Effectiveness of different exercise programs in individuals with non-specific neck pain: telerehabilitation, given with synchronous exercises versus home-based exercise

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Abstract. Non-specific neck pain (NSNP) is a common musculoskeletal disorder and one in two adult faces this problem. Aims of this study are to investigate the effect of telerehabilitation, given with synchronous exercise, and to compare the effectiveness of telerehabilitation and home exercise programs in individuals with NSNP. Thirty-four volunteers diagnosed with NSNP were randomly divided into the telerehabilitation (synchronous exercise) and home exercise groups. All participants performed a program including isometric neck exercises and posture exercises for 4 weeks. Baseline and post-treatment pain intensity, muscle endurance, posture and disability level data were analyzed.
Results. The groups were similar in terms of body mass index, daily working time, screen time, and adherence to exercise except mean age. Pain intensity, cervical muscle endurance, postural alignment, and disability levels of the groups before the exercise programs were similar ($p>0.05$). After the exercise intervention, both groups showed a decrease in pain intensity, disability levels ($p<0.01$) and positive effect on the cervical endurance and postural alignment of both groups ($p<0.05$). There was no significant difference between groups in these parameters ($p>0.05$).
Conclusion. We determined that intervention in the form of both telerehabilitation, given with synchronous exercise, and home program provided positive gains on pain, endurance, posture and disability. There was no superiority of the groups over each other in terms of gains achieved. We think that positive gains can be achieved with a one-session online exercise training given under suitable conditions.
Keywords*: neck pain, telerehabilitation, home exercise, disability, cervical muscle endurance.*

Introduction

Non-specific neck pain (NSNP) is a condition that can be caused by different reasons without any trauma or musculoskeletal pathology and causes multidimensional symptoms of varying severity (1). In its etiology, a wide spectrum ranging from nerve root compression, disc herniation and poor posture to fractures stands out (2). NSNP, which is one of the most common reasons for hospital admission, occurs at least once in a lifetime in 48-67% of the general population (3). NSNP, which has a higher incidence in women; It causes pain in the cervical region, limitation of joint movements, loss of muscle strength, endurance and functional disability (4,5).

Different conservative treatment methods are used in the treatment of NSNP. The most commonly used methods are exercise, massage, acupuncture, neural therapy, and electrotherapeutic modalities (6). Exercises; It includes many techniques such as stretching, static or dynamic strengthening, endurance training and proprioceptive exercises. Of these methods, isometric exercises are an important part of the rehabilitation program applied to improve functional skills (6,7). These exercises are easy to tolerate by the patient and able to be performed without the need for any equipment. Also they have positive contributions to general muscle strength increase and good posture (8). Purpose-oriented posture exercises added to the treatment of patients with NSNP also contribute to supporting posture and reducing complaints by improving body mechanics (9).

Due to extraordinary situations such as the SARS-CoV-2 pandemic, it has become widespread to present physiotherapy applications with web-based alternative methods such as Telemedicine and Telerehabilitation (10). These methods include assessment, rehabilitation goals, exercise program and patient follow-up, just

like hospital-based rehabilitation practices. In the NSNP, telerehabilitation-based assessment and applications for treatment have recently started to take place in the literature (11,12). No study has been found in the literature investigating the effectiveness of isometric and posture exercise programs applied with telerehabilitation in individuals with NSNP. The aim of this study was to investigate the effect of telerehabilitation cervical exercise programs on pain intensity, muscle endurance, postural alignment, and disability level in individuals with NSNP comparing the effectiveness of the telerehabilitation and home exercise programs.

Material and Method

Study Design and Participants. The study was carried out between January and June 2021, and ethical approval was obtained from the University Ethics Committee. Thirty-four volunteers who had been diagnosed with NSNP by an orthopedist and had neck pain for at least one month were included in the study. Inclusion criteria were (1) literate individuals between the ages of 18-55 years, (2) no hearing-sight and cooperation problems, (3) having pain in the occiput, nuchal muscle, shoulder, or arm.

Exclusion criteria were (1) pregnancy, (2) cancer, (3) presence of unhealed fractures in the cervical region, (4) cases with a history of trauma and undergoing any operation related to neck problems, (4) cases who regularly use analgesic and sedative drugs, (5) those with known cardiac, neurological, rheumatological, systemic diseases (hypertension, diabetes), (6) presence of neurological deficit in the cervical region, (7) vertebro-basilar insufficiency, (8) centralization of pain during active joint movement.

All patients were informed, and the consent form was signed before the first evaluation for participation in the study. Patients were divided into telerehabilitation exercise and home-based exercise program with web-based randomization software (www.randomizer.org) (Figure 1). All assessments were evaluated before the treatment program and at the end of the four-week exercise program.

Demographic Characteristics. Age, gender, weight, height, and body mass index (BMI) were recorded. The body mass index (BMI) was evaluated using with an electronical system (SOZO-IMPEDIMED 2727100). In addition, daily working time and computer usage were questioned.

Pain Intensity. To evaluate the pain intensity Visual Analogue Scale (VAS) was used. This scale was used to evaluate the patients' pain severity. Patients were asked to mark their cervical pain on a 10 cm scale. The value of “0” indicates no pain, and the value of “10 cm” indicates the most severe pain (13).

Cervical Muscle Endurance. Craniocervical Flexion Test (CSFT) and Craniocervical Extension Test (CSET) were used to assess the endurance of the cervical muscles. The camera was placed at an appropriate angle in both endurance tests for the evaluator to see the patient easily. The patient was shown an instructional video about the assessment methods before the tests. For the CSFT, the patients were asked to raise their heads from the ground (about 2-2.5 cm) with a craniocervical flexion movement and maintain this position to evaluate the cervical flexor muscle endurance. The time elapsed during the test was recorded as seconds (14). For the CSET, the patient was placed in the prone position and suspended his head from the bed. Then, patients were asked to put his head in a neutral position and maintain this position. The time he could continue the test was recorded in seconds.

Postural Alignment. New York Posture Rating Scale (NYPRS) was used and this test assesses static posture and evaluates the body with 13 items from the lateral and posterior. Each item is scored between 13-65 points in total by taking one of the 5-3-1 points. A high score means the situation closest to the ideal posture (15). In our study, we evaluated these regions from the posterior, anterior and lateral aspects using the head and neck section of the NYPRS. According to our evaluation, the highest score that patients can get from the test is 15 points, while the lowest is 3 points. The evaluation was made with the aid of a camera placed on a stable platform at shoulder level, 1.5 meters from the patient. Posterior, anterior, and lateral photographs of the patient were taken. To prevent the patient from reflexively correcting himself during the photo-shoot, the shots were repeated three times at 15-second intervals. Photos were evaluated with the NYPD.

Disability Levels: Copenhagen Neck Functional Disability Scale (CNFDS) is one of the most commonly used scales to evaluate neck disability. Turkish validity and reliability of the scale were made. The scale consists of 15 questions and answers; yes, occasionally, and no. The scale evaluates pain severity, disability in daily activities, involvement in social interaction and recreational activities, and future perception of neck pain. In scoring, the total score varies between 0-30 points, and a high score indicates maximal disability (16).

Exercise Programs

The exercise program of both groups consisted of isometric neck exercises and posture exercises for one month within the scope of the study.

Telerehabilitation exercise program: A 40-minute synchronous exercise program under the supervision of a physiotherapist was performed to this group. The synchronous exercise program continued three non-consecutive days a week for a month in front of the computer.

Home-based exercise program: One-session synchronous exercise patient training was given to this group. This training included maintaining proper posture while working, ergonomics rules, and describing exercises. During the training, the exercises were done synchronously, and the existing questions and incomprehensible points were highlighted. The group participants took a picture booklet and were asked to practice the exercises in front of the mirror for 40 minutes, three non-consecutive days of the week, for a month. Three days after the training, one more interview was held with each of the participants to control the learning. The continuity of the participants to the program was checked with weekly messages.

The contents of the exercise program are as follows:

- *Isometric Cervical Exercises:* Isometric muscle strength was increased to the maximal level at 2-second intervals. The desired tension was maintained for 6 seconds, and the patient was asked to relax slowly (17). Isometric exercises were performed in the direction of cervical flexion, extension, and lateral flexion. Each exercise was performed as two sets with 15 repetitions, and a 2-minute rest period was given between sets to prevent muscle fatigue.
- *Posture Exercises:* Five posture exercises for the cervical and upper body were used (18). The exercises were performed in 2 sets with 15 repetitions. A 2-minute rest period was given between sets to prevent fatigue (18).

Statistical analysis. All the obtained data were analyzed in the Statistical Package for the Social Sciences 11.5 (SPSS 11.5) software. The statistical significance level was accepted as 0.05. The normality of the data was tested with the Kolmogorov-Smirnov Z test. As a result, Independent Sample T-test and Paired Sample T-test were applied to the data. The study of Gialanella et al. was taken as a reference for calculating this study's sample size. The effect size was calculated as 0.95 using the mean and standard deviation values of the VAS score. When the alpha error was 5%, the power of the study was 80%, and the allocation ratio was 1, it was found sufficient to complete the study with at least 30 people (19).

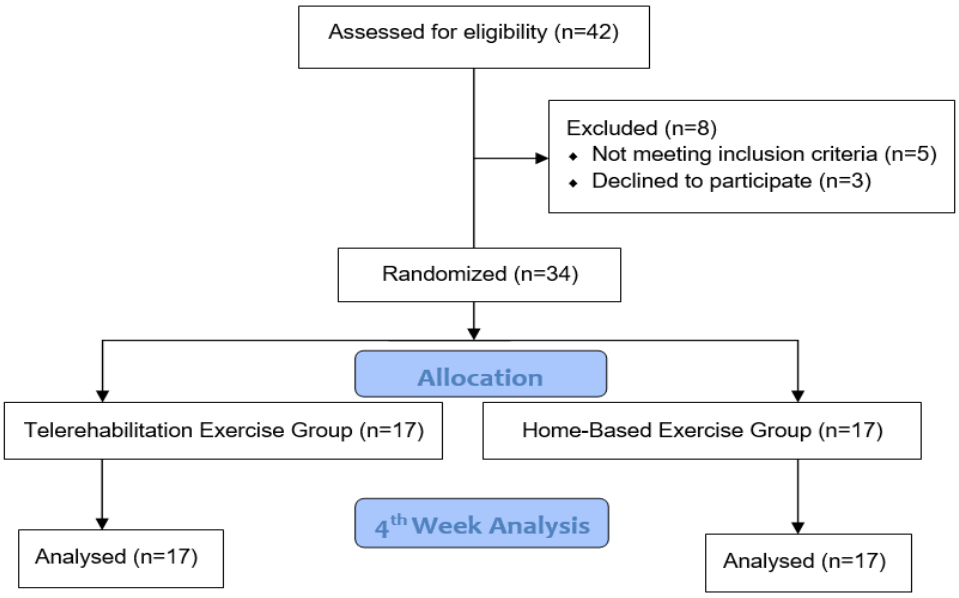

Figure 1. Flow Diagram of the Study

Results

In the study, which was completed with 34 people, the telerehabilitation exercise group consisted of 14 women and 3 men. The home-based exercise group consisted of 8 female and 9 male individuals. The participants' commitment to the program was determined according to their participation in the sessions.
Accordingly, the continuity of the program in the telerehabilitation exercise group was 10.12 ± 2.26 sessions, and the home-based exercise group was 10.06 ± 3.07 sessions and there was no significant difference between the groups in terms of adherence to exercise (p=0.950). The mean age of the groups was 29.12 ± 9.79 years in the telerehabilitation exercise group and 22.24 ± 2.72 years in the home-based exercise group. The mean age of the telerehabilitation group was higher than the home-based exercise group (p=0.009). The groups were similar in terms of body mass index, daily working time and screen time (Table I).

Table I. Comparison of Demographics of the Participants

Variables	**Telerehabilitation Exercise Program** Mean (SD)	**Home-Based Exercise Program** Mean (SD)	*p*
Age (year)	29.12 (9.79)	22.24 (2.72)	0.009
BMI (kg/m^2)	23.08 (3.15)	22.83 (2.78)	0.806
Working time (hour/day)	6.88 (3.83)	5.23 (5.47)	0.317
Using Computer (hour/day)	3.24 (1.67)	4.47 (3.22)	0.171

SD: Standard Deviation

Pain intensity, cervical muscle endurance, postural alignment and disability levels of the groups before the exercise programs were similar (p>0.05). The pain intensity of the telerehabilitation exercise group was 6.00 ± 1.87 before the four-week exercise program and 3.35 ± 1.80 after. In the home-based exercise program group, the pain intensity before the treatment was 5.41 ± 1.12 while it was calculated as 2.88 ± 0.99 after the treatment. After the exercise intervention, both groups showed a decrease in pain intensity (p=0.001). The change in VAS score was found to be similar in the intergroup evaluation results (p=0.818).
The results of the cervical endurance tests, postural alignment and disability levels of the participants are shown in table II.

Table 2. Comparison of Pain Intensity, Muscle Endurance, Postural Alignment and Disability Levels between Groups

Variables	**Time**	**Telerehabilitation Exercise Program**	**Home-Based Exercise Program**	**p***
VAS	Baseline	6.00 (1.87)	5.41 (1.12)	0.274
	4th week	3.35 (1.80)	2.88 (0.99)	0.352
	p**	0.001	0.001	-
CSFT	Baseline	52.65 (18.00)	59.18 (47.12)	0.597
	4th week	73.88 (30.38)	71.71 (52.92)	0.884
	p**	0.005	0.008	-
CSET	Baseline	82.06 (62.88)	60.47 (42.31)	0.249
	4th week	109.47 (61.16	77.12 (52.41)	0.107
	p**	0.001	0.002	-
NYPRS	Baseline	12.65 (1.90)	13.12 (1.31)	0.408
	4th week	13.35 (1.45)	13.35 (1.05)	1.00
	p**	0.009	0.163	-
CNFDS	Baseline	12.06 (5.05)	10.06 (5.64)	0.284
	4th week	5.88 (4.40)	3.88 (2.54)	0.117
	p**	0.001	0.001	-

*: Independent Sample T Test **: Paired Sample T Test; VAS: Visual analog scale; CSFT: Craniocervical flexion test; CSET: Craniocervical extension test; NYPRS: New York Posture Rating Scale; CNFDS: Copenhagen Neck Functional Disability Scale

According to these results, the both exercise programs had a positive effect on the cervical endurance and postures of both groups, resulting in significant improvements ($p<0.05$ for both groups).
However, it was observed that the results did not differ in the analyzes between the groups ($p>0.05$). Disability change scores were similar between the groups ($p>0.05$). According to the results of the within-group analysis, the disability levels was 12.06 ± 5.05 before the treatment in the telerehabilitation group while it was 5.88 ± 4.40 after the treatment ($p=0.001$). Significant improvement was observed in the home-based exercise group as the disability levels decreased from 10.06 ± 5.64 to 3.88 ± 2.54 ($p=0.001$).

Discussıon

In this study, it was aimed to investigate the effect of cervical exercise program on pain intensity, cervical muscle endurance, postural alignment and disability levels in individuals with NSNP and to compare synchronous telerehabilitation exercise and home-based exercise program. Early results at the end of the four-week program showed that pain intensity decreased in both groups. Improvement in cervical muscle endurance and postural alignment and decrease in neck disability score were detected in both groups. No superiority was found in the evaluations between groups.
It is known that strengthening and posture exercises have a positive effect on pain intensity and disability in the treatment of the cervical region (20–22). The main purpose of these exercises is to increase the strength and endurance of the deep cervical muscles, to provide stabilization in the proximal and thus to support the muscle balance in the cervical region (23). By providing an increase in balance and stability between the muscles, it is possible to reduce the symptoms (24).
Celenay et al. reported that cervical stabilization training including cervical bracing technique, different ROM holding constant, isometric exercises in addition to manual therapy had positive effects on pain level, disability and quality of life. However, it has been reported that the effect of stabilization exercises alone is lower (25). In a study comparing the effect of deep cervical flexor training used in cervical stabilization and conventional isomeric training on chronic neck pain, pain and disability were significantly reduced in both groups, while deep cervical flexor training was found to be more effective than conventional isometric training in correcting posture, reducing pain and disability (26). In another study comparing isometric exercises and range of motion exercises in chronic neck pain, it was reported that isometric exercises were superior to joint range of motion exercises in reducing pain and the Nortwick park neck pain questionnaire score (7).
Exercises increase muscle strength and provide the balance for a quality movement. Ylinen et al. reported that isometric exercises increase neck flexor muscle strength by 110%, neck extensor muscle strength by 69% and rotator muscle strength by 76% (23). In another study, it was stated that with isometric exercises, there was a decrease in pain and disability in dentists with chronic neck pain and a significant improvement in isometric neck muscle strength in all directions (27). In our study, we applied isometric exercises and posture exercises with two different methods that contribute to cervical stabilization for patients with NSNP. At the end of the programs, there was an increase of 21-40% in cervical muscle endurance. Our results showed that one-session patient education will also provide a positive response in appropriate cases in addition to the positive benefits of synchronous exercise education.
Although exercise has a positive effect on disability level and quality of life, there are studies stating that this effect lasts for a short time and that symptoms tend to recur after treatment is terminated (28–30). Low dependence on exercise reduces the effectiveness of exercise in musculoskeletal diseases such as NSNP (8). In a randomized study, it was found that the continuity of telerehabilitation was higher than the continuity to the clinical-based session (31). This supports the argument that adherence to exercise and improvement in clinical parameters are greater in telerehabilitation. Making exercise a lifestyle in the treatment of cervical region problems plays a key role in maintaining well-being. In cases where access to the clinic is difficult, the sustainability of online education is one of the essential points for preventive rehabilitation services. In our study, the participation of both groups in the sessions was quite high. In future studies, it is planned to investigate the long-term adherence and barriers to the exercise program of the participants and to compare synchronous and asynchronous exercise programs.
Studies cannot report a clear result regarding the effectiveness of exercise in the NSNP. Besides its pain-reducing effect (32–34), there are also authors who claim to be unclear (35). On the other hand, a Meta-analysis showed that only exercises have a significant effect in reducing pain (moderate-strong) in the short

and medium term in the NSNP (9). In our study, participants' pain intensity at rest was evaluated. In the baseline, there was no difference between participants in the telerehabilitation and home exercises groups.
At the end of the 4-week treatment, there was a significant improvement in the pain of both groups. In the intergroup comparison, the interventions were not superior to each other. This may be due to the participants' desire to avoid hospital conditions during the pandemic process and their interest in alternative remote treatment approaches offered to them instead of coming to the clinic. Because our participants preferred the remote program instead of the hospital due to the risk of contamination. In addition both of two exercise programs were given synchronously all participants.
It has been determined that neck pain affects muscle endurance, especially causing a decrease in extensor muscle endurance (36, 37). In a study conducted in 2016 with unhealthy and healthy adolescents, the effect of neck pain on cervical region muscle endurance was examined. It has been determined that both flexor and extensor muscle endurance of adolescents with neck pain are lower than healthy ones (38).
Take into account the studies showing the existence of a relationship between neck flexor muscle endurance and neck pain (38,39), we also evaluated the neck flexor and extensor muscle endurance of the participants in our study. There was also no significant difference between neck pain, neck flexor and extensor muscle endurance in the baseline. As a result of the 4-week exercise program, we found a significant improvement in the neck flexor and extensor muscles endurances in the telerehabilitation and home exercise group. No superiority was found in the comparison between groups. The similarity of participants' adherence to the programs may have an effect on the results.
Yip et al. found a negative correlation between insufficiency and cranio-vertebral angle in patients with neck pain (40). Falla et al., on the other hand, showed that bad sitting posture is associated with neck pain symptoms in their study on non-specific chronic neck pain patients (30). Different exercise models such as global posture training, postural biofeedback, yoga and basic neck exercises given to patients with NSNP contribute to the improvement in posture (30, 41–44). In the first evaluation of our study, the level of closeness to the ideal posture of the participants in the telerehabilitation and home exercises groups was similar to each other. After 4 weeks of treatment, significant improvement was observed in both groups compared to baseline. In the comparison between groups, the interventions had no superiority over each other. This may be related to the fact that the initial postures of the groups were not severely bad.
Neck pain ranks fourth among the factors that cause disability. Despite this frequency, it is possible to have a good long-term prognosis and to eliminate the problems arising from the disease by starting the treatment as soon as possible (45). In our study, we applied two different treatments to treat the negative effect of NSNP on disability and examined their effectiveness. According to the results of our study, there was an improvement in functional disability in both the telerehabilitation and home exercise groups and both methods reduced disability in a similar way. Tunwattanapong et al. gave a brochure containing stretching exercises to all individuals with neck pain, which they divided into two groups. Unlike the control group, the treatment group received training on the exercises in the brochure. According to the results of the study, the disability scores of the treatment group decreased more than the control group and the authors argued that stretching exercises increased neck functions (46). A decrease in disability scores was observed both in the fourth week and at the end of the twelve-week home exercise program applied to the cervical region. This decrease was similar to the groups that received medical treatment and manual therapy (47). In the study of Chung and Jeong in which they compared the effectiveness of neck isometric exercises and craniocervical flexion exercises at the end of an 8-week period in individuals with non-specific chronic neck pain, they found that both exercise programs improved neck disability at the same rate (48). It has been stated that physiotherapy programs including stabilization exercise are superior to home exercise and advice in reducing neck pain and disability in the NSNP (25). In another study completed with a low sample group, it was reported that a four-week computer-based stretching exercise program had no effect on disability (46). Our results are compatible with the literature in that two different exercise programs reduce pain intensity. As it is known, muscle weakness, disability and functional insufficiency occur due to the severity of neck pain (24,34). In our study, we attribute the increase in the functionality of our participants to the positive effect of the reduction in pain. In addition, the increase in the muscle endurance of the participants as a result of the program also positively affected the stability of the cervical region.

Limitation. The limitation of our research is that the effectiveness of exercise programs in the form of online and home programs cannot be compared with the face-to-face program. The inability to practice face-to-face exercise in the clinical setting due to the Covid 19 pandemic conditions has caused this situation.

Conclusion

Due to necessities such as the development of communication technologies, cost-effectiveness policies and the pandemic process, studies on online treatment programs and telerehabilitation methods are increasing. Within our knowledge, this research is a first synchronously exercise intervention study in cases with NSNP. In our study, we investigated the early effects of telerehabilitation, given with synchronous exercise, and home-based exercise program in the NSNP. The attendance of both groups to the program was found to be high.

We determined that intervention in the form of both telerehabilitation, given with synchronous exercise, and home program provided positive gains on pain intensity, muscle endurance, postural alignment and disability levels. There was no superiority of the groups over each other in terms of gains achieved. It is recommended to compare different telerehabilitation methods and to examine the long-term effects of telerehabilitation in future studies.

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