



## Telerehabilitation intervention in Patients with musculoskeletal Disorders to improve Functional Capacity and Quality of Life: A Narrative Review

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### Abstract

The use of various telecommunication systems like telephones, app-based, internet-based rehabilitation, video callings are discussed in this review of articles to lay out rehabilitation services in patients with musculoskeletal and spinal deformities. Methodology-All article was searched through Google Scholars, PubMed which were published from the year 2012-2023 of the articles revealing the outcomes of telerehabilitation on the different musculoskeletal conditions of the body. Conclusion-Thus we can conclude that telerehabilitation puts less pressure on therapist as well as the healthcare system.

**Keywords:** Telerehabilitation, Physiotherapy services, Musculoskeletal disorder

### Introduction

When a patient can't afford face-to-face care physical therapy services are offered remotely through a platform called telerehabilitation using communication methods like video conferencing or phone conversation. It has been demonstrated to be practical and successful is low resource contents. Telerehabilitation can involve a wide range of services, including evaluation, prevention, monitoring, intervention, education, counseling, consulting and supervision. Focusing on the reduction of barriers supervision. Focusing on the reduction of barriers like costs, a more patient - centered strategy might be formed. The length of the waiting list, the distance travelled, the increased session flexibility, the patient preference and promote delivery of services.

The need for physiotherapy will rise as the member of older person with various illness raises. Also, elder

adults have been shown to spend more time looking up health – related information than younger peers.<sup>[1]</sup>

In order for remote service delivery to be successful, it must be possible to give specialists access to the same data about their unique competencies and work environments. would be discovered during a customary in-home examination.

According to Lewis et al., telerehabilitation reduces the distance barrier to the delivery of full rehabilitation treatments and gives clients access to clinical services. Access to information and services has been cited as one of the potential advantages of telemedicine.

The provision of treatment that has not previously been provided, greater professional education, quality control in screening programmes, and decreased health care expenses are additional benefits.<sup>[2]</sup>

Patients may be monitored remotely and readily adapt to at-home exercise regimens thanks to telerehabilitation. It will be assured that people can perform their exercises at their best level outside of clinical settings in this way, and exercise application faults brought on by the learning effect that is usually noticed in traditional approaches will be avoided. For individuals with persistent neck pain, exercise is regarded as a crucial component of physical therapy and rehabilitation care. Studies show that persistent low back pain recurrence is patients can be monitored more effectively throughout their home exercise session with the use of the more economical treatment model known as "telerehabilitation". It is hoped that patients can be monitored more effectively throughout their home exercise session with the use of the more economical treatment model known as "telerehabilitation".

The study's objective is to assess the efficacy of at-home workout regimes for individuals with chronic neck pain that are video-based and telerehabilitation-based. The patients' discomfort, functioning, quality of life, and adherence to exercise are all to be assessed.

## 2. Methodology

This review article was designed and aims to deliver telerehabilitation of Physiotherapy services in remotely areas to increase access and convenience for patient using technology like telecommunication system. A systemic review and searches were performed in sets by the group, firstly by collection of relevant articles and reviewing it. Followed by primary sampling of articles for the final research. In this, 30 relevant articles that were found and proof seek were executed from PubMed, Google scholars. The extracted design study were from the articles posted in the year 2015-2017. The most looked up keywords used were 'tele-rehabilitation or rehabilitation' or tele-assessment' or telemedicine' 'physiotherapy or physiotherapy services' technology or advance technology' 'shoulder, elbow, wrist, cervical, upper limb, lower limb.

### Review of literature

**Seth Peterson ,2022** conducted a study the use of booster sessions for telerehabilitation (TR) and remote patient monitoring (RPM) for three female patients enduring persistent low back pain after they

were released from in-person physical therapy is examined in this case series. Using a mobile phone application, the patients monitored their daily pain level and adherence to their home exercise programme for a whole year. At months 1, 3, 6, and 12, synchronized TR booster sessions with audio and video were held. The patients showed remarkable self-efficacy and commitment to their home exercise programme, and they all achieved their unique objectives. All patients experienced a brief rise in pain, but they all handled without the use of any additional medical resources thanks only to the TR booster sessions. Overall, the data show that TR and RPM may be beneficial for enhancing.

**Francis Fatoye et al ;2019** conducted a study and she found and conducted that For individuals in Nigeria with nonspecific chronic low back pain (NCLBP), this study compared the clinical and financial efficacy of clinic-based telerehabilitation treatments. 47 patients in total were divided into two intervention groups: telerehabilitation and clinic-based treatments. For eight weeks, the clinic-based interventions were conducted three times a week. In order to calculate quality-adjusted life years (QALYs) for cost-effectiveness analysis, the level of disability was assessed using the Oswestry Disability Index (ODI) and health-related quality of life was quantified using the SF-6D. Sensitivity analysis was used to determine how altering the values of particular variables would affect the incremental cost-effectiveness ratio (ICER), which was obtained. The findings demonstrated the cost-effectiveness and cost-savings of telerehabilitation, with an ICER of -N800,000 (-\$2,213.0)/QALY gained. However, more research into the causes and Future studies are needed to assess this intervention's cost-effectiveness over the long run from the viewpoints of patients and society. Costs of the interventions need to be evaluated within a bigger sample size.

**Ayselyildizozar et al ;2021** found and conducted that For those with non-specific neck pain (NSNP), this study evaluated the efficacy of workout that is done synchronously on the internet to a home exercise programme. The two groups of thirty-four individuals were randomly assigned to a 4-week programme that included isometric neck exercises and posture drills. Both groups shown improvements in cervical endurance, postural alignment pain intensity, and

impairment levels. Regarding the advances made, there was no discernible difference between the groups. According to the study, under the right circumstances, positive results can be obtained with a single session of online fitness instruction.

**Wendy Shulver et al ;2016** conducted a study on found and conducted that Despite new studies showing that telerehabilitation is beneficial, its deployment has been delayed. This is especially important for elderly persons with impairments who frequently use the rehabilitation services offered by hospitals. Participants in a qualitative research who underwent as an alternative, a home telerehabilitation course to traditional rehabilitation and lived in communities. The findings of the interviews with 13 older participants, three spouses, and one caretaker revealed that telerehabilitation was practical, motivating, established good therapeutic connections, and did not replace conventional in-person rehabilitation methods. The participants adapted well to the technology and formed favourable opinions about it. The high levels of acceptance may have been influenced by the usage of commercially accessible technology. Implementation is impacted by the belief that telerehabilitation is a supplement to in-person care and in older people.

**Brian Fian et al ;2020** conducted a study he found that Governments all around the world have imposed strong limitations on physical therapy procedures as a result of the COVID-19 pandemic, which has led to the mean of telemedicine as a method of patient treatment. Patients with different spinal injuries, illnesses, and neurological abnormalities can benefit from telerehabilitation or telerehab using a visual-audio system. The development of telerehab, technical advancements, its application to spine patients, and its advantages for easing pain and enhancing bodily function are all covered in this scoping review. Telerehab requires accessibility, security, safety, and convenience of use. Evidence-based techniques and affordable services can assist the spread of these critical services and boost reimbursement by health insurance carriers.

**Suresh Mani et al;2019** conducted a study on The study's goal was to assess telerehabilitation's concurrent validity and reliability based cervical spine examination in people with non-specific neck pain (NS-NP). For assessments of pain, posture,

active range of motion, endurance, and disability utilising the TR system, the study discovered a high degree of concurrent validity and reliability. According to the findings, telePTsys-based TR-based cervical spine assessments are a valid and accurate method for assessing pain severity, AROM, DNF muscular

**Dilara Onan endurance et al;2023** In this study, spine stabilisation exercises (SSE) were given to patients with persistent, vague neck ache in order to assess the efficacy of telerehabilitation (TR) vs in-person rehabilitation. Results from the Neck Functional Capacity Evaluation Test (NFCET) were the main endpoint, with pain intensity, impairment, awareness, the structure of the neck muscles, and exercise enjoyment as secondary outcomes. There was no discernible difference between the TR group and the control group, according to the research, and both groups improved on all fronts. The study found that SSE was equally effective in enhancing results in CNRP patients whether it was administered under the supervision of clinic-based therapists or via telerehabilitation.

**Hana AlSobayel et al;2021** During the COVID-19 epidemics, the research sought to examine the therapeutic value and acceptability of telerehabilitation within the populace. For six weeks, 95 individuals with musculoskeletal disorders underwent individualised instruction and conditioning exercises using a web-based video conferencing platform (Google Meet). A satisfaction survey results were evaluated using the Patient-Specific Functional Scale, the Pain Self-Efficacy Questionnaire, and the Musculoskeletal Health Questionnaire. With effect sizes ranging from 0.6 to -1.9, the study demonstrated significant improvements in outcomes, and participants expressed high levels of response to the telerehabilitation intervention: satisfaction. According to the study's findings, telerehabilitation was a viable option for individuals with musculoskeletal disorders to get physiotherapy therapies throughout the pandemic.

**Chidozie e. mbada et al ;2019** In order to treat persistent low back pain, this study evaluated the efficacy of Telerehabilitation-Based McKenzie Therapy (TBMT) with Clinic-Based McKenzie Therapy (CBMT). 47 subject who preferred the McKenzie Extension Protocol's instruction were

divided into the TBMT or CBMT groups and underwent treatment three times per week for eight weeks. In terms of pain intensity, the endurance of the back extensor muscles, activity limitation, participation restriction, and general health status, both groups shown a considerable improvement. With the exception of the vitality scale in the GHS, where TBMT had a higher mean score, there were no discernible differences between TBMT and CBMT. The study comes to the conclusion that TBMT delivered via a mobile app is a useful adjunct platform for treating patients with low back pain.

**Rennie, Katherin et al;2022** This article emphasises the need for more study in this area as well as the growing use of telehealth services for musculoskeletal conditions during the COVID-19 epidemic. The article covers the outcomes of three original research that assessed the accuracy, health economics, and ethics of telehealth services for musculoskeletal conditions. According to the research, telemedicine services and in-person evaluations had an average agreement of 62% for knee assessments and 31% for shoulder exams. Additionally, the average cost reduction per patient using telerehabilitation services is £38.57, mostly as a consequence of lower travel expenses. In order to maximise its efficacy, the article's conclusion notes that while telehealth services for musculoskeletal problems are promising, more study is required.

**Fabiola Costa et al;2022** conducted a study on virtual recuperation for upper limb torment :a one arm arranged longitudinal cohort study. The principle objective was to report the outcomes of a totally far off pc based care program (DCP) for upper limbs torment (WP). 189 individuals began the DCP, out of which 149(78.8%) finished. Torment improvement was noticed and there was (51.3%) decrease (2.26% cl 1.73;2.78%) and 70.4% members succeeded clinical change. Changes connected with progress with incapacity (52.1%). FABQ-PA (32.2%) and recuperation of weakness exercises (65.4%). different domains of progress incorporate a invasive medical procedure expectation (76.1%), emotional well-being (67.0%) in tension and 72.7% in depression. The general loss of efficiency added (68.2%). The mean fulfillment score was 8.5/10.0(SD%8). All in all the review builds up that organization of WP is conceivable through a far off DCP, which diminishes usage of clinical consideration.

**Denny PratamaAditya et al.;2022** A study was led to decide viability of telerehabilitation to diminish agony and increment of life quality in individuals with WMSDs. The survey demonstrated use of telerehabilitation 3-3 times each week for 20-40 minutes or north of about a month and a half and that's only the tip of the iceberg. It was successful with laborers related with neck, shoulder, low back torment protests. It was concluded that use of telerehabilitation helps the laborers in lessening torment levels and furnishes good life quality within boundaries of VAS, QVAS, SF-36-HS, work ability Index and EQ5D.

**Naomi Mayer et al;2021**dedicated a pilot investigation of telerehabilitation program for further developing upper appendage capability among grown-ups following elbow breaks in which 18 individuals partook. They were partitioned into two gatherings as per age and break type (N=9,median age 33.0 +27.9 years, range 18.5-61.0) got 1-2 treatments consistently through a review of elbow motion and following 1-2 treatment were directed in OPD. The subsequent gathering were(N=9,median age 60.0 37.0years, range 20.5-73.0) with 3-4 treatments consistently from the centre.Self home practice was likewise trained. A sum of 4 assessment were finished after the intervention of 90 days and 1 year post surgical procedure which incorporated the Jebsen-Taylor hand capability test; the inabilities of arm, shoulder and hand poll, the patient evaluated elbow assessment; fulfillment; dynamic and detached scope of motion(ROM). And strength estimations. All in all there was no tremendous contrasts tracked down between the two gatherings, yet the members preferably answered to be more fulfilled over an aiding for training.

**Alejandro Suero- Pineda et al;2023** conducted a study on rehabilitation based on light of proof tablet for restoration of wounds close by hand, wrist and fingers. A sum of 633 patients partook which had less movement in the hand wrist due to injuries. The investigation showed enhancement for patient with wrist assessment of (P= .001) and upper limbs (P=.001) with medium ( $\eta^2 = 0.66 - 0.67$ ) parallel to the control group. A decline of 41% suggests face to face rehabilitation services, a decline of rehabilitation construction (mean difference=1.64;95% confidence interval, -2.64to -0.65) and physiotherapy sessions(mean difference=-8.52,95% confidence



interval, -16.92 to -0.65) compared to control group. In conclusion the patients with bone and delicate tissue wounds of upper limbs or potentially fingers, endorsing criticism directed practices performed on a tablet touchscreen was more successful for working on patients' utilitarian capacity and decreased the quantity of patients alluded to restoration conference and number of clinical arrangements.

**WicoHartzntri and Lydia Arfianti ;2020** conducted a review on blend of telerehabilitation and regular physiotherapy treatment of two hands with carpal tunnel syndrome. The case reports hopes to investigate believability and reasonability of implementing telerehabilitation to the show of physical therapy sessions to CTS. A 51 year old female accompanied CTS on the left hand preserving for over 5 weeks repair undertakings of common rehabilitation and eye to eye recuperation treatment and evaluation. The patient introduced extraordinary consistency and achieved the normal objective in anywhere near 5 weeks of treatment. clients showed betterment in the space of torment, motion, hand function ability and ADLS, rehabilitation got together with ordinary treatment were achievable in overseeing clients two sided CTS. The utilization of telerehabilitation could put on transparency while lessening genuine openness all together to restrict the bet of transaction of covid.

**Inal et al;2022** conducted a randomized controlled preliminary on telerehabilitation in view of preventive mentoring on lateral epicondylitis. Two gatherings of members were arbitrarily appointed. 1) phone based bunch, getting phonebased on top-level follow-up a locally established joint insurance training program. 2) locally situated bunch, getting locally-situated joint insurance training unaccompanied. The two gatherings were given knowledge in lateral epicondylitis and different locally situated practice plans. Evaluation of the first bunch was taken by phone 3 days a week for around 4 weeks. The consequence of the review concluded that the phone-based bunch shows preferred critical upgrades over the other gathering. The finishing of this review shows that phone-based joint defence training projects can offer a wellbeing administration inside the extension of conservative and defensive intercession plans for lateral epicondylitis.

**Sanjay TejrajParmar et al;2021** conducted a exploration on game-based telerehabilitation stage focusing on physical skills. The research was an internet game associated rehabilitation stage (GTP) that gives, internet play associated practice curricula for recuperation of physical mastery and to naturally save patients assessment and survey a clients thin and large hand coordinated movements. This study finds out the reasonable and simple to utilize objects, PC games and communicating between the two executing decisions. The outcomes proclaims that objective fulfillment for youngsters can be utilized and for grown-up stroke patients explicit personal satisfaction survey can be utilized.

**Hannah Lade et al;2012** conducted a study on assessing and diagnosing of various elbow disorders utilizing web based restoration and accommodation of statement. 10 individuals took part in normal non-intrusive treatment meetings and a web-based non-intrusive treatment assessment was directed by a specialist from a different location. Common non-intrusive treatment evaluation finding and experimental outcomes were contrasted with the web-based exercise based recuperation assessment which was led by the specialist from a different location with the assistance of tele-restoration method. The aftereffects of the review finished up >68% arrangements from every one of the information between the assessment ways. From this examination we can say that musculoskeletal analysis of the elbow joint is legitimate and generally solid.

**Lockery and Daniel ,2014** conducted a study on internet-based rehabilitation using gaming method for rheumatoid arthritis for clients focusing on phalanges and wrist functions. The research was based on internet-based rehabilitation gaming method that works on the motive of store and forward design. The main motive of the study was to monitor clients phalanges functions naturally monitoring patients finger hand function from a distant place on a small quantity and less management. The result of the study concludes that it enables available, trial of the purpose for physical rehabilitation individualized for rheumatoid arthritis (RA) patients through the use of internet based telerehabilitation gaming platform.

**Giuseppe AiròFarulla et al;2016** conducted a study on vision-based estimation (VPE) which Has all the earmarks of being mixed for both normal and smooth

cooperation between human client and a mechanical framework. The outcomes were assessed with the assistance of utilization of 3D variations of human biomechanics of hand joints with the utilization of RGB-D camera (Red Green Blue-Depth), and intense aiding event from far. measurements was created from 6 individuals in which the review was led for getting the consequence of how trustworthy and realistic the strategy was correspondence to the exhibition. The outcome answered emphatically while directing unconstrained hand motions.

**Jürgen Höher et al;2023** conducted a study on rehabilitation of knee after surgery using telecommunication and was based on sensors, which shows more adherence of patient. In telerehabilitation, putting evidence-based suggestions into practice with patient-individualized and situation-specific adjustments may boost adherence and improve clinical results. Data was evaluated from 604 Digital Medical Device (DMD) user, determining clinically expected recovery movements after knee wounds. DMD clients did various trials consisting ROM, harmonize, power and swiftness empowering knowledge and organize explicit restoration. Goal to handle examination uncovered DMD – clients for essentially higher adherence of intercession contrasted control bunch. DMD clients did suggested practices at house. HCP involved medical navigation no antagonistic occasions connected with DMD was accounted for. Faithfulness to usual treatment suggestions is to be expanded utilizing different great possibilities to further develop scientific restoration result. Empowering proof based telerehabilitation.

**Thusharika Dissanayaka et al;2022** performed a logistic regression analysis on various exercise management of osteoarthritis of people in Sri Lanka with the medium of telerehabilitation. Around 268 physiotherapist finished the review, comprehensively illustrative of areas and works. 3 out of 16 explanations got larger parts of understanding: these were phone conveyed care will not consume patients time (72%), set aside cash (68%) and work on patients security (67%). An agreement of visual attention set aside cash (79%), inclined toward this middling through phone conveyed attention. Absence for involvement in internet based rehabilitation was related in diminished attention over phone conveyed upkeep. Expanded attention in

visual upkeep related with regular consideration of knee osteoarthritis clients. Physical therapists saw specialized issues with telerehabilitation as a critical obstruction of carrying it out. Physical therapist saw visual based rehabilitation definitel rather concern supervision through phone. Diminished curiosity through rehabilitation related with consuming nil related knowledge in it. Also, specialized difficulties with rehabilitation is seen as principle interruption for utilization. Preparation program for physical therapist, the result was that proper rules and structure for better executing telerehabilitation might give in significant advantages for knee Osteoarthritis (OA) clients.

**Corelien J JKloek et al;2018** performed a group randomized controlled experimental study on money efficiency of combined physical therapy sittings and online tender were cohesive. 108 participants took part in this initiation and internet based training, including of rehabilitation sittings and internet submissions were received. A group of 99 patients acknowledged normal rehabilitation sessions. Charges were quantised with the help of self reported surveys. The result of this study concluded that charge of physical therapy sessions through internet based exercises associated to normal rehabilitation was significantly lower. With the help of quality - life adjusted years (QALYs) is found that the chance of internet based training is cost efficient in comparison to usual rehabilitation practices. The result of this study concludes that Internet based training is suggestively lesser in comparison to traditional physical therapy in clients of hip and knee osteoarthritis.

**Yuan-yuan Zhang et al;2022** conducted a study on internet based restoration framework with respect to hip capabilities, exercises of everyday existing and physical consolidative dimensions of older after the operation hip injury individuals. 58 older after operation hip trauma individuals acted in the arrangements. (n=29) were haphazardly appointed a phone group internet e based treatment bunch. The Harris hip score (HHS), practical freedom quantify (FIM), coordinated up-and-go test (TUG), actual execution battery (SPPB) was put into utilization for assessing the individuals disorder. In this study it was observed that internet based rehabilitation benefitable as per the TUG and SPPB score.

**AlessandroBerton et al;2020** conducted a review on recovery of musculoskeletal deformity of individuals utilizing simulated Reality(VR), Amplified Reality(AR), online game based and internet based rehabilitation. 2472 individuals incorporated. 24 examinations (9 randomized controlled trails (RCTs) and 15 less significant randomized investigations).review alarms (56%), and less significantly VR(28%), AR(28%), and gamification (16%). Distant simulated advances permits the conveyance of excellent consideration at decreased price. Far off simulated restoration was not inferior compared to conventional treatment, and actual enhancements were exhibited musculoskeletal simulation distant recovery diminished price connected with transportation, hospitalization and readmission.

**Hyosok Lim et al;2022** had conducted a study on rehabilitation of patients in a somewhat regulated home locations for constant stroke individuals. The review has 3 individuals with stroke. The program comprised of 20 min activities and 30 min lower limbs drill utilizing the game-based ground framework (DIG\_I-PRIMETM). Assessment was done on the basis of 10 minutes test of gait and practical stride evaluation. The aftereffects of this review reasoned that somewhat regulated drilling plans for stroke individuals is profited as far as limb function recovery.

**Huiqiong Deng et al;2012** had performed a randomized controlled trial on 16 clients for assessment of ankle training in stroke patients with the help of internet based rehabilitation. 10 minutes of walking assessment and a gesture apprehend system were put into application to evaluate observable difference in the clients conditions. Impediment of the review were that no subsequent test was led and that a little example size was utilized but dorsiflexion while walking was altogether moved to the next level. Consequence of the knowledge sediments that telerehabilitation, focusing on perplexing undertaking training with the not usable appendages, is plausible and can be successful in advancing additional dorsiflexion of individuals with persistent stroke.

**ZMarialuisaGandofli et al;2017** conducted a randomized controlled trial on reducing postural unsteadiness of Parkinson disease(PD) clientson

internet based rehabilitation. 76PD patients were arbitrarily allotted to gain VR telerehabilitation at home(n=38) and in hospital sensory integration balance training in 21 sitting , for 7 successive weeks. clients assessment was done consistently before and after the sittings and after a month of training. For evaluation Berg balance scale was used. Noteworthy betterment was noticed for the VR internet based rehabilitation group. The result of the study concludes that VR is a practicable alternative in comparison to in hospital SIBT for dropping postural unsteadiness in clients of PD.

**Bradley R Richardson et al;2016** conducted a study on diagnosis and assessment of various knee conditions by a telerehabilitation. The purpose of the trial was to assess the exactness of anconnected physical therapy session in contrast with usual assessment. 18 participants with knee pain participated in traditional as well as remote telerehabilitation. The results of the study concluded that internet connectedvaluation of the knee complex isviable, reliable, lower problem of appendage musculoskeletal agony and debility.

**NurulBashirahAminyet et al;2022** conducted a study on weight- bearing training for better balance balance (WEBB) using telerehabilitation for obese man. This study mainly focused on tibialis anterior and gastrocnemius muscles stimulation. The trial consisted of 10 vigorous men with grade 2 obese. Acknowledgeda rehabilitation WEBB interference for 8 weeks. Assessment of muscle stimulation was completedobserving fullness values and fullnessregulationin muscle MostVolunteerIsometricalRetrenchment whiledoing shut eyes One LimbPostureexaminationoverEMG inspection. The results of these studies concluded that internet based rehabilitation recover muscle stimulation in vigorousobese men.

## Conclusion

Above all review article shows that telecommunication has made it easier for treatment of several musculoskeletal disorders compared to the normal rehabilitation treatments in a clinic or in a hospital setup. By reviewing of the articles we can conclude that rehabilitation through telecommunication seems to be more convenient and dependable.

## Reference

1. Airò Farulla, G., Pianu, D., Cempini, M., Cortese, M., Russo, L. O., Indaco, M., and Vitiello, N. 2016. Vision-based pose estimation for robot-mediated hand telerehabilitation. *Sensors*, 16(2): 208.
2. Alsobayel, H., Alodaibi, F., Albarrati, A., Alsalamah, N., Alhawas, F., and Alhowimel, A. 2021. Does telerehabilitation help in reducing disability among people with musculoskeletal conditions? A preliminary study. *International Journal of Environmental Research and Public Health*, 19(1):72.
3. Aminy, N. B., Andriana, M., Andriati, A., Pawana, I. P. A., Novida, H., and Melaniani, S. 2022. The effect of Weight-bearing Exercise for Better Balance (WEBB) by telerehabilitation on tibialis anterior and gastrocnemius muscles activation in obese men. *International Journal of Health Sciences*, 6 (S6): p335-346.
4. Bansal, S., Anand, B., Gupta, M., and Solanki, I. 2023. Effectiveness of Exercises by Telerehabilitation for Neck and Shoulder Rehabilitation: A Scoping Review.
5. Berton, A., Longo, U. G., Candela, V., Fioravanti, S., Giannone, L., Arcangeli, V., and Denaro, V. 2020. Virtual reality, augmented reality, gamification, and telerehabilitation: psychological impact on orthopedic patients' rehabilitation. *Journal of clinical medicine*, 9(8):2567.
6. Costa, F., Janela, D., Molinos, M., Moulder, R. G., Lains, J., Francisco, G. E., and Correia, F. D. 2022. Digital rehabilitation for hand and wrist pain: a single-arm prospective longitudinal cohort study. *Pain Reports*, 7(5).
7. Costa, F., Janela, D., Molinos, M., Moulder, R. G., Lains, J., Francisco, G. E., and Correia, F. D. 2022. Digital rehabilitation for hand and wrist pain: a single-arm prospective longitudinal cohort study. *Pain Reports*, 7(5).
8. Deng, H., Durfee, W. K., Nuckley, D. J., Rheude, B. S., Severson, A. E., Skluzacek, K. M., and Carey, J. R. 2012. Complex versus simple ankle movement training in stroke using telerehabilitation: a randomized controlled trial. *Physical therapy*, 92(2): 197-209.
9. Dissanayaka, T., Nakandala, P., and Sanjeeva, C. 2022. Physiotherapists' perceptions and barriers to use of telerehabilitation for exercise management of people with knee osteoarthritis in Sri Lanka. *Disability and Rehabilitation: Assistive Technology*:1-10.
10. Eriksson, L., Lindström, B., and Ekenberg, L. 2011. Patients' experiences of telerehabilitation at home after shoulder joint replacement. *Journal of telemedicine and telecare*, 17(1): 25-30.
11. Fatoye, F., Gebrye, T., Fatoye, C., and Mbada, C. E. 2019. Clinical and cost-effectiveness analysis of telerehabilitation intervention for people with nonspecific chronic low back pain. *JMIR mHealth and uHealth*, 10.
12. Fiani, B., Siddiqi, I., Lee, S. C., and Dhillon, L. 2020. Telerehabilitation: development, application, and need for increased usage in the COVID-19 era for patients with spinal pathology. *Cureus*,12(9).
13. Gandolfi, M., Geroin, C., Dimitrova, E., Boldrini, P., Waldner, A., Bonadiman, S., ... and Smania, N. 2017. Virtual reality telerehabilitation for postural instability in Parkinson's disease: a multicenter, single-blind, randomized, controlled trial. *BioMed research international*, 2017.
14. Hartantri, W., & Arfianti, L. 2020. Combination of telerehabilitation with conventional therapy in the treatment of bilateral carpal tunnel syndrome: a case report. *Surabaya Phys Med Rehabil J*, 2(2): 73.
15. Höher, J., Lischke, B., Petersen, W., Mengis, N., Niederer, D., Stein, T., and Schmidt-Lucke, C. 2023. Sensor-based telerehabilitation system increases patient adherence after knee surgery. *PLOS Digital Health*, 2(2): e0000175.
16. İnal, Ö., and Tunçer, B. 2022. Telephone-based joint protection education in lateral epicondylitis: A randomized controlled trial. *Work*, 72(4):1421-1428.
17. Kloek, C. J., Van Dongen, J. M., De Bakker, D. H., Bossen, D., Dekker, J., and Veenhof, C. 2018. Cost-effectiveness of a blended physiotherapy intervention compared to usual physiotherapy in patients with hip and/or knee osteoarthritis: a cluster randomized controlled trial. *BMC Public Health*, 18:1-12.
18. Lade, H., McKenzie, S., Steele, L., and Russell, T. G. 2012. Validity and reliability of the assessment and diagnosis of musculoskeletal



- elbow disorders using telerehabilitation. *Journal of Telemedicine and Telecare*, 18(7): 413-418.
19. Lim, H., Marjanovic, N., Luciano, C., and Madhavan, S. 2022. Feasibility and Acceptability of Game-Based Cortical Priming and Functional Lower Limb Training in a Remotely Supervised Home Setting for Chronic Stroke: A Case Series. *Frontiers in Rehabilitation Sciences*, 3: 775496.
  20. Lockery, D. 2014. Profiling finger-hand function of rheumatoid arthritis patients using a telerehabilitation gaming system.
  21. Mani, S., Sharma, S., and Singh, D. K. 2021. Concurrent validity and reliability of telerehabilitation-based physiotherapy assessment of cervical spine in adults with non-specific neck pain. *Journal of telemedicine and telecare*, 27(2): 88-97.
  22. Mayer, N., Portnoy, S., Palti, R., and Levanon, Y. 2021. The efficacy of tele-rehabilitation program for improving upper limb function among adults following elbow fractures: a pilot study. *Applied Sciences*, 11(4):1708.
  23. Mbada, C., Olaoye, M., Ayanniyi, O., Johnson, O., Odole, A., and Dada, O. 2017. Comparative efficacy of clinic-based and telerehabilitation application of Mckenzie therapy in low-back pain. *Archives of physical medicine and rehabilitation*, 98(10):e46-e47.
  24. Onan, D., Ulger, O., and Martelletti, P. 2023. Effects of spinal stabilization exercises delivered using telerehabilitation on outcomes in patients with chronic neck pain: a randomized controlled trial. *Expert Review of Neurotherapeutics*, 23(3):269-280.
  25. Ozer, A. Y., Kapsigay, B., Şenocak, E., Karaca, S., Tanhan, A., Elma, H., ... and Polat, M. G. 2021. Effectiveness of different exercise programs in individuals with non-specific neck pain: telerehabilitation, given with synchronous exercises versus homebased exercise. *Medicina Sportiva: Journal of Romanian Sports Medicine Society*, 17(2): 3327-3335.
  26. Parmar, S. T., Kanitkar, A., Sepehri, N., Bhairannawar, S., and Szturm, T. 2021. Computer Game-Based Telerehabilitation Platform Targeting Manual Dexterity: Exercise Is Fun. "You Are Kidding—Right?". *Sensors*, 21(17):5766.
  27. Peterson, S. (2018). Telerehabilitation booster sessions and remote patient monitoring in the management of chronic low back pain: a case series. *Physiotherapy theory and practice*, 34(5): 393-402.
  28. Rennie, K., Taylor, C., Corriero, A. C., Chong, C., Sewell, E., Hadley, J., and Ardani, S. (2022). The current accuracy, cost-effectiveness, and uses of musculoskeletal telehealth and telerehabilitation services. *Current Sports Medicine Reports*, 21(7): 247-260.
  29. Richardson, B. R., Truter, P., Blumke, R., and Russell, T. G. (2017). Physiotherapy assessment and diagnosis of musculoskeletal disorders of the knee via telerehabilitation. *Journal of telemedicine and telecare*, 23(1): 88-95.
  30. Shulver, W., Killington, M., Morris, C., & Crotty, M. (2017). 'Well, if the kids can do it, I can do it': older rehabilitation patients' experiences of telerehabilitation. *Health Expectations*, 20(1), 120-129.
  31. Suero-Pineda, A., Oliva-Pascual-Vaca, Á., Durán, M. R. P., Sánchez-Laulhé, P. R., García-Frasquet, M. Á., and Blanquero, J. (2023). Effectiveness of a Telerehabilitation Evidence-Based Tablet App for Rehabilitation in Traumatic Bone and Soft Tissue Injuries of the Hand, Wrist, and Fingers. *Archives of Physical Medicine and Rehabilitation*, 104(6):932-941.
  32. Zhang, Y. Y., Zhang, Y. G., Li, Z., Li, S. H., and Xu, W. G. (2022). Effect of home-based telerehabilitation on the postoperative rehabilitation outcome of hip fracture in the aging population. *Orthopaedic Surgery*, 14(8): 1768-1777.