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Impact of Exercise on the Course of Dermatomyositis: A Narrative Review of Recent Studies.

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ABSTRACT

Introduction and Purpose: Dermatomyositis (DM) is a rare autoimmune inflammatory myopathy characterized by muscle weakness and distinctive skin manifestations, impacting both children and adults. This narrative review aims to examine the latest studies assessing the impact of physical activity on the course of dermatomyositis and determine which forms of exercise are beneficial for DM patients.

Methods: A comprehensive literature review was conducted using the PubMed and Google Scholar databases, focusing on articles published between 2018 and 2024.

State of Knowledge: The review identified consistent evidence supporting the safety and efficacy of exercise in DM patients. Exercise regimens, including resistance, aerobic, and stretching exercises, were found to improve muscle strength, aerobic capacity, and metabolic functions without increasing disease activity. Novel exercise approaches, such as blood flow restriction training and aquatic plyometric exercises, also showed promising results. However, the heterogeneity of the trials and small sample sizes highlight the need for larger, more diverse cohorts and long-term studies

Summary: The findings underscore the potential of structured exercise programs to enhance muscle strength, aerobic capacity, and overall physical function in DM patients. These improvements are achieved without exacerbating disease activity, highlighting the safety of exercise interventions. The review emphasizes the importance of incorporating physical activity into treatment plans for DM, advocating for personalized exercise prescriptions tailored to the unique inflammatory nature of idiopathic inflammatory myopathies (IIM).

Keywords: dermatomyositis; physical activity; exercise; muscle weakness; idiopathic inflammatory myopathies

Introduction

Dermatomyositis (DM) is an autoimmune inflammatory myopathy, characterized by muscle weakness and distinctive skin manifestations, affecting both children and adults with a slightly higher incidence in females. Understanding its symptoms and pathogenesis is crucial for effective diagnosis and management. [1]

Muscle weakness is a defining feature of DM, predominantly impacting the proximal muscles, such as those of the shoulders, upper arms, hips, and thighs. This weakness often results in difficulty performing everyday activities like climbing stairs, rising from a seated position, or lifting objects. [2]

A distinctive aspect of DM among myopathies is its dermatological features. Patients often exhibit a heliotrope rash, which is a violet or dusky rash around the eyes, sometimes accompanied by swelling.

Gottron's papules are raised, scaly bumps typically found over the knuckles, elbows, and knees. The shawl sign and V-sign refer to red or purplish discoloration on the upper back, shoulders, and chest, resembling the pattern of a shawl or V-neck T-shirt. Additionally, patients may develop mechanic's hands, characterized by rough, cracked skin on the sides of the fingers, reminiscent of manual laborers' hands. [3]

Systemic symptoms are also prevalent in DM. Interstitial lung disease affects the lungs, leading to cough and breathlessness. Dysphagia, or difficulty swallowing, occurs due to the involvement of esophageal muscles. Some patients experience arthritis, manifesting as joint pain and swelling. General symptoms like fever and fatigue are common, reflecting a general sense of malaise and elevated body temperature. [4]

The pathogenesis of DM involves a complex interplay of genetic, environmental, and immunological factors. Genetic predisposition is significant, with certain HLA (human leukocyte antigen) types being more prevalent in patients, suggesting a genetic susceptibility. [5]

Variations in genes related to immune response and inflammation have also been implicated.

DM is primarily an autoimmune disorder, where the body's immune system erroneously attacks its own tissues. This immune response is characterized by the presence of specific autoantibodies, such as anti-Mi-2, anti-Jo-1, and anti-TIF1-γ, which indicate disease subsets and can influence clinical features and prognosis. Complement activation involves immune complexes and complement proteins deposited in the small blood vessels of muscles and skin, leading to inflammation and tissue damage. [6]

Muscle pathology in DM involves several mechanisms. Muscle biopsies often reveal perifascicular atrophy, which is the atrophy of muscle fibers around the edges of muscle fascicles. Lymphocytic infiltration, particularly CD4+ T cells and B cells, is commonly found in affected muscles. Additionally, damage and loss of capillaries contribute to muscle ischemia (reduced blood flow) and necrosis (cell death). Skin pathology mirrors that of muscle, with similar immune complex deposition and inflammation leading to characteristic skin lesions. Damage to endothelial cells in small blood vessels of the skin results in distinctive rashes and papules. [7]

Environmental factors may trigger DM in genetically predisposed individuals. Potential triggers include viral infections, such as those caused by Coxsackievirus, which have been associated with the onset of the disease. Sun exposure, particularly ultraviolet (UV) radiation, can exacerbate skin symptoms and is considered a triggering factor for disease flares. Certain medications and environmental toxins have also been implicated in triggering autoimmune responses in susceptible individuals. [8]

DM is a multifaceted disease with significant morbidity due to its muscular and dermatological manifestations. The interplay between genetic predisposition, immune system dysfunction, and environmental triggers underscores its complex pathogenesis. Recognizing the diverse symptoms and understanding the underlying mechanisms are essential for timely diagnosis and effective management, thereby improving the quality of life for affected individuals. Further research into the molecular and immunological pathways involved in DM will continue to enhance therapeutic strategies and patient outcomes. [9]

Traditionally, patients with DM were advised against exercise due to fears of exacerbating inflammation and muscle damage.

However, recent research suggests that exercise can be safely incorporated into the management of idiopathic inflammatory myopathies (IIM), with potential benefits for muscle function and overall health. [9]

A comprehensive review of 2967 records identified 16 studies specifically focusing on exercise interventions for individuals with IIM. The review revealed consistent evidence supporting the safety of exercise, as indicated by stable levels of serum creatine kinase and inflammatory markers, and in some cases, an anti-inflammatory effect was noted. Notably, muscle biopsies from two studies showed no increase in inflammation, further confirming the safety of exercise interventions in this population.

Aerobic exercise protocols, employed in eight studies, demonstrated significant improvements in cardiorespiratory fitness and exercise capacity. Similarly, six studies focusing on strength training reported enhancements in muscle function. Some of these studies also noted upregulation of genes associated with the recycling of damaged proteins, suggesting a potential mechanistic benefit of strength training at the molecular level.

Functional improvements were documented in nine out of thirteen studies measuring outcomes such as walking speed and endurance, although not all studies observed significant changes. This variability might be attributed to differences in study design, including the primary focus on physiological outcomes rather than functional activities.

Behavioral interventions also showed promise. One notable study implemented a 16-week self-management program combining aerobic exercise, energy conservation, and relapse prevention, facilitated by occupational and physiotherapists. This approach resulted in significant improvements in participants' functional measures, indicating the value of educational and supportive interventions in promoting long-term exercise adherence and self-management.

The evidence underscores the importance of personalized exercise prescriptions. While the generic application of exercise programs across various neuromuscular diseases might offer some benefits, tailored interventions that consider the unique inflammatory nature of IIM are likely to be more effective and safer. For instance, inclusion body myositis (IBM) patients, who do not typically respond to immunosuppression, showed continued muscle strength decline without exercise, whereas exercise interventions provided noticeable improvements.

Future research should focus on long-term studies to determine if exercise can modify disease trajectories and enhance quality of life sustainably. Moreover, integrating behavioral change theories and personalized exercise regimens will be crucial in ensuring that individuals with IIM can effectively incorporate physical activity into their daily lives, thereby maximizing the therapeutic potential of exercise. [10]

The aim of our review is to examine the latest studies assessing the effect of physical activity on the course of DM and to determine which forms of exercise are beneficial for patients with DM and which are not.

Materials and methods of research

A comprehensive literature review was undertaken using the PubMed and Google Scholar databases, with search terms including “dermatomyositis”, “physical activity”, “exercise”, “muscle weakness”, and “idiopathic inflammatory myopathies”. Articles published between 2018 and 2024 were selected.

Filters were applied to include observational studies, clinical trials, meta-analyses, and systematic reviews, while excluding non-English articles and book chapters. To ensure quality, the selected studies were evaluated based on their relevance, methodology, and significance. Systematic data extraction was conducted, covering key findings, study design details, and participant characteristics.

Description of the state of knowledge

Quality of life in patients with DM

Christopher-Stine et al. aimed to characterize the frequency and pattern of flare activity in DM and polymyositis (PM) from the patient perspective, and to assess the impact of flare frequency on disability, pain, healthcare resource utilization, work productivity loss, and nonwork activity impairment. The study utilized an online survey conducted between December 2017 and May 2018, with participants recruited from The Myositis Association (TMA) and the Johns Hopkins Myositis Center (JHMC). The survey collected data on flare frequency, disability, pain, emergency department/urgent care (ED/UC) visits, hospital admissions, and work productivity. A total of 564 individuals with self-reported diagnoses of DM or PM participated in the survey, with 524 recalling symptom flares. The majority of respondents were female (78.1%) with a mean age of 55 years. The study employed the Health Assessment Questionnaire Disability Index (HAQ-DI) and HAQ-Pain Index to measure disability and pain, respectively, while work productivity and activity impairment were assessed using the Work Productivity and Activity Impairment (WPAI) scale.

The results revealed that 72.1% of respondents reported experiencing at least one flare in the past year. The most common symptoms reported during flares were muscle weakness (83%), extreme fatigue (78%), and muscle pain/discomfort (64%). The frequency of flares was similar between DM and PM patients. Increased flare frequency was associated with higher HAQ-DI and HAQ-Pain scores, indicating greater disability and pain. Higher flare frequency also correlated with increased myositis-related ED/UC visits and hospital admissions. Employed respondents reported significant work productivity loss and nonwork activity impairment due to increased flare frequency.

These findings highlight the importance of considering patient-reported flare activity in the clinical assessment and management of DM and PM to better address the burden of these diseases [11]

The study by Kleitsch et al. involved interviews with seventeen patients with cutaneous DM who were already enrolled in a longitudinal database study at an autoimmune dermatology clinic. The patients were asked about their most troubling aspects of their skin condition, how bothersome it was, and its impact on their daily lives. Their responses were recorded by a scribe, and themes were generated from the interviews to ensure a comprehensive understanding of the patient experiences.

The demographic profile of the participants showed that all were female, with a median age of 65 years. Seven participants had amyopathic DM, a subtype of the disease, and the median duration of their cutaneous symptoms was 6.7 years. The severity of their condition, measured by the Cutaneous DM Disease Area and Severity Index (CDASI), had a median score of 12, indicating varying levels of disease activity among the participants.

From the analysis, seven primary themes emerged regarding the impact of cutaneous DM on patients: physical manifestations, disruption of daily life, emotional symptoms, social impact, optimism, uncertainty about the disease, and difficulty in management. Physical manifestations were universally reported, with common issues including itchiness and pain or discomfort. Many patients described how their disease physically restricted their activities, limiting what they could do.

Disruption of daily life was another significant theme, with patients frequently mentioning limitations in activities to avoid sun or heat exposure. The necessity to constantly protect themselves from the sun, especially during summer, and changes in skincare and cosmetic routines were commonly reported. Sleep disruption due to itchiness and adverse effects or restrictions from DM-related medications were also highlighted.

Emotional symptoms such as fear, anxiety, frustration, worry, guilt, and discontent were prevalent among the patients. Many expressed frustration with the disease's management, its physical manifestations, and uncertainty about its triggers and progression. Social impacts included self-consciousness about their appearance and social restrictions due to the visible skin manifestations. Patients often felt uncomfortable in social settings and avoided activities that could exacerbate their symptoms or expose their condition.

Despite the challenges, some patients expressed optimism, noting that their disease was well-controlled or that its impact lessened over time. These patients often felt less affected by the disease as they adjusted to living with it. However, there was also considerable uncertainty among patients about the disease's cause, its progression, and the initial diagnosis, reflecting a significant emotional burden.

Finally, a few patients discussed the difficulty in managing their condition, particularly the unpredictable nature of flares and the lack of control over the disease process. The study emphasized that while current skin-specific Quality of Life Inventory (QoL) instruments highlight patient distress, they do not fully capture the unique concerns of DM patients, such as uncertainty about the disease and its progression. [12]

Impact of exercise on DM

de Oliveira et al. aimed to evaluate the effects of exercise training on intramuscular lipid content and genes related to the insulin pathway in patients with systemic autoimmune myopathies, specifically focusing on DM and immune-mediated necrotizing myopathy (IMNM). The study involved a quasi-experimental, prospective cohort design, conducted at the University of São Paulo between January 2016 and May 2019. The participants included seven patients with DM, six with IMNM, and ten healthy controls matched for age, sex, and body mass index.

Participants with DM and IMNM were subjected to a 12-week combined exercise training program that included resistance, aerobic, and stretching exercises. Muscle biopsies from the vastus lateralis were taken before and after the intervention to measure intramuscular lipid content, and skeletal muscle gene expression was analyzed. The control group did not undergo the exercise intervention and was only assessed at the beginning of the study.

The findings indicated that the DM group had a higher intramuscular lipid content in type II muscle fibers compared to the control group.

Following the exercise intervention, there was a significant reduction in lipid content in both type I and type II muscle fibers in the DM and IMNM groups. This reduction suggests that exercise training effectively mitigated fat infiltration within the skeletal muscles of these patients.

In terms of genetic analysis, the control group showed a significantly higher expression of genes related to the insulin and lipid oxidation pathways, including AMPKb2, AS160, INSR, PGC1-a, PI3K, and RAB14, compared to the DM group. Post-intervention, there was a notable increase in the expression of these genes in the DM group, indicating an improvement in the metabolic functions of their skeletal muscles. Similarly, in the IMNM group, genes such as AKT2, AMPKb2, RAB10, RAB14, and PGC1-a showed increased expression following the exercise training, further supporting the positive impact of the exercise regimen on muscle metabolism.

These results underscore the potential of exercise training as an effective strategy to improve muscle quality and metabolic functions in patients with DM and IMNM. [13]

Calado et al. investigated the effects of a rehabilitation program on a 19-year-old female diagnosed with DM positive for anti-NXP-2 autoantibodies. DM, an IIM, typically manifests as proximal, progressive, symmetrical muscle weakness accompanied by specific dermatological signs. In this case, the patient exhibited severe joint involvement in the shoulders, elbows, wrists, and ankles, with calcinosis observed in radiographic images. Additionally, heliotrope erythema on the eyelids and Gottron's papules on the interphalangeal joints of the hands were noted.

Upon initial presentation, the patient had significant proximal muscle weakness, impaired balance and gait, and weakened respiratory muscles, resulting in dysphonia and dysphagia. Laboratory tests revealed elevated levels of transaminases, gamma-glutamyl transferase, creatine kinase, myoglobin, and lactic dehydrogenase, with positive NXP-2 autoantibodies. Electromyography indicated severe myopathy with muscle fiber necrosis, and respiratory function tests showed moderate restrictive respiratory syndrome. The initial treatment regimen included high-dose methylprednisolone, followed by prednisolone and azathioprine, which led to improvements in muscle strength, dermatological symptoms, and swallowing difficulties. A muscle biopsy confirmed the diagnosis, showing muscle fiber atrophy, necrosis, regeneration, and inflammatory cells in the perimysium.

Following the diagnostic phase and the commencement of targeted therapy, the patient was admitted to an inpatient Physical Medicine and Rehabilitation Department. A multidisciplinary rehabilitation program was initiated, involving physiotherapy, occupational therapy, and speech therapy. Upon admission, the patient presented with generalized muscular atrophy, limited range of motion in affected joints, and significant muscle weakness. Functional assessments included the Manual Muscle Testing-8 (MMT-8), the Functional Independence Measure (FIM), and the Barthel Index (BI).

Throughout the rehabilitation period, the patient exhibited marked improvement. Muscle strength, as measured by MMT-8, increased from 73/150 at admission to 94/150 at discharge. The FIM score rose from 87/126 to 118/126, and the BI improved from 50/100 to 90/100. The range of motion in various joints also showed significant enhancement, with shoulder flexion increasing from 120° to 170° and shoulder abduction from 90° to 180° by the end of the rehabilitation period.

Muscle strength gains were observed across multiple muscle groups, including the neck flexors, deltoids, biceps brachii, gluteus maximus, gluteus medius, quadriceps, wrist extensors, and ankle dorsiflexors.

During the inpatient rehabilitation, the patient received weekly analytical reassessments and a progressive increase in the azathioprine dose. She also maintained follow-ups with psychology and nutrition services to optimize her nutritional intake, resulting in favorable progress. By the time of discharge, she had regained normal swallowing function, improved speech phonetics, and modified independence in transfers and gait, capable of navigating stairs with minimal assistance.

This case highlights the potential benefits of early and individualized rehabilitation programs for patients with DM. [14]

da Silva et al. in their systematic review and meta-analysis aimed to summarize and critically analyze existing evidence to support the hypothesis that exercise is safe and beneficial in improving muscle strength and aerobic capacity in these patient populations.

The study includes 19 clinical trials with a total of 298 participants, encompassing a range of randomized controlled trials (RCTs) and quasi-experimental studies. The participants in these trials had various levels of disease activity and included both adult and juvenile cases. The trials investigated the effects of different types of physical exercise, including aerobic and resistance training, on outcomes such as muscle strength, aerobic capacity, and safety indicators.

The meta-analysis revealed that physical exercise led to significant improvements in muscle strength and aerobic capacity among patients with DM and PM. Specifically, the standardized mean difference (SMD) for muscle strength was 0.61 (95% confidence interval [CI]: 0.37-0.85, $P < .00001$), indicating a moderate effect size. For aerobic capacity, the SMD was 0.82 (95% CI: 0.29-1.34, $P = .002$), suggesting a larger effect size. These results were derived from various measures of strength and aerobic performance, such as peak isometric torque (PIT), repetition maximum (RM), and peak oxygen uptake (VO2max).

Importantly, the analysis found no significant changes in creatine phosphokinase (CPK) levels after the interventions (SMD = -0.23, 95% CI: -0.5-0.03, $P = .08$), indicating that exercise did not exacerbate muscle inflammation. This is a critical finding given the historical concerns that exercise might worsen muscle inflammation in these patients.

No adverse effects or disease exacerbations were reported across the studies, reinforcing the safety of physical exercise for individuals with DM and PM. Additionally, the benefits of exercise were observed across different stages of the disease and various age groups, although the authors noted that future research might yield different results as new classification criteria for PM and other IIM are developed.

The review also highlighted promising novel exercise approaches, such as blood flow restriction training and aquatic plyometric exercises, which could offer additional benefits. However, the certainty of the evidence was downgraded due to unbalanced confounding variables, small sample sizes, and the heterogeneous nature of the trials included. [15]

The study by Samhan et al. aimed to assess the effectiveness of land-based and aquatic-based exercises on children diagnosed with Juvenile DM (JDM).

This study was designed as an assessor-blinded, controlled 2x2 crossover trial and took place between June 2017 and February 2019 at the Physical Therapy Department of New Kasr Elaini Hospital, Cairo University, Egypt. The participants were recruited from the pediatric rheumatology clinic at Abu El-rish Pediatric Hospital of Cairo University and other tertiary referral hospitals across Egypt.

Seventeen subjects with JDM were initially invited to participate, with sixteen agreeing to join the study. However, two participants withdrew during the first training period, leaving a final sample of fourteen children (4 boys and 10 girls) with a mean age of 11.7 years. The children were randomly assigned to two groups based on the treatment sequences they would follow. The first group received land-based exercises (LBEs) first, followed by aquatic-based exercises (AQBEs) after a one-month washout period, while the second group followed the opposite sequence. The study's protocol was approved by the Cairo University Hospitals' Ethics Committee, and written informed consent was obtained from the guardians of each patient. The study was conducted in accordance with the Declaration of Helsinki.

Participants were included in the study if they met the criteria for JDM diagnosis as described by Bohan and Peter, which included proximal muscle weakness, characteristic skin rash, elevated skeletal muscle enzymes, inflammatory changes on MRI, typical muscle biopsy findings, and electromyographic changes characteristic of myopathy. Additionally, the children had to be in a chronic phase of JDM (disease duration greater than one year) and stable (no change in medication for at least one month before enrollment). Exclusion criteria included recent relapses or concurrent health issues that could be exacerbated by exercise, such as cardiovascular diseases, undernourishment, or chronic pulmonary diseases.

The overall disease activity was assessed using the Patient Global Assessment (PGA) where patients rated their global health on a visual analog scale from 0 to 10, with higher scores indicating greater disease activity or worse health. A score of 2.0 or lower indicated low global assessment.

The study's primary outcome measures included evaluations of muscle strength, functional ability, and disease activity. These were assessed using the Childhood Health Assessment Questionnaire (CHAQ) for functional status, the Quality of My Life (QoML) questionnaire for quality of life, Manual Muscle Testing (MMT-8) for muscle strength, the Childhood Myositis Assessment Scale (CMAS) for physical function, and a timed squat test for physical performance. Additionally, the physician global assessment of overall disease activity and the Myositis Disease Activity Assessment Visual Analogue Scales (MYOACT-VAS) were used to measure disease activity.

The results showed that the intervention generally favored improvement without worsening disease activity, regardless of the disease phase. Muscle strength assessed through various methods, including manual muscle tests and functional indexes, typically showed significant improvement, with no studies reporting a decline in strength. The Wingate test, a measure of anaerobic power, was also explored for its feasibility and correlation with other clinical assessments, demonstrating that it was a suitable and potentially resource-saving measure for children with JDM. [16]

Landon-Cardinal et al. aimed to explore the relationship between changes in clinical status and daily life physical activity (PA) in patients diagnosed with IIM. The research included patients with various forms of IIM, such as DM, IMNM, and overlap myositis (OM).

These patients were either experiencing new-onset or relapsing IIM, were in a stable phase of the disease while on maintenance therapy, or were undergoing immunosuppressant tapering. The evaluation of the patients occurred at three different points: at the initial visit (V0), and two subsequent follow-ups (V1, approximately 94 days after V0, and V2, roughly 96 days after V1). The American College of Rheumatology/European League against Rheumatism (ACR/EULAR) response criteria were employed to record clinical status. Physical activity was monitored using 14-day raw accelerometry data collected via a wrist-worn accelerometer, and the mean daily Euclidean norm minus 1 g (ENMO) was computed from this data.

Fifty-five patients participated in the study, including 16 with OM, 27 with IMNM, and 12 with DM. At the baseline measurement, 67% of these patients had an ENMO Z-score less than 1, indicating low physical activity levels. The initial data revealed significant correlations between ENMO and several clinical measures: health assessment questionnaire score (HAQ), manual muscle testing 8 (MMT8), creatinine level, and the SF-36 physical functioning score. Specifically, ENMO was negatively correlated with HAQ ($r=-0.51$, $p<0.01$) and positively correlated with MMT8 ($r=0.42$, $p<0.01$), creatinine level ($r=0.41$, $p<0.01$), and SF-36 physical functioning score ($r=0.38$, $p<0.002$).

Throughout the follow-up period, changes in ENMO were significantly correlated with changes in muscle strength (MMT8), physical function (HAQ), fatigue (SF-36 fatigue), and depression scores. All correlations were greater than 0.43 and statistically significant ($p<0.001$). The level of agreement between the ACR/EULAR response criteria and changes in PA was categorized as 15% for minimal improvement, 45% for moderate improvement, and 90% for major improvement, indicating that PA changes were closely tied to the extent of clinical improvement.

The study concluded that baseline PA levels and their changes over time were significantly related to muscle strength and function. Additionally, changes in PA were influenced by psychological factors. Notably, only those patients who showed major clinical improvements according to the ACR/EULAR criteria demonstrated significant increases in physical activity. This suggests that the use of accelerometers could provide a valuable, objective measure of real-life outcomes in patients with IIM and could enhance the assessment of interventions and clinical management in future studies and practices. [17]

Astley et al. performed the prospective, quasi-experimental study, and utilized a mixed-methods approach, combining both quantitative and qualitative data. It was conducted between July and December 2020, a period marked by strict COVID-19 lockdown measures in Brazil. The participants, aged between 10 and 19 years, were recruited from the Pediatric Rheumatology Unit of the Children's and Adolescents' Institute and the Juvenile Rheumatology Outpatient Clinic at the Clinical Hospital, University of São Paulo. Inclusion criteria required a definitive diagnosis of JDM according to the Bohan and Peter criteria, active treatment or follow-up at the aforementioned clinic, and the absence of cardiovascular involvement, undernourishment, chronic kidney disease, or chronic pulmonary disease. Additionally, all participants obtained medical clearance and had not engaged in any form of exercise for at least three months prior to and during the study.

The exercise program itself was structured into 12 weeks of aerobic and bodyweight exercises. Sessions occurred three times a week, with one supervised session conducted online and the remaining two sessions being unsupervised.

To facilitate adherence, patients were provided with instructional videos, photos, and gifs illustrating the exercise routines. Furthermore, they received immediate feedback from the trainer after completing each session. Supervision and monitoring were conducted via WhatsApp or Google Meets, depending on the patients' preferences. Progression in the exercise regimen was achieved every four weeks by increasing the number of sets, repetitions, and duration of the exercises. Patients' adherence to the program was rigorously tracked using training logs and direct feedback from supervised sessions.

Quantitative data were collected using validated tools: the Strengths and Difficulties Questionnaire (SDQ) to assess symptoms of mental health disorders, the Pediatric Quality of Life Inventory (PedsQOL) to measure health-related quality of life, and the Pittsburgh Sleep Quality Index (PSQI) to evaluate sleep quality. Additionally, the Manual Muscle Test (MMT), Childhood Muscle Assessment Scale (CMAS), and Disease Activity Score (DAS) were used to measure JDM-specific outcomes.

From an initial pool of 27 patients assessed for eligibility, 11 met the inclusion criteria and participated in the study. The majority of participants were female, with a mean age of 13.5 years. Adherence to the exercise protocol was 72.6%, including dropouts, and 80.9% excluding dropouts. Importantly, there were no adverse effects reported by the patients, and there were no partially completed training sessions. Quantitative results indicated no significant changes in the SDQ Total Difficulties Score (TDS), SDQ domains, PedsQOL domains, or PSQI scores after the intervention.

The qualitative aspect of the study revealed six key themes from the patients' and parents' comments. These included the suitability of the home-based format, appropriate trainer supervision, appropriateness of the exercises, online group sessions as a motivating factor, online group sessions as a barrier, and perceived health benefits. Feedback was collected at two time points: four weeks into the exercise program and after its completion. This feedback provided insight into what the participants liked about the program, what they did not like, suggestions for improvement, and perceived changes in their general health due to the exercise regimen.

The study concluded that the 12-week home-based exercise program was well-received and feasible for adolescents with JDM during the pandemic. Despite the lack of significant quantitative changes in mental health, quality of life, and sleep quality measures, the qualitative feedback highlighted several perceived benefits and provided valuable insights for future interventions. [18]

Elnaggar et al. conducted a randomized, single-blind, crossover pilot trial between July 2018 and November 2019 at Prince Sattam bin Abdulaziz University, the study involved 16 participants aged between 8 and 18 years. These participants were recruited from the Rheumatology Outpatient Clinic of four large children's hospitals in Riyadh, Saudi Arabia. Inclusion criteria required a confirmed diagnosis of JDM, a stable condition for at least three months before enrollment, and the ability to adhere to a 24-session treatment schedule divided into two periods with a one-month washout period.

The participants were randomized to receive either aqua-plyometric (Aqua-PLYO) exercises or standard of care (SoC) treatment in the first period, followed by the alternate treatment in the second period.

Each participant completed 12 treatment sessions in each period, ensuring a high adherence rate. Assessments of muscle strength, fatigue, functional ability, and disease activity were conducted before and after both treatment periods.

Results demonstrated significant improvements in muscle strength and functional ability, alongside reductions in fatigue levels and disease activity, following both Aqua-PLYO and SoC treatments. Specifically, muscle strength, measured through hip flexor and abductor strength, showed a greater increase after Aqua-PLYO treatment compared to SoC. The mean change in hip flexor strength in response to Aqua-PLYO was 6.77%, significantly higher than the 2.16% change observed with SoC. Similarly, hip abductor strength increased by 6.33% with Aqua-PLYO compared to a 1.91% increase with SoC. Knee flexor and extensor strengths also followed this trend, with Aqua-PLYO yielding significantly higher mean changes of 7.87% and 8.12%, respectively, compared to 1.56% and 3.54% with SoC.

The crossover analysis revealed that Aqua-PLYO was more effective than SoC in enhancing muscle strength without significant period or carryover effects. These findings suggest that Aqua-PLYO exercises can be a valuable component in the rehabilitation regimen for children with JDM, offering superior improvements in muscle strength and functional capacity compared to conventional treatments. Additionally, Aqua-PLYO exercises are noted to potentially enhance psychological well-being by increasing motivation, interest in exercise programs, and overall quality of life. [19]

Corrado et al. conducted a systematic review of RCTs to ascertain the impact of supervised exercise programs on these conditions.

The study employed the PICOS method to formulate its clinical query, focusing on patients with PM/DM undergoing physical exercise or supervised physiotherapy, compared to inactive control groups, and measuring outcomes such as improvements in muscular strength and quality of life. Eligible studies had to be in English, involve adult patients with PM/DM, and provide relevant data for evaluation. The review excluded non-RCTs and other non-peer-reviewed sources.

The search process involved a comprehensive review of databases including PubMed, Embase, Web of Science, and Cochrane Library, using specific search terms related to PM, DM, physical exercise, and physiotherapy. The initial search yielded 2591 articles, which were then screened for eligibility. Six RCTs met the inclusion criteria and were included in the final analysis. These studies investigated various supervised exercise programs focusing on muscle strengthening or aerobic work.

The results of the review demonstrated that supervised physical therapy led to significant improvements in several key areas. There was an increase in the maximum rate of oxygen consumption, indicating enhanced aerobic capacity. Additionally, there was a decrease in creatine phosphokinase levels, reflecting reduced muscle inflammation. Patients also showed improved aerobic performance and better quality of life scores. The exercise programs were generally well-tolerated, with no significant adverse effects reported.

The methodological quality of the included studies ranged from 3 to 4.5 on the modified Jadad scale, and all were classified as level 2b evidence according to the Oxford Centre for Evidence-Based Medicine Levels of Evidence guide. The main criticisms of the studies were related to the randomization methods and lack of double-blinding, which limited the strength of the evidence.

Despite these limitations, the review concluded that supervised physical therapy is a safe and effective treatment for PM/DM, capable of improving muscle strength, aerobic capacity, and quality of life without contraindications. [20]

Waghe et al. conducted a case study focusing on the management of DM with polyneuropathy using a combination of isotonic exercises. The subject of the study was a 23-year-old female who presented with a two-month history of thigh pain, bilateral weakness in both upper and lower limbs, and difficulty swallowing. She also exhibited a facial rash, joint stiffness, and reduced mobility. Clinical assessments revealed quadriparesis and motor axonal polyneuropathy, confirmed by a nerve conduction velocity (NCV) test.

The study's primary goal was to address the patient's muscle weakness and improve motor function using a targeted rehabilitation plan. The therapeutic intervention included proprioceptive neuromuscular facilitation (PNF), a physical therapy technique that incorporates isotonic exercises (concentric, eccentric, and isometric contractions). These exercises were designed to enhance dynamic trunk balance, muscle strength, and daily functional activities.

The patient followed a six-week regimen that involved PNF exercises for the upper, lower limbs, and trunk. Each session lasted 20 minutes per day, five days a week. Significant improvements were noted in muscle strength and functionality by the end of the treatment. Manual muscle testing showed notable gains, and outcome measures such as the Visual Analogue Scale (VAS) for pain and the Barthel Index for daily activity showed considerable improvement. The patient's quality of life improved from 50/100 to 80/100, and her dysphagia severity decreased.

This study concludes that the combination of isotonic exercises and PNF was effective in reducing muscle weakness, improving motor function, and enhancing the overall quality of life for the patient with DM and polyneuropathy. The approach could be beneficial for similar cases, emphasizing the role of physiotherapy in managing neuromuscular disorders.[21]

Summary

The evidence presented in this review highlights the significant and multifaceted benefits of physical exercise for patients with DM. The studies collectively demonstrate that structured exercise programs can improve muscle strength, aerobic capacity, and overall physical function in DM patients, without exacerbating disease activity. The findings underscore the safety and efficacy of both land-based and aquatic-based exercise interventions across various patient populations, including children and adults.

Importantly, the review identifies a gap in the existing literature regarding the long-term effects of exercise interventions and the need for larger, more diverse study cohorts. The heterogeneity of the trials and the small sample sizes limit the generalizability of the findings, emphasizing the necessity for more robust and well-designed studies. Additionally, while the studies reviewed confirm the immediate benefits of exercise, ongoing research should explore the sustained impact of regular physical activity on disease progression and quality of life in DM patients.

Disclosure
Conceptualization, KC, and MK; methodology, KC; software, KK; check, MK, KK and JL; formal analysis, JL; investigation, MK; resources, KK; data curation, JL; writing - rough preparation, KC, JL, MK; writing - review and editing, KK, MK; visualization, MK, KC, MK, KK, JL; supervision, KC; project administration, KC; receiving funding, MK
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Conflicts of Interest
The authors declare no conflicts of interest.

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