and improved function and quality of life. Therefore, the use of the mobile application tested is a good strategy for self-management and health promotion for patients with low back pain.

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