ABSTRACT
Chronic non-specific neck pain is one of the most common musculoskeletal conditions affecting the work and lifestyle of those suffering from it. Physiotherapy interventions, such as strength training and stretching, have positively influenced neck pain. Patient adherence to home-based exercises is a growing concern that could be easily improved through telerehabilitation exercise programmes. This can also be a cost-effective, time-efficient and patient-suitable service. Therefore, this study aims to establish the effectiveness of telerehabilitation exercise intervention by measuring patient adherence, pain score, disability index, cervical range of motion (CROM) and cervical muscle endurance. This randomised controlled trial will include n=60 participants, aged 18–45 years, in a 6-week home-based exercise programme delivered through telerehabilitation or paper-based instructions. Outcome measures from participants will be obtained at baseline and on completion of 6 weeks. These will include the Visual Analogue Scale for Pain, Neck Disability Index questionnaire, CROM by using the CROM instrument and cervical muscle endurance through the Cranio-Cervical Flexion Test. For baseline differences between groups, an independent samples t-test will be used. Repeated measures analysis of variance will be used for within-group and between-group analyses at three different time points (0 weeks, 3 weeks, 6 weeks). Trial registration number:NCT06076174.

BACKGROUND
Chronic non-specific neck pain has become one of the most common musculoskeletal conditions. Most of the people who have this musculoskeletal disorder end up either being unresponsive to any intervention or just not finding any solution to their pain, thus negatively impacting their work and lifestyle. The rising cost of healthcare, for diagnosis as well as treatment, is one of the main obstacles in getting the right kind of help for those who suffer from neck pain, leading it to become a chronic and persistent part of their lives. Numerous studies have identified several risk factors for neck pain, such as high physical demands of work, improper working environment, stress and anxiety as part of psychosocial factors, vital health-related components such as sleep, a history of chronic low back pain and female gender. There is ever-growing evidence of the positive influence physical therapy interventions have on pain intensity, level of disability and cervical range of motion (CROM) in these patients. These exercise programmes include...
strength, endurance, stretching and postural training. Predominantly, isometric exercises and activation of deep cervical flexor muscle have proved to be more effective in relieving chronic neck pain and improving function in addition to postural correction. Combined strength and endurance training have shown positive results in neck pain and disability, as measured through pain score and Neck Disability Index (NDI). Likewise, deep neck flexor muscle endurance is a significant outcome measurement, for it is known to be reduced in those afflicted with chronic neck pain. The deep neck flexor endurance test has been established as a reliable part of cervical spine stability assessment. Patient education is another key factor in determining the effectiveness of patient outcomes following the intervention. In this regard, video-based advice has proved far more successful than simple written instructions.

In recent decades, there has been an increased need for cost-effective, time-efficient and patient-suitable exercise programmes. Video-based instructions have been recommended for musculoskeletal pain, mainly due to patients’ much better adherence to the prescribed exercise programme. Patients who completed real-time online sessions supervised by their physiotherapist and those who followed prerecorded videos exhibited greater adherence to exercise programmes, lowered pain intensity, enhanced muscle endurance, improved postural alignment and better functionality. A duration of 30–45 min for each exercise session has been deemed appropriate and easily attainable. Furthermore, in patients with chronic neck pain, high-frequency exercise interventions are not considered suitable as they have a negative impact on adherence.

Hence, telerehabilitation interventions, which have gained a lot of popularity recently, much of which can be attributed to the global situation brought out by the COVID-19 pandemic, have been opted for in this regard. Telerehabilitation is a mode of healthcare delivery that physiotherapists may use either online (live exercise session on teleconference) or offline (electronic documents, images and prerecorded videos of exercises). This has turned out to be largely beneficial for patients suffering from chronic neck pain, especially those with limited access to healthcare. Other factors that can be conveniently tackled through growing population rehabilitation include time constraints, transportation and high treatment costs. Several studies have demonstrated the benefits of this mode of healthcare delivery, with particular interest in patient adherence to treatment. CareSpace is a digital platform for patient care management, developed by Neave Technologies, tailored to the needs of this study for recording exercises and using in conjunction with the ConnectToMyDoctor application as a means of telerehabilitation.

Chronic neck pain, particularly non-specific, has become a rising healthcare concern. While home-based exercise programmes have proven to reduce neck pain and disability as well as improve functionality in patients, an issue many studies observed was the low adherence of these patients to the prescribed exercises. Consequently, telerehabilitation is deemed an appropriate exercise programme delivery mode to ensure patients consistently follow the prescribed frequency and time of exercise sessions. Therefore, the purpose of this study is to determine if monitoring exercise programmes through telerehabilitation software is as effective as written instructions for patients with chronic non-specific neck pain by way of measuring the pain score, disability index, CROM, cervical muscle endurance and, most importantly, adherence to exercise programme.

METHODOLOGY

Study design
A randomised controlled trial (RCT) will be conducted, comparing the effectiveness of two modes of delivery of the same 6-week exercise programme for chronic non-specific neck pain. The first group will be monitored via the software that records each session so the therapist can review, and the second will have written instructions on paper to follow through on their own. Pretest and post-test measurements will be taken before and after completing the exercise programme at the College of Health Sciences, University of Sharjah. These will include the pain score on VAS Pain (Visual Analogue Scale for Pain), the score on the NDI questionnaire, CROM measurement via the CROM instrument and cervical muscle endurance measurement by CCFT (Craniocervical Flexion Test). The CROM measurements will be carried out for cervical flexion, extension, lateral flexion and cervical rotation. Adherence will be self-reported using an exercise diary for the conventional group. In contrast, it will be verified by the researchers as each session will be recorded and stored on the cloud for the telerehabilitation group.

Inclusion and exclusion criteria
Recruited participants will be included in this study based on the criteria: (1) residents of United Arab Emirates, both males and females(2) aged between 18 and 45 years (3) have normal body mass index, (4) referred to physiotherapy for chronic non-specific neck pain, (5) minimum pain score of 3 cm on the VAS, (6) pain onset at least 3 weeks ago and (7) have given informed consent for voluntary participation. The exclusion criteria will be as follows: (1): diagnosed by a physician with any pathological condition as cause of chronic neck pain, (2) presently undergoing any physical treatment or taking any medication for said pain, (3) has comorbidities, such as diabetes and hypertension, (4) has conditions such as migraine and cervicogenic headache, (5) has vertigo and/or verteobasilar insufficiency, (6) physically disabled or has recent immobilising injury, (6) orthopaedic conditions, such as spondylisis, spondylolthesis, wryneck and (8) history of neurological conditions.

Recruitment, screening and informed consent
To advertise the study’s participant recruitment, e-posters containing study details will be distributed around the
University of Sharjah. Those who express interest in participating can receive an information sheet via a QR code or by contacting the researchers. Participation is completely voluntary. The researcher will assess the individual’s eligibility for the study, and only once all the criteria are satisfied will they be asked to sign a digital informed consent form that will be generated using Microsoft Forms.

**Randomisation, allocation and blinding**

Using the permuted block randomisation method, the researcher will randomise the study participants into two groups: the telerehabilitation group and the conventional group. Five permuted blocks will be used, each with a size of 6, for example, ABABAB, BABABA, AABBBB, ABBABB and BBAAAB. Allocation will be done by the study’s coinvestigator using sequentially numbered, sealed, opaque envelopes as a concealment method. Due to the nature of the study, blinding of researchers or participants will not be possible.

**Exercise programme**

All participants will have an in-person session with the physiotherapist so that all exercises can be demonstrated to them before beginning the programme. They will conduct the exercises independently at home for 6 weeks, thrice a week, giving 18 sessions, each lasting 30 min. The software group will do each session via the CareSpace software that will record and store the entirety of the session on the cloud, giving the therapist access to review it. On the other hand, the conventional group would be given a flyer with written instructions on how to perform each exercise. After 2 weeks, the physiotherapist will hold the first review session with each participant, held online face to face for those in the software group (via the ConnectToMyDoctor application) and over the telephone for those in the conventional group.

Similarly, after four weeks, the second review session will be held. Progressions for exercises will be given to the participants at both review sessions. After completing all 6 weeks of the exercise programme, post-test measurements will be carried out in person. The exercise programme will be as follows (figure 1):

1. **Strengthening exercises**: chin tucks—5 reps progressing to 10 reps, chin tucks with overpressure—5 reps progressing to 10 reps, shoulder blade pulls—5 reps progressing to 10 reps, shoulder shrugs—10 reps progressing to 2 sets, shoulder rotations—20 reps clockwise and 20 reps anticlockwise.
2. **Stretching exercises**: forward and backward bend, side-bending, towel stretch—holding each position for 30s, 3–5 reps.

**Measures**

**Primary outcome measure**

**Adherence**

Adherence indicates how well a patient complies with given professional advice regarding a home exercise programme (frequency per week and duration per session). This study will be self-reported using an exercise diary. For the telerehabilitation group, it will be verified by the researchers as each session will be recorded and stored on the cloud.

**Secondary outcome measures**

**Pain**

Pain intensity is self-reported on the VAS Pain, which is a continuous scale in the form of a 100 mm line, marked by ‘no pain’ (score of 0) on one end and ‘pain as bad as it could be’ (score of 100) on the other end. The participant must make a perpendicular line on the VAS scale that best represents their pain intensity. The reliability of this scale is good (0.94), in addition to the validity for chronic conditions ranges from 0.62 to 0.91, making it...
ideal for use in this study. This will be considered the primary outcome.

**Disability**
The NDI is a standard self-reporting questionnaire to measure neck pain and disability due to said neck pain. It consists of 10 items, each scored from 0 to 5, giving a total of 50, where a higher score indicates increased disability. The alpha coefficient is 0.08, implying good reliability for measuring neck pain and disability.

**Cervical ROM**
The CROM will be assessed using the CROM instrument to measure the ROM for cervical flexion and extension, lateral bending and rotation to both sides. The CROM instrument is used as it holds compasses in each plane, mounted in a firm headgear, thereby showing good validity and reliability for CROM measurement.

**Endurance**
The participant will be supine and head neutral for the CCFT. A pressure biofeedback unit will be placed under the cervical region, starting pressure at 20 mmHg. The participant will be required to perform a gentle head-nodding movement (chin tuck), attempting to hold the position for 10 s at five gradually increasing pressure levels, from 22 mm Hg to 30 mm Hg. The highest pressure level maintained will be noted. The intraclass correlation coefficient for intraexaminer and interexaminer reliability is moderate (0.63–0.86).
Data management and confidentiality

Pretest and post-test assessments will be conducted in a private room at the University of Sharjah. All data will be stored on a secure account in a secure computer. For those in the telerehabilitation group, recorded videos will be stored in the cloud, and only the primary investigator (female) will have access to this. The software provider company or anyone else in the university department cannot access this data. All patient information and data will be kept confidential. The participant’s name will not be used for any publication or presentation.

Statistical analysis

Sample size
A total sample size of 30 participants in each group (figure 2), both male and female, will be satisfactory as calculated based on the effect size of 0.95 using mean and SD values of VAS, with alpha error of 5%, power of the study 80% and allocation ratio of 1. In case participants drop out of the study, intention-to-treat analysis will be carried out for all participants included in the study.

Data analysis

On completion of all exercise sessions, pain score, disability index, CROM and cervical muscle endurance outcome measures from all participants will be repeated, in addition to adherence. The distribution of the data will be analysed using Shapiro-Wilk test. Descriptive analyses will calculate frequencies, means and SD. For baseline differences between groups, an independent samples t-test will be used. Repeated measures analysis of variance will be used for within-group and between-group analyses at three different time points (0 weeks, 3 weeks, 6 weeks). A p<0.05 will be considered significant. Statistical analyses will be done by using SPSS V.26.0.

Patient and public involvement

There was no patient or public involvement in the design of this study.

DISCUSSION

Chronic non-specific neck pain is a growing healthcare concern.3 This study protocol describes the methodology used to evaluate how effective telerehabilitation is as an exercise programme delivery mode in patients with chronic non-specific neck pain compared with paper-based instructions. Using a randomised controlled design, this study aims to establish the effectiveness of telerehabilitation exercise intervention by measuring the pain score, disability index, CROM, cervical muscle endurance and, most importantly, adherence to the exercise programme. While home-based exercise programmes have proven to reduce neck pain and disability as well as improve functionality in patients, an issue many studies observed was the low adherence of these patients to the prescribed exercises.19 10 Consequently, telerehabilitation is deemed an appropriate exercise programme delivery mode to ensure patients consistently follow the prescribed frequency and time of exercise sessions.14 Telerehabilitation might just solve the lack of patient adherence to prescribed exercise programmes. Based on the results of this study, healthcare providers would be urged to adopt this mode of intervention, a possible extension to in-patient care, for its convenience, cost-effectiveness and, mainly, patient adherence. Telerehabilitation can ensure the success of subsequent exercise sessions and, thereby, treatment programmes for patients with chronic non-specific neck pain.13 15

Dissemination

The results of this study will be disseminated via publication in conference presentations, disciplinary-specific journals and as part of a master’s thesis.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by University of Sharjah Research Ethics Committee (REC-23-02-27-01-PG). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request. Datasets are available on reasonable request to the corresponding author.

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