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INNOVATIVE APPROACHES TO PAIN MANAGEMENT: THE ROLE OF PHYSIOTHERAPY IN CHRONIC MUSCULOSKELETAL DISORDERS

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Abstract
Chronic Musculoskeletal Disorders (CMDs) represent one of the most significant global health concerns and are estimated to affect 1.71 billion individuals thereby causing disability, mobility impairments, and limitation of activities and participation. The increasing incidence of CMDs is attributed to an increase in population growth and aging. Chronic musculoskeletal pain, one of the key features of CMDs, requires new approaches to the enhancement of functional abilities and actualization of the quality of life. Physiotherapy has become one of the key approaches to managing CMD by providing non-drug treatments based on the patients' characteristics. Following that, this study aims to evaluate the impact of physiotherapy interventions, including cognitive-behavioral therapy, eHealth, and multimodal approaches, on pain management, functionality, and quality of life in individuals with musculoskeletal disorders. A qualitative synthesis of 12 articles following systemic literature review approach was made. Multiple databases were searched using keyword search strategy and PEO framework was used to draft the research question. Interventions incorporated CBT, biobehavioral mechanisms, tele-rehabilitation and client centered rehabilitation protocols. The results showed that physiotherapy interventions led to reduced pain, better functional outcomes and improved quality of life across all the identified themes. Telerehabilitation and eHealth strategies provided more convenient and satisfactory experiences for patients. Both multimodal and personalized strategy had a positive long-term effect in the reduction of symptoms and disability, thus reaffirming the need to incorporate digital solutions with conventional physiotherapy. In conclusion, physiotherapy interventions effectively manage pain and improve quality of life for MSDs, necessitating further research for enhanced implementation.

Keywords: Physiotherapy Interventions, Musculoskeletal Disorders (MSDs), Pain Management, Quality of Life, eHealth and Telerehabilitation.

Introduction
Musculoskeletal health is defined as the optimal function of the musculoskeletal system, which comprises muscles, bones, joints, and connective tissues. Being a crucial facet of human well-being, it encompasses the ability to move, grasp things, and engage in daily tasks. However, more than 150 musculoskeletal disorders (MSDs) are known to be a burden to the global health systems. These

disorders broadly defined by pain, inflammation, and limitations in function cover nearly 1.71 billion inhabitants in the universe (WHO, 2022). They are the fourth biggest cause of disability in the world with low back pain accounting for 33% of the cases; they affect mobility and productivity in 160 countries. As the incidence and prevalence of MSDs continue to increase, there is a dire need to come up with efficient and effective interventions that can help in management to improve the lives of those affected. The fact that MSDs show variation points out that is a complicated issue. These include osteoarthritis, rheumatoid arthritis, gout, osteoporosis, bone fractures, and fibromyalgia among others. These disorders do not affect a certain age group; they are prevalent throughout the lifecycle (Farazi, 2024). For example, juvenile arthritis impacts kids at developmental stages that are so sensitive, and low back pain is a major reason for people's early retirement among adults. MSDs are aware of very significant economic consequences, whose indirect costs due to productivity loss and staff absence are more than the direct costs of treating them (APHA, 2011).

MSDs are the leading worldwide contributors to short-term and chronic severe pain and disability. According to the Institute for Health Metrics and Evaluation (2019), It is estimated they contribute to over one-fifth of the total YLDs worldwide, with LBP taking up to 7.4% of total YLDs (IHME). Other leading contributors include osteoarthritis (528 million cases, 19 million YLDs) and neck pain (222 million cases, 22 million YLDs). These disorders do not only limit the quality of life of persons experiencing such problems, but also carry a large economic burden in terms of health care and economic productivity. The World Health Organisation's 2010 report revealed that musculoskeletal disorders are a leading cause of disability and for the year 2004; musculoskeletal conditions cost $849 billion in direct and indirect health costs in the United States alone (APHA, 2011). MSDs frequently result in substantial restrictions in the range and intensity of movement and involvement in activities related to employment and social interaction.

For instance, osteoarthritis commonly affects the upper limb weight-bearing joints leading to pain, stiffness, and limited joint movements. In the same manner, rheumatoid arthritis causes systematic inflammation that impacts other bodily organs and also leads to additional deterioration of function (Chowdhury et al., 2024; Farazi, 2024). Conditions like scoliosis and kyphosis can develop out of bad posture habits as well as contribute to chronic pain and respiratory problems, placing more strain on persons and the health care system (Sadineni et al., 2024). These conditions also often occur with other noncommunicable diseases like cardiovascular diseases and mental health disorders hence presenting a higher care need. Most especially, patients with chronic musculoskeletal pain demonstrate fatigue, depression and anxiety that only complicate their daily management of the disease (APHA, 2011).

MSDs have proved to be demanding musculoskeletal conditions that respond to a combination of physiotherapy practices, which are clinically proven to be effective in alleviating pain and promoting the overall well-being of the clients. The use of evidence-based practices in physiotherapy also guarantees that treatment approaches are supported by theoretical, empirical, and practical studies (Mozumder et al., 2024; Farazi, 2024). The concept of the systematic integration of high-quality research including randomized controlled trials and meta-analyses into practice decision-making is another of the principles of EBP. In this approach, physiotherapists can focus on using interventions deemed safe and effective to promote the best results for the patient (Sadineni et al., 2024). Accuracy of diagnosis is a key factor in the effectiveness of physiotherapy interventions in clients with MSDs. For special needs, technologies of MRI, ultrasound, and digital skills help in diagnosing individual differences in injuries and prescribe corresponding treatments. Other physiotherapy interventions are manual interventions, therapeutic exercise, and sensorimotor training which addresses the underlying causes of an individual's pain and disability (Elhag, 2024; Elhag et al., 2024). For example, according to the American Public Health Association (2011), in manual therapy, the results obtained have major impacts in enhancing joint mobilization and in therapeutic exercise, strength, and flexibility of muscles that may have led to the required injuries.

MSDs are a major public health concern since they are prevalent in approximately 1.71 billion people across the world and are the world's foremost source of disability (WHO, 2022). According to the National Academies of Sciences (2020), disorders which include osteoarthritis, rheumatoid arthritis, low back pain, and fibromyalgia syndrome, are debilitating and exert heavy physical, emotional, and economic costs on society and healthcare plans. Societal costs are huge, the costs of lost productivity and decrease in work output due to illnesses and sickness days are far greater than the actual costs of health care. However, conventional care fails to effectively respond to the complexity of chronic musculoskeletal pain since the causes are usually multiple and interacting, and patients also have mental health problems and systemic illnesses. Such gaps explain the rationale for seeking novel, individualized, and cost-effective approaches to advance the needs of such patients. Given that, this study follows the PEO framework, it will systematically address the critical dimensions of managing MSDs through targeted physiotherapy interventions. The question focuses on individuals with musculoskeletal disorders (P), such as osteoarthritis, low back pain, and fibromyalgia, experiencing chronic pain and functional limitations. It explores evidence-based physiotherapy interventions (E), including manual therapy, therapeutic exercises, cognitive-behavioral approaches, and innovative technologies like ehealth and telerehabilitation, aimed at addressing physical, psychological, and social dimensions of pain. The anticipated outcomes (O) are improved pain management, enhanced mobility, functional capacity, reduced disability, and better quality of life, answering the central question of physiotherapy's impact on MSD management. By framing the research through this structured approach, the study aims to answer the central question: **How do physiotherapy interventions impact pain management, functional improvement, and quality of life in individuals with musculoskeletal disorders?**

Methodology

The current systematic literature review follows the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) to identify and analyse a comprehensive understanding of existing literature on physiotherapy for MSDs. A keyword search strategy ensured reproducibility and transparency throughout the review process. Multiple databases, including SpringerLink, ScienceDirect, and Google Scholar, were searched for relevant literature. The inclusion criteria for the selection of the studies were developed based on the checklist of the PEO framework. The literature search used articles on patients with musculoskeletal conditions defined as osteoarthritis, low back pain, rheumatoid arthritis, fibromyalgia, and other chronic conditions of the musculoskeletal system. These studies compared the efficacy or feasibility of physiotherapy interventions in the form of manual therapy, therapeutic exercises, cognitive-behavioral strategies, or the use of wearable technology or tele-rehabilitation platforms. Moreover, eligible studies documented at least one indicating the result regarding pain management, the performers' ability to move, Data Analysis disability decrease, or the increase in the quality of life. Only the articles that used primary research designs including the randomized controlled trials Common, single centre trials, Case control trials, Cohort trials, population trials, effect of physiotherapy intervention on the said outcomes were selected. This approach allowed for the inclusion of multisectoral evaluation of the impact of physiotherapy interventions in MSDs management.

Search Strategy

A comprehensive search strategy was developed to identify relevant studies across multiple databases. The following keywords and phrases were utilized in the search: "physiotherapy," "musculoskeletal disorders," "manual therapy," "therapeutic exercises," "cognitive-behavioral therapy," "tele-rehabilitation," "wearable technology," "chronic pain management," "functional outcomes," "mobility improvement," "disability reduction," "quality of life," and "patient-centered care." Boolean operators (AND, OR) were used to combine these terms effectively. The search was limited to articles from the past five years, published between 2019 and 2024, to ensure the inclusion of recent advancements in the field of physiotherapy and musculoskeletal disorder management.

Study Selection

The procedure for inclusion of studies followed a systematic approach where all the articles retrieved were first saved in reference manager including end note and duplicate records were excluded. Subsequently, two separate screening steps were carried out by two authors after reviewing the titles and abstracts based on the following predefined criteria. All the articles identified at this stage were retrieved in full-text and were then screened against the inclusion and exclusion criteria by the same reviewers. The applied criteria for inclusion of the papers involved identification of studies comparing physiotherapy interventions in managing musculoskeletal disorders, which may include manual therapy, therapeutic exercise, cognitive-behavioral approaches, and tele-rehabilitation. It was limited to the articles that documented the condition of the patients post treatment such as pain control, functionality and quality of life. Studies included in the analysis were RCTs of any style, cohort studies, case-control studies, and experimental studies. The publication period limited was set to 2019 to 2024 to ensure only the most recent practices in physiotherapy where captured. The following considerations were used to exclude some articles: if the article discussed other diseases apart from musculoskeletal disorders, if it did not correspond to the health of the patients, or if it only talked about devices or models without looking at the clinical effectiveness. Publication before 2019 and works that were not Randomized Controlled Trials, case reports/series or experimental studies were also excluded. It is important to note that in case there were disagreements between the reviewers, they were always resolved through a discussion. In case of a disagreement, a third reviewer was brought in to conduct another review until consensus was reached. A PRISMA flow diagram was employed to report the study selection process in a clear and comprehensive manner; see Figure 1.

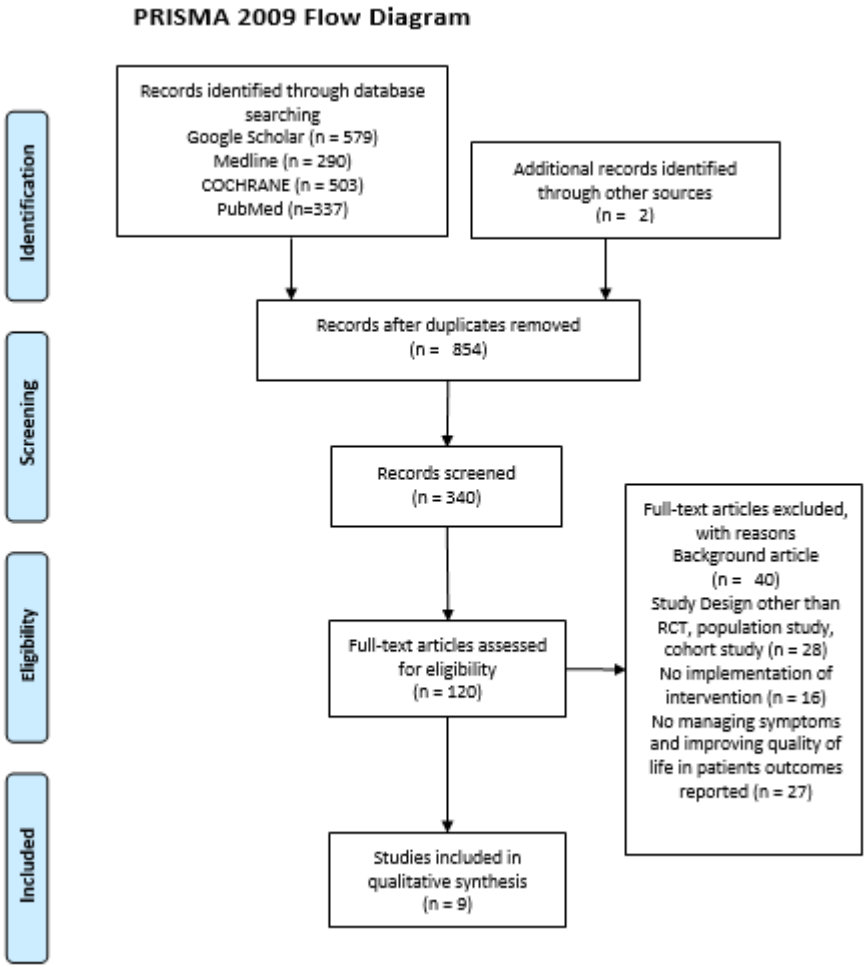

Figure 1 PRISMA Flowchart

Data Extraction

A standardized data extraction form was developed to collect relevant information systematically. The form included the following details: Studied characteristics; authors and publication year; study design; sample size; patient details; musculoskeletal disorders; baseline characteristics; physiotherapy techniques; manual therapy; therapeutic exercises; cognitive-behavioral approaches; tele-rehabilitation technologies; pain management; functional improvement and mobility; disability reduction; and health-related quality of life. To further minimize the risk of bias, data extraction was performed by two separate reviewers while achieving inter-reviewer agreement. The extracted data was again reviewed and any differences pointed out were thoroughly discussed and disagreed.

Data Analysis

The obtained data were analysed thematically to be able to understand the themes and patterns that are present in the qualitative data. The subsequent step was familiarisation, in which the reviewers re-read the articles in order to assimilate data and comprehend the information obtained. Subsequently, themes depicting the review propositions, centered on aspects of physiotherapy intervention that expounded on the desirable results for the clients with MSDs were developed. To ensure that the themes are coherent and relevant to the presented evidence, these were reviewed to align them with existing themes. Each theme was made distinct to pinpoint the aspects of physiotherapy interventions like the pain relief, functional enhancement and quality of life. The results obtained were then categorized in a planned manner to ensure that a clear profile of physiotherapy intervention treatment of MSDs was well captured.

Results

This systematic review of studies has found 9 systematic reviews concerning physiotherapy interventions including eHealth and self-management to address a variety of outcomes like pain, function, and quality of life in patients with MSDs. Three areas of focus were identified, showing the relationship between physiotherapy interventions and better outcomes for patients. These results indicate the advantage of active application of innovative approaches to physiotherapy, including eHealth and individualized rehabilitation in the treatment of MSDs and improvement of patients' quality of life. Table 1 below summarises the details of the key themes with the preliminary findings made for each of these.

Table 1 Preliminary Findings of the Selected Articles

ID	Author	Year	Title	Study Design	Sample Size	Disorder Type	Patient Outcome	Intervention Type
1	Bornhöft et al., 2019	2019	More cost-effective management of patients with musculoskeletal disorders in primary care after direct triaging to physiotherapists for initial assessment compared to initial general practitioner assessment	Randomized Controlled Trial (RCT)	55 participants	Musculoskeletal Disorders (MSDs)	Slightly larger gains in Quality-Adjusted Life Years (QALYs) for the physiotherapist-triaged group. Lower total costs for healthcare and production loss compared to GP-led triaging. High likelihood of cost-effectiveness (85% at €20,000 willingness-to-pay threshold, increasing to 93% at higher thresholds)	Direct triaging to physiotherapists
2	Mesa-Castrillon et al., 2021	2021	eHealth to empower patients with musculoskeletal pain in rural Australia (EMPoweR) a	Randomized Clinical Trial (RCT)	156 participants (78 in the eHealth intervention group and	Chronic non-specific Low Back Pain	Improved physical function (measured by Patient-Specific Functional Scale - PSFS). Reduced	eHealth intervention

			randomized clinical trial: study protocol		78 in the usual care group)	(LBP) and Knee Osteoarthritis (OA)	pain intensity, increased physical activity levels, fewer activity limitations, improved quality of life, and better pain coping strategies	
3	Barnes et al., 2019	2019	Improvements in health-related quality of life and function in middle-aged women with chronic diseases of lifestyle after participating in a non-pharmacological intervention programme: A pragmatic randomised controlled trial	Pragmatic Randomized Controlled Trial (RCT)	42 participants (22 in the intervention group and 20 in the control group)	Musculoskeletal Conditions with co-morbid chronic diseases of lifestyle	Significant improvements in health-related quality of life for the intervention group (compared to no improvement in the control group). Twice the change in median utility scores in the intervention group compared to the control group. Significant within-group improvements in self-efficacy for managing fatigue and discomfort	A 6-week physiotherapy intervention
4	Bornhöft et al., 2019	2019	Health effects of direct triaging to physiotherapists in primary care for patients with musculoskeletal disorders: a pragmatic randomized controlled trial	Pragmatic Randomized Controlled Trial (RCT)	63 participants /group	Musculoskeletal Disorders	Significant improvement in health-related quality of life at 26 weeks. Nonsignificant trends toward greater reductions in current pain, mean pain (over 3 months), functional disability, and risk of developing chronic pain compared to GP triaging.	Direct triaging to physiotherapists for primary assessment in primary care
5	Mozhi et al., 2021	2021	Effects of cognitive-behavioral therapy in patients with fibromyalgia: a single-blind, randomized, controlled trial	Experimental Study (Randomized Controlled Trial)	60 participants	Fibromyalgia (FM)	Significant improvement in all outcome measures ($p < 0.05$) for the group receiving integrated physiotherapy and cognitive behavioural therapy.	Integrated physiotherapy combined with cognitive behavioral therapy
6	Lopez-de-Uralde-Villanueva et al., 2020	2020	Pain management using a multimodal physiotherapy program including a biobehavioural approach for chronic nonspecific neck pain: a randomized controlled trial	Single-blind Randomized Controlled Trial (RCT)	47 participants	Chronic Non-Specific Neck Pain (CNSNP)	Significant reduction in pain intensity (Visual Analog Scale) in the Exp2 group compared to Exp1 and the control group at 4 months. Improvement in illness severity and global improvement (Clinical Global Impression Scale)	**Control Group:** Manual Therapy (MT) only

7	Trulsson et al., 2021	2021	Physiotherapist-led rehabilitation for patients with chronic musculoskeletal pain: interventions and promising long-term outcomes	Observational Study (Retrospective cohort analysis)	274 patients	Chronic Musculoskeletal Pain	• 45% improvement in pain. 61% improvement in disability. 50% improvement in overall health at discharge and maintained at 1-year follow-up	Individualized education Sensorimotor training Physical activity advice Manual techniques Stretching
8	Kelly et al., 2022	2022	eHealth interventions to support self-management: Perceptions and experiences of people with musculoskeletal disorders and physiotherapists - 'eHealth: It's TIME': A qualitative study	Qualitative Study (Interpretive descriptive approach)	26 participants (13 musculoskeletal physiotherapists and 13 people with musculoskeletal disorders)	Musculoskeletal Disorders (MSDs)	Enhanced flexibility and feasibility within a blended care model for self-management. eHealth recognized as a useful facilitator for self-management support, particularly for follow-up purposes. Challenges include difficulties in assessment, diagnosis, establishing therapeutic relationships, lack of resources, and suboptimal user experience	eHealth-mediated self-management support interventions,
9	Alsobayel et al., 2022	2022	Does Telerehabilitation Help in Reducing Disability among People with Musculoskeletal Conditions? A Preliminary Study	Preliminary Study	95 participants	Musculoskeletal Conditions (e.g., lower back pain, knee pain, neck pain, post-operative conditions)	Significant improvements in pain self-efficacy, functional scale scores, and musculoskeletal health ($p < 0.001$). High level of patient satisfaction with telerehabilitation	Telerehabilitation via online video platform (Google Meet). Tailored education and conditioning exercises, delivered 2–3 times a week for 6 weeks.

Functional Improvement and Disability Reduction

It focuses on how assigning referrals directly to physiotherapists and other creative interventions helps increase patients' functional abilities and diminish their disability with MSDs. Bornhöft et al. (2019) conducted one type of study that aimed at comparing the cost-effectiveness of direct access to physiotherapist for patients with MSDs than GPs in a sample of 55 patients through a randomized controlled trial. Data showed that patients in the physiotherapist-triaged group fared better in QALY at a significantly lower cost and with 85% probability of being cost-effective when valued at €20,000. In line with previous studies, both functional improvement and cost reduction were found to be significant, while the study has a small sample size and participants from a single centre, which may limit its generalizability. In another study, Bornhöft et al. (2019) compared 63 patients randomly assigned to either physiotherapist triage or GP triage. The results showed that the patients in the physiotherapist-triaged group achieved a clinically significant improvement in the health-related quality of life by 26 weeks and trends toward decrease in pain and functional disability. However, there were several non-significant results, which indicates variability in the participants' response and underlines the importance of having a replication of these studies with a bigger sample size.

A recent study by Mesa-Castrillon et al (2021) involved a quantitative study of 156 participants with CLBP and Knee OA in rural Australia with eHealth interventions. The eHealth group consisting of patients that received delivered remote exercise programs by physiotherapists showed functional improvement and lower activity limitation compared with the usual care group. From this study, the coordination and delivery of support services can be seen as a key area of focus in eradicating barriers in accessing these services among the disadvantaged groups. However, low compliance with remote programs, and technological limitations are some of the issues experienced. Barnes et al. (2019) aimed to conduct a 6-week physiotherapy education and discussion and exercise intervention for 42 women with musculoskeletal and co-morbid lifestyle conditions. These results indicate the superiority of the intervention group and suggest functional gains following rehabilitative intervention alongside better ability to manage fatigue and discomfort. However, the major concern is the issues encountered in the recruitment of participants and the small number of people under consideration.

Pain Management through Physiotherapy Interventions

This theme underscores the effectiveness of physiotherapy interventions in managing pain for individuals with musculoskeletal disorders. Mozhi et al. (2021) designed a single-blind randomized controlled trial including 60 fibromyalgia patients to study the synergistic impact of integrated physiotherapy and CBT during 12-weeks programs. The study showed a better assessment of the pain intensity and other selected variables ($p < 0.05$) for combined CBT and physiotherapy group than for only physiotherapy. These findings indicate positive outcomes when both physical and psychological aspects of pain are considered, but the reduced number of participants points to the necessity for larger treatment trials. Lopez-de-Uralde-Villanueva and colleagues conducted a study on the effectiveness of a multimodal physiotherapy model with the biobehavioural approach for CNSNP. In the study, three groups were analysed: manual therapy as the control, manual therapy with TPE, and manual therapy with TPE and therapeutic exercises. The third group, where patients received all three types of interventions, including exercise, manual, and educational ones, revealed the highest pain reduction and the best global health improvements. Downside therefore originates from the relatively short of the follow-up period thus only suggesting immediate improvements.

Trulsson et al. (2021) explored the effectiveness of the six-week supervised physiotherapist rehabilitation program in 274 patients with chronic musculoskeletal pain. This consisted of tutorial instructions, sensorio-motor instructions, manipulation and mobilization and stretching programmes. At discharge, 45% patients had clinically significant improvement in their pain and the improvement was maintained at 1 year follow up. The findings bear implications for tailored approaches to eating and physical activity, but the observational nature of the research restricts conclusions about causality. All these studies confirm that physiotherapy interventions are central for pain management among patients diagnosed with MSDs.

Enhancing Quality of Life through Multimodal Approaches

This theme focuses on how multimodal approaches, including eHealth and telerehabilitation interventions, contribute to improving the quality of life in individuals with musculoskeletal disorders (MSDs). In Kelly et al. (2022) qualitative study with 13 physiotherapists and 13 people with MSDs using eHealth interventions for self-management. In accordance with the results of the study, there is a marked improvement in the flexibility and feasibility of a combined in-person and tele physiotherapy care. Participants noted that the use of eHealth interventions was mostly for follow-up care and greatly helped in long-term management of the condition. However, the study also pointed out some issues, such as assessment/diagnosis, building relationships with clients, and technology. However, due to these barriers, eHealth interventions were regarded as a useful approach to engaging patients with their chronic conditions; however, they require enhancement to enhance their effectiveness.

Another study by Alsobayel et al. (2022) involve a pilot randomized control trial to assess the effectiveness of telerehabilitation among 95 patients with musculoskeletal complaints involving lower

back pain, knee pain and postoperative cases. Education and conditioning exercises were delivered in an online format through Google Meet over a six-week period. It was observed that the results have proven the effectiveness of this intervention integrating positive changes in their pain self-efficacy, musculoskeletal health and functional scores with statistically significant differences of $p < 0.001$. Participants also expressed their satisfaction with the intervention, suggesting that telerehabilitation may be a viable form of intervention that is easily accessible to patients. However, issues like availability of internet, and patients' compliance with the remote sessions cannot be underestimated.

Discussion

The present review also emphasizes that physiotherapy interventions play an important role in the MSDs management through pain management methods, improving the quality of life, and other modalities employing multimodal approach. These thematic points are consistent with prior studies and support physiotherapy interventions for pain reduction, functional gains, and an overall betterment in the quality of life of patients with MSDs.

The quantitative studies by Mozhi et al. (2021), Lopez-de-Uralde-Villanueva et al. (2020) and Trulsson et al. (2021) showed to which extent physiotherapy-based interventions contribute to pain reduction. Mozhi et al. CBT with physiotherapy have found their success in relieving fibromyalgia patients, the reduction of intensity pain and other related symptoms was significant. CBT is underlined as the psychological component that concurs with the findings of earlier research on chronic pain treatment (Yu et al., 2021). Likewise, Lopez-de-Uralde-Villanueva et al. (2020) demonstrated notable improvements in a group of patients with chronic nonspecific neck pain though employing biobehavioural approach concurrent with manual therapy and therapeutic exercises. Combination of educational and exercise based interventions are consistent with clinical recommendations for treatment of chronic pain regarding the use of a multidisciplinary approach (Joypaul et al., 2019). Trulsson et al. (2021) also proved that long-term outcomes regarding pain and disability were significantly blessed when receiving individually tailored rehabilitation programmes supporting the usage of individual care plans once again.

A cross-sectional survey by Kelly et al. (2022) Also, Alsobayel et al. (2022) report on the impact of eHealth and telerehabilitation services in enhancing quality of life related to MSDs. As indicated by the study by Kelly et al., eHealth interventions are versatile in that they enable long-term condition management and self-management. However, issues arising from the assessment exterior validity and related to the technological applicability that have been raised are equally similar to the past criticisms of the nature of digital health technologies (Guo et al., 2020). Likewise, in their work, Also Fiani et al. (2020), support the increased use of telerehabilitation to expand access to and enhance the functional rehabilitation experiences of patients during COVID-19 and beyond. Such findings call for the expansion of integrated digital health approaches as the research has demonstrated barriers to access to care because of geographical location and availability of health care resources. Still, such interventions should not only focus on concerns of digital divide and patient compliance to enhance the result.

The thematic result of this review does corroborate with the existing literatures calling for modality and patient-centred physiotherapy to manage MSDs. Interventions in pain management such as biobehavioural treatments and CBT have also been supported by the studies which stress the biopsychosocial model of chronic pain management. In addition, the use of digital health solutions is an increasing trend in the development of new tools that contribute to the improvement of access and patients' involvement, especially, for vulnerable groups (Awad et al., 2021). Nevertheless, some issues like the digital divide between patients, adherence to regimes and requirement of retraining among physiotherapists for using eHealth platforms are emerged.

The findings reveal directions for future research that are considered critical. Additional larger, multi-centre trials should be conducted to assess multimodal interventions and digital health solutions in

different patient populations. Furthermore, the longitudinal research should examine the effect of such interventions on pain and quality of life in the later periods. Finally, optimization of eHealth and telerehabilitation platforms by minimizing emerging technological issues should be addressed to optimally harness the benefits of these devices.

In conclusion, physiotherapy interventions play a vital role in managing musculoskeletal disorders, improving pain, functionality, and quality of life. Cognitive-behavioral therapy, biobehavioural approaches, manual therapies and telerehabilitation have been found to provide solutions to management of adult TBI. Despite the effectiveness of eHealth, it has some barriers in terms of usability as well as digital divide. More studies must be conducted to address these challenges and substantiate durable positive impacts to improve patient centeredness for MSDs.

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