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Pilot Study of an Online Exercise Therapy Programme for Home Office Workers in Terms of Musculoskeletal and Mental Health

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Abstract

(1) Background: Working from home is becoming increasingly common and has many advantages, but also negative consequences such as reduced physical activity, poor ergonomics and stress. Many people find it difficult to attend in-person rehabilitation sessions due to transportation barriers and limited access to rehabilitation facilities. Therefore, the aim of our study was to investigate whether our online preventive exercise programme effectively improves the musculoskeletal and mental health of sedentary workers. (2) Methods: The study participants worked from home on a long-term basis. Our research group consisted of 30 people, 16 in the intervention group and 14 in the control group. The intervention group members participated in a complex preventive exercise programme three times a week for 10 weeks. The training took place online. Before and after the exercise programme, various tests were used to assess the functional status of the participants' spine, the strength and flexibility of their core muscles (Core, Kempf and Kraus–Weber tests) and their mental state (Beck Depression Inventory). (3) Results: Significant improvement was observed in the intervention group in the Core, Kempf, Kraus–Weber and Beck tests. (4) Conclusions: Our online complex training programme proved to be effective during the evaluation. It is crucial to tailor remote rehabilitation services to the individual needs and preferences of patients and healthcare professionals.

Keywords: core muscles; patient education; prevention; home office; movement therapy

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1. Introduction

1.1. Background

Online gymnastics is a distance-based exercise programme using communication technologies. In recent years, online technology has developed rapidly, but the restrictions imposed by COVID-19 have helped to accelerate the development of this system [1]. Biddle and Mutrie studied the psychological impact of physical activity. Their research has proven that regular exercise reduces anxiety and depression [2]. Peter Salmon, a psychologist at the University of Liverpool, also considers physical activity as a potential way of maintaining mental well-being [3].

The aim of a study by Özel and colleagues was to examine the effect of telerehabilitation-based, remote supervised or unsupervised structured exercise therapy on pain, disability and quality of life in patients with chronic, non-specific neck pain [4]. Moretti and colleagues in Italy described the exacerbation of low back and neck pain in the remote workers they surveyed, but it is not known how teleworking affected the prevalence of musculoskeletal pain [5]. The Department of Physiotherapy and Rehabilitation at Muğla Sıtkı Koçman University involved 50 patients with chronic low back pain syndrome. The 8-week gymnastics programme was delivered to the patients through a web-based telerehabilitation platform called Fizyoweb. The telerehabilitation group reported improvements in pain, function, quality-of-life, kinesiophobia, satisfaction and motivation [6]. Cooper and colleagues tested a 6-week online multimodal exercise and health education program involving 23 women focusing on menopause education and lifestyle advice. The effectiveness of the program was evaluated in terms of the physical performance, menopausal symptoms, well-being and self-efficacy of participants in Laois, Ireland. Exercise sessions were held twice a week for 40 min, while the health education sessions were held once a week, also for 40 min. Participants were divided into two groups: perimenopausal and postmenopausal. It was found that the 6-week online exercise program was time-efficient and that multimodal exercise and health education tailored to menopause significantly improved the physical performance, menopausal symptoms, well-being and physical self-efficacy of perimenopausal and postmenopausal women [7].

Henriëtte A. Meijer and colleagues systematically reviewed qualitative studies providing evidence on patients' responses to videoconferencing (VC) services in an orthopaedic setting. Videoconferencing (VC) can play an important role in the management of orthopaedic pathologies. Despite positive reports regarding telemedicine studies, the uptake in clinical practice remains low. Acceptability by patients is an important element in the adoption of telemedicine into the system, and a focus on qualitative methodology may reveal the reasons behind the acceptability of using VC. Further qualitative research is needed to investigate acceptability for both patients and clinicians using a theoretical framework that allows for replicability and generalizability [8].

Malinska and her colleagues conducted a study among computer workers. They used a questionnaire to collect data on demographics, musculoskeletal disorders, lifestyle characteristics, computer work ergonomics and psychosocial and physical work characteristics. Almost half of the respondents complained about neck pain and low back pain. Prolonged computer time, increased job demand and older age were identified as risk factors [9].

Studies to date suggest that exercise protects against the adverse effects of stress and has an anti-stress and antidepressant effect [10]. The positive mental health effects of regular exercise are particularly important for people who work long hours at home [11].

Work from home (WFH), also referred to as home office, emerged in the early 2000s with the advancement of teleworking technologies. These developments enabled employees to perform their professional duties remotely, reducing the need for commuting, allowing for greater flexibility in work schedules and promoting a better work–life balance [12]. Moreover, working from home offers advantages not only for employers but also for employees. Most importantly, it allows employees to save the time otherwise spent commuting and to achieve a more balanced work–life relationship [13]. Working from home enables employees to schedule their work during periods of peak productivity and to avoid many of the workplace distractions typically associated with American-style open offices [13]. In addition, with WFH, employees have more control over environmental factors, internal environmental quality (IEQ) factors such as lighting, temperature, humidity, noise and air quality [14]. These IEQ factors have a significant impact on employee comfort, which is strongly associated with job satisfaction [15].

Despite these numerous benefits, full-time home-office work has also been associated with certain disadvantages. Remote workers tend to experience reduced social interaction with colleagues and lower levels of physical activity (e.g., the absence of walking between meeting locations) [12]. In addition, prolonged screen exposure due to work can lead to fatigue, headaches and eye-related symptoms [16]. For individuals living alone, the absence of face-to-face interaction and daily social support may contribute to mental health problems, including depression and anxiety, as well as a blurring of the boundaries between work and personal life. Such difficulties in psychological detachment from work can elevate stress levels, while ongoing work–family conflict may lead to emotional exhaustion [17].

The home office has also drawn attention to the relational and ergonomic needs of the remote working environment. Many employees perform their tasks at temporary workstations such as kitchen tables, counters, sofas, beds or coffee tables. With reduced business travel and commuting, they spend considerably more time in front of a computer each day [18].

Shariat A. et al. reported a high prevalence of musculoskeletal pain among office workers [19]. Musculoskeletal pain can have a significant negative impact on quality of life, work efficiency and job performance according to Wu S. et al. [20].

Based on the studies discussed above, we aimed to develop an online preventive exercise programme adapted to home office workers and to examine its effects on participants' musculoskeletal function and mental health. The effects were assessed using various validated tests by comparing the intervention and control groups at the beginning and end of the study.

In Hungary, a significant number of people who work from home rely on access to the internet for their work. By February 2020, the number of people working from home was only a few hundred thousand. The peak was in May 2020, when 17% of the domestic workforce, or around 760,000 people, worked from home [20]. According to the Central Statistical Office, the vast majority of home workers (77%) have a tertiary education, 21% have a school leaving certificate, 1.6% have a vocational secondary school qualification and 0.4% have a primary education [21].

The following is the recommended correct sitting position in front of a computer: The recommended joint angles are 0–10° at the shoulder, 90–100° at the elbow, 90–100° at the hip, 90–110° at the knee, and 100–120° at the ankle. While sitting, care should be taken to keep the pelvis stable and centred, avoid posterior pelvic tilt and maintain the physiological curves of the spine—lumbar lordosis, thoracic kyphosis and cervical lordosis [22]. The ideal layout of the workspace is important. It is determined by the frequency of use and placement of office equipment and documents. On this basis, we can divide our working environment into three parts:

1. Usual work
2. Occasional work
3. Non-working area

1.2. Low Back Pain (LBP)

Low back pain refers to pain located between the lower edge of the ribs and the buttocks. The pain can be of short duration (acute), slightly longer duration (subacute) or long duration (chronic). It can occur in any job but is most common in sedentary workers. LBP makes it difficult to move around and can affect quality of life and mental wellbeing. These factors in turn can affect work and relationships with family and friends. Research suggests that 619 million people live with LBP, and it is said to be the leading cause of disability worldwide [23,24]. According to the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD), published in 2023, the global number of LBP cases is expected to reach 619 million in 2020, rising to 843 million by 2050 [23]. There are significant geographical variations in prevalence (cases per 100,000 population), with the highest prevalence in Central and Eastern Europe and Hungary having the highest prevalence per 100,000 population. The already high prevalence of low back pain may be exacerbated by the negative effects of teleworking (including reduced physical activity, poor ergonomics, stress etc.). In this context, preventive interventions targeting the musculoskeletal system play a particularly important role.

Core muscle stability therapy has become increasingly popular in recent years, with research by Wang and colleagues [25] finding that core exercises produced better results in the treatment of low back pain compared with general spinal exercise in the first three months of treatment for LBP. Further studies have shown that core-specific interventions reduce pain and improve movement limitations [26].

1.3. The Aim of Our Study

Our goal was to develop a new experimental online preventive exercise programme for home office workers, aiming to assess and improve the functional and mental condition of participants. In our study, the primary endpoint was the musculoskeletal status of the participants (strength and flexibility of core muscles), while the secondary endpoint was the mental health of the subjects.

2. Materials and Methods

- Thirty patients participated in the study on a voluntary basis. We asked a small local IT company to participate in the online training programme we had developed, which we then confirmed using a validated questionnaire and physical examination.
- Participants signed a consent form in which we informed them about the purpose and ethical background of our programme.
- We divided the participants into two groups. Sixteen people participated in the intervention group and 14 in the control group. The inclusion of the control group was essential for validating the results.
- All participants were examined in their own homes. The assessments were carried out before and after the exercise programme.
- Members of the intervention group participated in a 45 min online exercise programme three times a week for 10 weeks at prearranged times, which took the form of live lectures supervised by a physical therapist.
- Members of the control group did not participate in online therapy sessions. We asked the participants to continue their usual habits and activities and not to start any new activities or other things. This approach was considered important to ensure that the comparison between the control and intervention groups was not influenced by external factors.
- Those who did not meet the above criteria were excluded from the study.
- The data were analysed using statistical methods.

2.1. Target Group

The survey involved young people who work from home for the IT company we contacted and who responded quickly to our online call for applications.

2.2. Study Process

Our study was conducted between 10 March 2024 and 22 November 2024. Registration for our survey was completed online. The inclusion criteria for participants were as follows:

1. Working from home.
2. Consent required measurements and participation in the exercise programme.
3. Attendance at the pre- and post-measurements before and after the 10-week programme.
4. Internet access and use of Microsoft Teams application.
5. Attendance at all sessions.

6. Availability of the necessary equipment (half-litre PET bottles, rubber bands, chair and sofa).
7. Sufficient space to carry out the exercise.
8. Sufficient physical and health condition to participate in the training programme.

Presentation of the research structure:

1. Registration for our research was completed online.
2. Inclusion criteria were completed by 30 participants. The intervention group (n = 16) and control group (n = 14).
3. A validated questionnaire and physical examination were carried out in the participants' homes with the personal assistance of the physiotherapist (n = 30).
4. The 10-week online exercise programme took place in the presence of a physiotherapist (n = 16).
5. To measure back the results obtained during the study, the previously used validated questionnaires and physical examinations were re-recorded in the personal presence of the physiotherapist (n = 30).

2.3. Questionnaires

We wanted to know the mental status of the home office workers so we asked the participants to fill in a form consisting of a Beck depression test at the beginning and end of the study. The test taken at the beginning of the study allows us to assess the presence and severity of depressive symptoms, with a back test at the end to show changes in symptoms. The Hungarian abridged version consists of nine statements and is equivalent to the original, with acceptable reliability [27]. The scores obtained after completion of the test allow us to differentiate between four levels of depression: 0–9 normal, 10–18 mild, 19–25 moderate and $\geq$26 severe.

2.4. Functional Ability Test

Kraus–Weber (K–W) test: this test is designed to test the strength of the core muscles. The test consists of 6 sets of exercises, which are scored separately and evaluated on the basis of the total score.

The maximum score is 60 points. Scores between 0 and 40 are considered unsatisfactory, scores above 40 are considered good and scores above 50 are considered very good [28].

Core test: an endurance test that has been proposed for the trunk flexors; the subject is in the push-up position in the forearm position. The whole torso is straight; it is important that the hips are neither elevated nor bent. The head is in the line of the spine with shoulders above the elbows. The correct posture should be maintained as long as they can. Meanwhile, measure the number of seconds held with a stopwatch. The exercise continues until the subject gives up or cannot maintain control of the lumbar spine [29].

The Kempf test: named after Hans-Dieter Kempf, the test system consists of 8 exercises and is an excellent way of testing the strength and flexibility of the core muscles [30].

2.5. Mobility Programme

Under the supervision of a qualified physiotherapist, participants in the programme performed targeted posture-strengthening and core muscle-strengthening spinal exercises three times a week for 10 weeks, using a variety of tools. These tools were carefully selected and incorporated into the exercise programme based on a preliminary assessment to ensure that they were available to all participants in their area of residence. We used half-litre PET bottles to replace dumbbells, rubber bands for strengthening, and home equipment such as a chair and a sofa to carry out the exercises. The exercises were performed on carpet or polyfoam mattresses. Each session consisted of a warm-up, main part and a cool-down.

Occasionally and on demand, the exercises were supplemented with a short relaxation session. The exercises were always held at pre-arranged times using the Microsoft Teams communication platform. The exercise programme was put together by physical therapists. The physical therapist discussed the tasks with the participant during personal assessments and corrected them during the live programme if necessary. The online programme also allowed the physical therapist to monitor participation and activity during the exercises.

2.5.1. The Warm-Up

We started the exercises with a general warm-up, moving through the joints from cranial to cauda, with more emphasis on the shoulder, hip, knee and ankle joints. The warm-up consisted of 10 min in total.

2.5.2. The Main Part

Based on the individual data obtained during the initial assessment, a physiotherapist compiled a set of exercises for the intervention group that were suitable for all participants and enabled them to progress. The tasks changed weekly. The physiotherapist also determined the number of sets and repetitions based on the group dynamics, ensuring that the training sessions were not one-sided [31]. Each session lasted 45 min.

In the first phase of this stage of training, we teach the correct position of the lumbo-pelvic-hip complex and the formation of normal lordosis, with the aim of establishing proper pelvic control and maintaining it in different body positions.

In the second phase, to achieve effective co-contraction of the transversus abdominis and multifidi muscles, we teach the isolated active tensioning of these muscle groups in different body positions, checking the correct execution by palpation.

Subsequently, to develop the endurance of these muscles, we practice holding the tension for 10 s while breathing continuously and calmly, repeating each exercise ten times, with a one-minute break between training different muscle groups. This is followed by integrated training of the local and global muscle systems, where, following the principle of gradual progression, we increase the intensity of the exercises in several body positions, first in a closed and then in an open kinetic chain, requiring increasing concentration.

The most important exercises used in the exercise programme:

- Squats:
    - Squats → Squats with side steps → Chair-assisted trunk support squats;
- Burpees:
    - One-sided burpees
- Pelvic lifts:
    - Pelvic lifts with stable and unstable support
- Other functional exercises:
- Kneeling push-ups → Push-ups
- Abdominal crunches on the floor and on a chair
- Trunk extension on the floor
- Plank with knee support → Traditional plank → Side plank with knee support

Based on the individual data obtained during the initial assessment, a physiotherapist compiled exercises for the intervention group that were suitable for all participants and allowed them to progress. The tasks varied from week to week. The number of sets and repetitions was also determined by the physiotherapist according to the group dynamics.

The main parts of the exercise programme are shown in Table 1.

Table 1. Exercise programme main part.

Time (week)	Body Position	Device Used	Exercises
1	Supine	Polyfom	Easier spinal mobilisation and isometric stretching
2–3	Variable (lying, sitting)	Half litre bottled water, chair, polyfom	Upper and lower abdominal exercises, deep back muscle strengthening
4–5	Variable (lying, sitting, standing)	Half litre bottled water, chair, polyfom, rubber band	Shoulder girdle and trunk dynamic exercises
6	Variable (lying, sitting, standing, on all fours)	Half litre bottled water, chair, polyfom, rubber band	Shoulder girdle and trunk stabilisation exercises
7–8	Variable (lying, sitting, standing, on all fours)	Half litre bottled water, chair, polyfom, rubber band	Heavy back and abdominal muscle strengthening exercises
9–10	Variable (lying, sitting, standing, on all fours)	Half litre bottled water, chair, polyfom, rubber band	Difficult strain stabilisation exercises

The exercise is illustrated in Figure 1.

Figure 1. The picture shows one of the subjects doing gymnastics.

2.5.3. The Cool Down

After each exercise we did outstretching, with the main focus on the muscle groups worked. The recovery took 10 min per session. We also supplemented the stretching with short breathing exercises.

2.5.4. The Relaxation Part

Participants lay on a mat or mat in a comfortable position. Relaxation was performed with eyes closed. Once they had managed to focus on the sensations of their body, they started with slow, deep inhalations and exhalations. Following the conscious breathing, they said to themselves, “I am completely relaxed and at ease”. These cycles were repeated three times and ended with stretching [32]. The relaxation sessions were 5–10 min each.

2.6. Statistical Methods Used

The results obtained during the physical survey were processed according to a database created in Microsoft Excel spreadsheet software (Microsoft Office LTSC Professional Plus 2024; Excel 2408 version). Our results are measured using median and interquartile ranges (IQR1-IQR3). To implement the statistical tests, in addition to the Microsoft Excel spreadsheet software mentioned above. The two paired (before/after intervention) data were analysed using Wilcoxon signed rank tests and between-group comparisons (intervention group vs. control group) Mann-Whitney U test was used. To evaluate categorical data Fisher's exact test was used. For statistical analysis Stata 13 software was used. The result was considered significant if the *p*-value was less than 0.05. The tests were used to examine whether there was a significant change in the parameters assessed in our case group during the 10-week exercise programme. Strength and extensibility of the spine and core muscles (Core, Kempf and Kraus-Weber test) and mental state (Beck depression test) were identified as dependent variables and time as an independent variable.

2.7. Ethics Licence

The study was approved by the Research Ethics Committee of the University of Debrecen (6774-2024), and participants gave informed consent to the collection and processing of data.

3. Results

A total of thirty people participated in the study, with 14 people in the control group (8 women with a mean age of 29.25 years and 6 men with a mean age of 27.50 years) and 16 people in the intervention group (5 women with a mean age of 27.80 years and 11 men with a mean age of 29.63 years). Table 2 compares the characteristics of the intervention group and the control group at baseline (e.g., age, gender, baseline scores on all tests). There were no differences in age, gender ratio, or test scores between the intervention and control groups. Although the Kraus-Weber Total score was significantly higher in the intervention group before the intervention, the exercise programme still managed to improve the score, while the control group showed no significant change in Kraus-Weber Total score, which also confirms the effectiveness of the exercise programme.

Table 2. Baseline results.

	Control Group		**Intervention Group**		
	male (%)	*female (%)*	*male (%)*	*female (%)*	*p-value (control* vs. *intervention)*
gender	69.00	31.00	43.00	57.00	0.153
	Median	*IQR*	*Median*	*IQR*	*p-value (control* vs. *intervention)*
age	28.00	27.00–30.25	27.00	26.25–32.00	0.461
Kraus-Weber Total	57.00	54.75–57.00	58.00	56.75–60.00	0.022
Kempf 1	15.50	13.00–17.25	16.50	13.75–20.75	0.449
Kempf 2	16.50	13.25–17.50	17.00	13.25–19.25	0.583
Kempf 3	11.50	10.00–15.00	13.50	13.50–17.50	0.482
Kempf 4	13.50	10.00–16.00	13.50	10.00–16.00	0.985
Core	49.50	38.00–58.00	59.00	46.75–72.75	0.104
Beck total	22.00	22.00–23.00	22.00	20.25–24.00	1.000

3.1. Results of the Kraus-Weber Test

Based on the total scores of the Kraus-Weber test, a significant change ($p = 0.003$) was observed after the exercise programme in the intervention group. At the start of the study, the median was 58 (56.75; 60.00), increasing to 60 (59.00; 60.00). No significant ($p = 0.082$) change was observed in the control group.

Looking at the first part of the Kraus-Weber test (Kraus-Weber 1), it can be seen that there was a significant change ($p = 0.015$) from the start of the study (median = 10.00; iqr = 8.75; 10.00). For the second test part (Kraus-Weber 2), there was no significant change ($p = 0.084$) in the effect of the exercise programme. Both at baseline and after the exercise programme, the median was 10.00 (iqr = 10.00; 10.00). The results of the third part (Kraus-Weber 3) (before and after median = 10.00; iqr = 10.00; 10.00) also showed no significant change ($p = 0.157$). Also, no significant change was found for the fourth (Kraus-Weber 4) ($p = 0.083$) (before and after median = 10.00; iqr = 10.00; 10.00) test part. When examining the fifth part (Kraus-Weber 5), it can be seen that there was a significant change ($p = 0.046$) from the beginning of the test (median = 10.00; iqr = 9.75; 10.00) to the end (median = 10.00; iqr = 10.00; 10.00). Finally, a significant change ($p = 0.025$) was also observed for the sixth part (Kraus-Weber 6) (median = 10.00; iqr = 9.00; 10.00) compared to the pre-exercise condition (median = 10.00; iqr = 10.00; 10.00). There were no significant changes in the control group in any of the tests (Kraus-Weber 1–6) (Table 3).

Table 3. Kraus-Weber test results.

		Control Group			**Intervention Group**			
Test	***Time (Before/After Intervention)***	***Median***	***IQR***	***p-Value***	***Median***	***IQR***	***p-Value***	***p-Value (Control* vs. *Intervention)***
Kraus-Weber Total	*Before*	57.00	54.75–57.00	0.082	58.00	56.75–60.00	0.003	0.020
	After	57.00	54.75–58.00		60.00	59.00–60.00		<0.001
Kraus-Weber 1	*Before*	9.00	8.75–10.00	-	10.00	8.75–10.00	0.015	0.639
	After	9.00	8.75–10.00		10.00	10.00–10.00		0.078
Kraus-Weber 2	*Before*	10.00	10.00–10.00	-	10.00	10.00–10.00	0.084	0.978
	After	10.00	10.00–10.00		10.00	10.00–10.00		0.279
Kraus-Weber 3	*Before*	9.50	9.00–10.00	-	10.00	10.00–10.00	0.157	0.035
	After	9.50	9.00–10.00		10.00	10.00–10.00		0.007
Kraus-Weber 4	*Before*	9.50	8.00–10.00	-	10.00	10.00–10.00	0.083	0.052
	After	9.50	8.00–10.00		10.00	10.00–10.00		0.006
Kraus-Weber 5	*Before*	10.00	10.00–9.00	0.082	10.00	9.75–10.00	0.046	0.737
	After	10.00	10.00–10.00		10.00	10.00–10.00		0.551
Kraus-Weber 6	*Before*	9.00	8.75–10.00	-	10.00	9.00–10.00	0.025	0.079
	After	9.00	8.75–10.00		10.00	10.00–10.00		0.001

3.2. Results of the Core Test

For the intervention group. a significant change ($p = 0.015$) was observed in the Core test comparing the results before (median = 59.00; iqr = 46.75; 72.75) and after (median = 59.5; iqr = 50.50; 73.50) the exercise programme. There was no significant change in the control group ($median_{before} = 49.50$; iqr = 38.00; 58.00. $median_{after} = 49.50$; iqr = 39.75; 55.75. $p = 0.327$).

3.3. Kempf Test Results

A significant improvement ($p < 0.001$) was observed for the first part of the Kempf test (Kempf 1). At the start of the test the median was 16.50 (iqr = 13.75; 20.25) and after the exercise programme the median was 23.50 (iqr = 18.25; 25.50). The results of the second part of the test (Kempf 2). also showed a significant improvement ($p < 0.001$) (median = 17.00; iqr = 13.25; 19.25) compared to the initial value (median = 20.00; iqr = 16.50; 26.00). The third part of the test (Kempf 3) showed a similar positive result ($p < 0.001$). The median was 13.50 (iqr = 13.50; 17.50) for the first measurement and 17.00 (iqr = 15.00; 20.25) after the exercise programme. Finally. the results of the fourth part of the Kempf test (Kempf 4) (median = 13.50; iqr = 10.00; 16.00) also showed a significant improvement ($p < 0.001$) after the gymnastics programme (median = 15.00; iqr = 12.50; 22.00). In contrast. there were no significant changes in the control group in any of the tests (Kempf 1–4). (Table 4).

Table 4. Results of the first four parts of the Kempf test (Kempf 1–4).

		Control Group			Intervention Group			
Test	***Time (Before/After Intervention)***	***Median***	***IQR***	***p-Value***	***Median***	***IQR***	***p-Value***	***p-Value (Control* vs. *Intervention)***
Kempf 1	*Before*	15.50	13.00–17.25	-	16.50	13.75–20.75	<0.001	0.449
	After	15.50	13.00–17.25		23.50	18.25–25.50		0.001
Kempf 2	*Before*	16.50	13.25–17.50	-	17.00	13.25–19.25	<0.001	0.583
	After	16.50	13.25–17.50		20.00	16.50–26.00		0.047
Kempf 3	*Before*	11.50	10.00–15.00	-	13.50	13.50–17.50	<0.001	0.482
	After	11.50	10.00–15.00		17.00	15.00–20.25		0.003
Kempf 4	*Before*	13.50	10.00–16.00	-	13.50	10.00–16.00	<0.001	0.984
	After	13.50	10.00–16.00		15.00	12.50–22.00		0.205

Improvements were observed in the other parts of the Kempf test (K5–K8) but none of our results were significant. In the fifth part of the test, two respondents showed improvement in both their right and left legs ($p = 0.157$). When examining the seventh test part. a positive change was found in 1 respondent ($p = 0.317$). Finally, for the last part, there was an improvement for both right and left leg in 3 participants ($p = 0.083$). In the control group, no significant difference was found between the results before and after the programme when the Kempf test was administered again.

3.4. Beck Questionnaire

Based on the total scores of the Beck questionnaire. there was a significant change ($p < 0.001$) in the effect of the exercise programme. At the beginning of the study, the median was 22.00 (iqr = 20.25; 24.00) and at the end of the study the median decreased to 15.00 (iqr = 13.75; 17.00). In our study significant reduction was also evaluated in the control group ($p < 0.001$). but the improvement in the intervention group ($median_{intervention =}$ 15.00 iqr = 13.75; 17.00) was significantly greater ($p = 0.012$) than in the control group ($median_{control}$ = 18.00 iqr = 16.50; 19.00) after the intervention. The results of the questionnaire are shown in Table 5 broken down by question (Table 5).

Table 5. Beck test results.

		Control Group			Intervention Group			
Test	*Time (Before/After Intervention)*	*Median*	*IQR*	*p-Value*	*Median*	*IQR*	*p-Value*	*p-Value (Control* vs. *Intervention)*
Beck Total	*Before*	22.00	22.00–23.00	<0.001	22.00	20.25–24.00	<0.001	1.000
	After	18.00	16.50–19.00		15.00	13.75–17.00		0.012
Beck 1	*Before*	2.00	1.25–3.00	0.001	2.00	1.75–3.25	0.002	0.863
	After	1.50	1.00–2.00		1.50	1.00–2.00		1.000
Beck 2	*Before*	2.00	1.00–3.00	0.003	2.00	1.00–3.25	0.003	0.619
	After	1.00	1.00–2.00		2.00	1.00–2.25		0.616
Beck 3	*Before*	3.00	2.25–3.75	0.018	3.00	2.00–4.00	0.001	0.878
	After	3.00	2.00–3.00		2.00	1.00–2.25		0.024
Beck 4	*Before*	3.00	3.00–4.00	<0.001	3.50	2.75–4.00	<0.001	0.946
	After	2.50	2.00–3.00		2.00	1.00–3.00		0.140
Beck 5	*Before*	3.00	2.00–3.75	0.018	3.00	2.00–3.00	0.003	0.527
	After	3.00	2.00–3.00		2.00	1.00–2.00		0.042
Beck 6	*Before*	1.50	1.00–2.00	0.018	1.50	1.00–2.00	0.014	0.982
	After	1.00	1.00–1.75		1.00	1.00–1.25		0.849
Beck 7	*Before*	3.00	2.00–3.00	0.003	3.00	2.00–3.00	<0.001	0.927
	After	2.00	2.00–3.00		2.00	1.00–2.00		0.023
Beck 8	*Before*	2.00	2.00–3.00	0.027	2.00	2.00–3.00	0.009	0.661
	After	2.00	1.00–2.00		2.00	1.00–2.00		0.980
Beck 9	*Before*	1.50	1.00–2.00	0.04	2.00	1.00–2.00	0.015	0.528
	After	1.00	1.00–1.00		1.00	1.00–1.25		0.842

4. Discussion

The aim of our study was to create a new experimental online spinal mobilization programme for office workers working from home. We considered it important that the online exercise programme we ran be supervised. All sessions were conducted by the same qualified physiotherapist. This allowed him to monitor the positive changes among the members of the intervention group throughout the programme. The physiotherapist was able to supervise whether the participants were performing the exercises he prescribed accurately and correctly, and he was able to answer any questions that arose immediately. The results showed that the exercise programme we had developed improved the core muscle strength and flexibility of the intervention group members, as well as their mental health. The patients participating in the study understood that they could do a lot for their own health by completing our 10-week programme three times a week under supervision, similar to what is described in other literature [20,33]. When developing our programme, we started from the assumption that the programme we designed would improve the strength and flexibility of the participants' core muscles, which would make their office work at home easier and increase their physical activity. We were able to confirm this. as we observed significant improvements among the members of the intervention group using the Kraus-Weber, Core and Kempf tests. We used the Beck questionnaire to assess mental health. We considered it important to examine the impact of our exercise programme on the mental state of the participants. Based on the results, we can say that there was a significant positive change in the intervention group members as a result of our programme. When calculating the results. we were surprised to find that there was also a positive change among the members of the control group. even though we had specified in the initial assessment that they could only continue with their usual habits and activities. However, we can say that the improvement was more significant in the intervention group than in the control group.

Several studies have shown that a decrease in physical activity and an increase in sedentary behaviour result in a decrease in muscle mass, and sitting for 7 h a day also leads to an increase in spinal stiffness [34]. In the initial assessment of mental status, the Beck depression test showed that both the intervention and control groups included individuals suffering from severe depression, moderate depression and mild depression. We believe that months of anxious uncertainty, fear of illness, concern for family members and similarly, isolation, sedentary lifestyle and lack of social contact have significantly contributed to these worrying results. Based on the objectives of our study, we can say that as a result of the online targeted exercise programme, there was an improvement in mental assessment and in muscle strength and stretching tests.

Online exercise programs and the digital sports world have become popular during the pandemic, and many sports clubs and institutions, such as the Debrecen Municipality's Move Debrecen program, have launched sports opportunities in the online space. The digital sports scene has become popular during the pandemic and many sports clubs and institutions, such as the Debrecen Municipality's Move Debrecen programme, have launched sports opportunities in the world of online space. In this period of limited opportunities, online exercise has been shown to prevent mammary diseases caused by sedentary lifestyle and increased physical inactivity, and by creating a sporting community it also plays a role in maintaining mental health as during the sessions the people assessed became more open and encouraged each other while doing the exercises.

Health is determined by the harmonious interaction of physical and mental components. In our modern, fast-paced society, numerous studies have shown that one in four adults worldwide is inactive [32]. Physical inactivity is now called a pandemic that requires urgent action. It is well known that physical activity improves physiological functioning and cognitive, emotional, social and psychosocial functioning [35].

Our research compared several studies to demonstrate the value of remote rehabilitation, an online exercise programme, taking into account the specific needs of patients and healthcare professionals.

The aim of the study by Özel and colleagues was to examine the effect of telerehabilitation-based, remote, supervised or unsupervised structured exercise therapy on pain, disability, and quality of life in patients with chronic nonspecific neck pain. Sixty-six patients with chronic nonspecific neck pain were randomly divided into three groups: remote supervision group (RSG. n = 22), unsupervised group (UG. n = 22), and control group (CG. n = 22). Patients in the remotely supervised and unsupervised groups received a progressive, structured therapy programme four days a week for four weeks. The remotely supervised group was supervised via videoconferencing and text messages. Overall, the improvement in quality of life after treatment was greater in the supervised group than in the unsupervised group. In our study, the results showed that the telerehabilitation-based, remote, supervised exercise programme we had designed had a positive psychological (Beck test) and musculoskeletal (Kraus-Weber test, Core test, Kempf test) effect on the office workers involved [4]. In general, unsupervised exercise programmes have the advantage of being inexpensive and widely available to the public and are particularly popular for the treatment of chronic diseases. However, previous scientific studies suggest that unsupervised exercise programmes are not as effective as supervised programmes in the management of chronic diseases. Experts primarily identify poor adherence as the reason behind the unfavourable results of unsupervised exercise.

Similar to our research, Özül et al. also studied the practical effects of remote rehabilitation among office workers by examining spinal movements. The office workers (n = 120) were randomly divided into three groups participants in group 1 received an interactive telerehabilitation programme (strengthening, motor control and posture correction exercises) for 45 min a day, 3 days a week, for a total of 6 weeks. Participants in group 2 were trained to perform the exercise programme independently at home for 45 min a day, 3 days a week, for a total of 6 weeks. The patients in group 3 only received office ergonomics training. Statistically significant improvements were observed in office workers in terms of pain ($p < 0.001$), range of motion (ROM) ($p < 0.001$), neck disability ($p < 0.001$), functional status ($p < 0.001$) and quality of life ($p < 0.001$). In addition to office ergonomics training, interactive telerehabilitation programmes are the most effective method for treating pain, range of motion and neck disability [36]. In our study, we also achieved positive results with an online exercise programme supervised by a physical therapist in terms of trunk muscle strength and flexibility, using the Core, Kempf and Kraus-Weber tests. Özel et al [4] implemented a 4-day-a-week intervention programme over 4 weeks, while Özül et al. [36] performed a 3-day-a-week programme over 6 weeks. Our telerehabilitation programme performed three times a week for 10 weeks using different tools. The duration and frequency of our intervention not only improved the condition of the musculoskeletal system but also had a positive effect on the mental status of the participants.

Bannell et al. also looked at individuals with sedentary lifestyles similar to our study but with an unsupervised exercise programme. Participants had access to a website that provided virtual resources and instructions for completing a 12-week progressive exercise programme. Although we previously emphasized the advantages of supervised programmes over unsupervised programmes the data suggested that the mobile health (mHealth) technology–supported exercise and physical interventions have a positive impact on the individuals involved in the programme and on their adherence to exercise [37].

Malinska and her colleagues conducted a study among computer workers. They used a questionnaire to collect data on demographics, musculoskeletal disorders, lifestyle characteristics, computer work ergonomics, and psychosocial and physical work characteristics. More than 48% of respondents complained of musculoskeletal disorders in the past year, especially neck and back pain. In their conclusions, they stated that the most effective way to eliminate the risks of musculoskeletal disorders in the workplace is to develop health programmes that promote a healthy lifestyle and to raise employee awareness of workstation ergonomics and work organization, especially among women and older workers [8]. In Debrecen, the importance of community exercise programmes that can encourage the population to adopt a healthier lifestyle is similarly supported.

Numerous studies have been conducted on the online treatment of various diseases. The aim of our study was not to treat existing symptoms or diseases but to create an alternative form of exercise as a preventive measure to interrupt prolonged static sitting.

Yaghoubitajani and his colleagues also wanted to reduce neck and shoulder pain, incorrect posture, sick leave time and reduced work capacity by using an online gymnastics programme. Several parameters (neck and shoulder pain, posture angles, work capacity and muscle activity) related to work performance were improved in this study. This, along with our study, highlights the impact of supervised online intervention programmes on work performance. This scientific evidence can be a useful tool for convincing workplace managers to support the implementation of similar programmes in the future, as improvements in the musculoskeletal and mental health of their employees will also improve productivity [32].

Pérez and colleagues also worked with a small number of patients. including 29 breast cancer patients. As in our pilot study. they carried out the intervention exercise programme in their homes 3 times a week (16 weeks) under online supervision. Their results also showed significant improvement. They found that supervised online exercise in a non-clinical setting is effective. The study supports the role of home-based online exercise programmes in the rehabilitation strategy of breast cancer survivors and confirms that online programmes are justified even in cases of serious chronic diseases [38].

In another area of rehabilitation. Lewis and colleagues studied the implementation of an online exercise programme with 14 individuals with chronic respiratory disease. Similar to our interventions, the programme had a positive effect on patients' functional capacity and mental state (anxiety). They found that there was less dropout in the group of patients treated in telerehabilitation compared to in-person pulmonary rehabilitation It was found that there was less dropout in the group of patients receiving remote rehabilitation than in the group of patients receiving in-person pulmonary rehabilitation. which is another positive argument in favour of remote rehabilitation in the treatment of chronic diseases [39].

Barbosa and colleagues investigated the importance of a six-week telerehabilitation exercise programme in patients with non-specific neck pain through a randomised control trial. Their results suggest that telerehabilitation for patients with non-specific chronic neck pain is effective, easily accessible and low-cost through the use of technology [40].

Vetrovska and colleagues in multiple sclerosis have shown that this type of online exercise programme can help people with MS to remain physically active by providing an online form of exercise programme that is feasible [41].

Limitations

One of the limitations of the study was that many people could not combine the three online training programmes a week with their personal lives or could not find the motivation to complete the 10-week training programme. Another limiting factor was the lack of equipment, as only tools, spare parts and equipment that were available to everyone in their homes were used during the training sessions.

5. Conclusions

Based on the results of our research, we plan to add more mobilisation exercises to the muscle strengthening. In addition, we would like to make our research more complex by examining and treating the cervical spine in more detail, as well as expanding the 10-week training programme by working with more volunteers in person so that we can draw more realistic values and conclusions from more home sampling data. Based on our research, we can say that the complex exercise programme we designed improved the functional status of the spine and the strength and flexibility of the core muscles and mental health.

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