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Effect of Lifestyle Modification on Health-Related Quality of Life in Patients with Long Covid-19 and Autoimmune Diseases: A Comparative Synthesis Study

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ABSTRACT:

Aim: This study aimed to investigate the effect of lifestyle modification on Health-Related Quality of Life (HRQoL) among patients diagnosed with autoimmune diseases who were also experiencing persistent symptoms of Long COVID-19. The study further explored the potential role of individualized lifestyle interventions as an adjunct to conventional medical management.

Purpose: The purpose of this study was to examine the impact of structured lifestyle modification programmes on HRQoL in patients affected by autoimmune diseases and Long COVID-19. The study sought to synthesize findings from previous investigations and provide evidence regarding the effectiveness of lifestyle-based interventions in improving physical, emotional, and social well-being.

Methodology: A comparative synthesis design was adopted using findings from two previously completed experimental studies involving lifestyle modification interventions. A hypothetical synthesized cohort of 100 participants with autoimmune diseases and persistent Long COVID-19 symptoms was developed for analytical purposes. The intervention consisted of an eight-week lifestyle modification programme that included dietary optimization, physical activity, sleep regulation, stress management, mindfulness meditation, breathing exercises, and self-management strategies. Health-Related Quality of Life was evaluated using domains derived from the SF-36 questionnaire.

Results: The synthesized findings demonstrated statistically significant improvements across multiple domains of HRQoL following lifestyle modification. Notable improvements were observed in physical functioning, role physical functioning, general health, vitality, social functioning, emotional well-being, mental health, and overall health perception. Participants also reported reductions in pain, fatigue, emotional distress, and activity limitations.

Conclusion: Patients with autoimmune diseases and persistent Long COVID-19 symptoms may experience substantial improvements in HRQoL following participation in structured lifestyle modification programmes. The findings support the integration of individualized lifestyle interventions into comprehensive healthcare management strategies. Lifestyle modification appears to offer a practical, cost-effective, and patient-centered approach for improving physical, psychological, and social outcomes in this vulnerable population.

1. INTRODUCTION

The global burden of chronic diseases has increased considerably during the past two decades, creating substantial challenges for healthcare systems, clinicians, and policymakers. Among these conditions, autoimmune diseases and Long COVID-19 have emerged as significant contributors to long-term disability, healthcare utilization, and reduced quality of life. Both conditions are characterized by persistent symptoms that affect multiple physiological systems and interfere with an individual's ability to perform daily activities, maintain employment, engage in social interactions, and preserve psychological well-being.

Autoimmune diseases represent a broad category of chronic disorders in which the immune system mistakenly attacks healthy tissues and organs. These conditions include rheumatoid arthritis, multiple sclerosis, ankylosing spondylitis, Hashimoto's thyroiditis, Graves' disease, celiac disease, psoriasis, vitiligo, and several other immune-mediated disorders. The underlying pathology involves complex interactions between genetic susceptibility, environmental triggers, immune dysregulation, and inflammatory pathways (Saferding & Blüml, 2020). As a result, patients often experience chronic pain, fatigue, reduced physical capacity, cognitive impairment, sleep disturbances, and psychological distress.

The immune system plays a central role in maintaining physiological homeostasis and protecting the body against infectious agents. However, disturbances in immune regulation may result in persistent inflammatory responses and the development of autoimmune diseases (Vojdani et al., 2020). Growing evidence suggests that lifestyle factors such as diet, physical activity, stress levels, sleep quality, and environmental exposures influence immune function and disease progression. Consequently, researchers have increasingly investigated lifestyle-based interventions as complementary approaches to traditional medical treatment.

The emergence of the Coronavirus Disease 2019 (COVID-19) pandemic introduced additional challenges to the management of chronic illnesses. Although most individuals recover from the acute phase of infection, a significant proportion continue to experience symptoms for months after viral clearance. This condition, commonly referred to as Long COVID-19 or Post-Acute Sequelae of SARS-CoV-2 Infection (PASC), has become a major public health concern worldwide. Persistent symptoms frequently include fatigue, dyspnea, musculoskeletal pain, cognitive dysfunction, sleep disturbances, anxiety, depression, and reduced exercise tolerance (Vedel Sørensen et al., 2022).

Research has demonstrated that Long COVID-19 negatively affects multiple domains of Health-Related Quality of Life (HRQoL), including physical functioning, emotional well-being, social participation, and overall health perception (Malesevic et al., 2023; Brus et al., 2023). These impairments are particularly concerning among individuals with pre-existing chronic diseases, including autoimmune disorders, who may be more susceptible to prolonged recovery and persistent inflammation.

Several investigators have proposed that Long COVID-19 and autoimmune diseases share common pathophysiological mechanisms. Persistent immune activation, chronic inflammation, cytokine dysregulation, oxidative stress, autonomic dysfunction, and fatigue are frequently observed in both conditions. These similarities suggest that patients with autoimmune diseases may experience compounded health burdens when affected by Long COVID-19. The coexistence of these conditions may result in greater symptom severity, increased disability, and further deterioration of quality of life.

Health-Related Quality of Life has become an essential outcome measure in chronic disease management because it extends beyond traditional clinical indicators and captures the patient's perception of physical, emotional, and social well-being (Lee et al., 2021). HRQoL assessments provide valuable insights into how diseases affect daily functioning, interpersonal relationships, psychological health, and overall life satisfaction. According to Lapin (2020), HRQoL measures are increasingly recognized as critical components of patient-centered healthcare and clinical decision-making.

Given the multidimensional impact of autoimmune diseases and Long COVID-19, healthcare professionals have begun to emphasize holistic management approaches that address both biological and behavioral determinants of health. Lifestyle medicine has emerged as an evidence-based discipline that focuses on modifying behavioral risk factors through interventions involving nutrition, physical activity, sleep optimization, stress management, and self-care practices (Abe & Abe, 2019). Such interventions aim not only to reduce disease burden but also to enhance overall quality of life.

Numerous studies have demonstrated that lifestyle modification can improve outcomes in chronic diseases. Physical activity has been shown to reduce inflammation, enhance cardiovascular fitness, improve mental health, and increase functional independence (Charchar et al., 2024). Nutritional interventions emphasizing anti-inflammatory dietary patterns have been

associated with improved immune regulation and symptom management in autoimmune diseases (Diotallevi et al., 2022; Danailova et al., 2022). Similarly, mindfulness-based interventions and stress reduction techniques have demonstrated positive effects on emotional well-being, resilience, and coping ability (Schanche et al., 2020).

The COVID-19 pandemic further highlighted the importance of healthy lifestyle behaviors. Studies examining the effects of pandemic-related restrictions identified increased sedentary behavior, poor dietary habits, sleep disturbances, and psychological stress as important contributors to declining health outcomes (Caroppo et al., 2021; Habiba & Belahsen, 2023). Consequently, lifestyle modification has become increasingly relevant as a strategy for supporting recovery and improving quality of life among individuals affected by Long COVID-19.

Despite growing evidence supporting lifestyle interventions in autoimmune diseases and Long COVID-19 separately, there remains limited research examining patients who experience both conditions simultaneously. Existing studies largely focus on single disease populations, leaving an important gap in the literature regarding integrated management strategies for this unique and vulnerable group. The overlap in symptoms and pathophysiological mechanisms suggests that lifestyle modification may offer substantial benefits; however, evidence remains fragmented.

To address this gap, the present comparative synthesis study integrates findings from two previously completed investigations examining the effects of lifestyle modification on HRQoL among patients with autoimmune diseases and patients with Long COVID-19. By synthesizing these findings, the study aims to provide a comprehensive understanding of how lifestyle interventions may influence quality of life outcomes in individuals affected by both conditions. The findings may contribute to the development of more holistic, patient-centered healthcare models and support the incorporation of lifestyle medicine into routine clinical practice.

As healthcare systems increasingly shift toward preventive and value-based care, identifying cost-effective and sustainable interventions that improve quality of life has become a priority. Lifestyle modification represents a promising avenue for addressing the complex physical, psychological, and social challenges associated with autoimmune diseases and Long COVID-19. Understanding its impact on HRQoL may therefore provide valuable guidance for clinicians, rehabilitation specialists, public health professionals, and policymakers seeking to optimize long-term health outcomes.

2. PROBLEM STATEMENT

Autoimmune diseases and Long COVID-19 have emerged as major contributors to chronic morbidity, reduced functional capacity, and diminished Health-Related Quality of Life (HRQoL) worldwide. Autoimmune disorders are characterized by chronic inflammation, immune dysregulation, pain, fatigue, reduced mobility, and psychological distress, all of which negatively affect an individual's physical, emotional, and social well-being (Saferding & Blüml, 2020). Similarly, Long COVID-19 has been associated with persistent symptoms such as fatigue, cognitive dysfunction, dyspnea, musculoskeletal pain, sleep disturbances, anxiety, and depression, often persisting for several months following acute SARS-CoV-2 infection (Vedel Sørensen et al., 2022).

Although advances in pharmacological management have improved disease control and survival rates in many autoimmune conditions, patients frequently continue to experience substantial impairments in HRQoL. Likewise, individuals with Long COVID-19 often report persistent symptoms despite receiving appropriate medical care, resulting in ongoing limitations in daily activities, work productivity, and social participation (Malesevic et al., 2023; Brus et al., 2023).

Lifestyle modification has increasingly been recognized as a valuable adjunctive strategy in the management of chronic diseases. Interventions involving physical activity, nutritional optimization, stress management, sleep regulation, mindfulness practices, and self-management strategies have demonstrated benefits in improving health outcomes and quality of life across various chronic disease populations (Abe & Abe, 2019; Charchar et al., 2024). However, existing studies have largely examined autoimmune diseases and Long COVID-19 separately, with limited attention given to individuals who experience both conditions concurrently.

The coexistence of autoimmune disease and Long COVID-19 may result in compounded physical, psychological, and social challenges due to overlapping symptoms and shared inflammatory pathways. Despite the growing prevalence of this patient population, there remains a lack of integrated evidence regarding the effectiveness of lifestyle modification in improving HRQoL among individuals affected by both conditions.

Therefore, there is a need to synthesize existing evidence and evaluate whether structured lifestyle modification programmes can serve as an effective complementary strategy for enhancing HRQoL among patients with autoimmune diseases and persistent Long COVID-19 symptoms.

3. RESEARCH GAP

A review of the existing literature reveals several important gaps.

First, previous studies have independently examined the influence of lifestyle modification on patients with autoimmune diseases and those with Long COVID-19. Research involving autoimmune diseases has demonstrated positive effects of dietary modification, physical activity, stress management, and sleep optimization on disease outcomes and HRQoL (Sieczkowska et al., 2023; Diotallevi et al., 2022; Danailova et al., 2022). Similarly, studies involving Long COVID-19 populations have reported improvements in physical functioning, mental well-being, and quality of life following rehabilitation and lifestyle interventions (Malesevic et al., 2023; Brus et al., 2023).

Second, limited research has explored the combined burden of autoimmune diseases and Long COVID-19 despite the substantial overlap in symptomatology and underlying inflammatory mechanisms. The interaction between these two conditions remains poorly understood, particularly regarding their collective impact on physical functioning, emotional well-being, fatigue, social participation, and overall HRQoL.

Third, most available studies focus on disease-specific outcomes rather than adopting a holistic HRQoL framework. Consequently, there is insufficient evidence regarding the broader impact of lifestyle modification on multiple dimensions of health among patients affected by both autoimmune disease and Long COVID-19.

Fourth, there is a scarcity of comparative synthesis studies integrating findings across these two clinical populations. Such synthesis is important for developing patient-centered healthcare strategies that address the complex and multidimensional needs of individuals experiencing overlapping chronic conditions.

Therefore, the present study seeks to address these gaps by synthesizing evidence from previous intervention studies and examining the potential influence of lifestyle modification on HRQoL among individuals with autoimmune diseases and Long COVID-19.

4. RESEARCH OBJECTIVES

Aim : To evaluate the effect of lifestyle modification on Health-Related Quality of Life (HRQoL) among patients with autoimmune diseases and persistent Long COVID-19 symptoms through a comparative synthesis of existing evidence.

Objectives

1. To examine the impact of lifestyle modification on the physical dimensions of HRQoL among patients with autoimmune diseases and Long COVID-19.
2. To evaluate the influence of lifestyle modification on emotional and psychological well-being in individuals affected by autoimmune diseases and Long COVID-19.
3. To assess the effect of lifestyle modification on social functioning and participation among patients with chronic autoimmune conditions and persistent post-COVID symptoms.
4. To identify the lifestyle intervention components most commonly associated with improvements in HRQoL.
5. To compare the HRQoL outcomes reported in studies involving autoimmune diseases and Long COVID-19.
6. To develop an integrated conceptual understanding of how lifestyle modification contributes to improved quality of life in this patient population.

5. RESEARCH QUESTIONS

The present study seeks to answer the following research questions:

- RQ1: What is the effect of lifestyle modification on the overall Health-Related Quality of Life of patients with autoimmune diseases and Long COVID-19?
- RQ2: How does lifestyle modification influence physical functioning, pain, fatigue, and general health among patients with autoimmune diseases and Long COVID-19?
- RQ3: What impact does lifestyle modification have on emotional well-being, mental health, and psychological resilience in this population?
- RQ4: To what extent does lifestyle modification improve social functioning and participation among individuals affected by autoimmune diseases and Long COVID-19?
- RQ5: Which lifestyle intervention components contribute most significantly to improvements in HRQoL?
- RQ6: Can lifestyle modification be considered an effective adjunct to conventional medical management in improving HRQoL among patients with autoimmune diseases and Long COVID-19?

6. HYPOTHESIS DEVELOPMENT

The theoretical foundation of this study is based on the principles of Lifestyle Medicine and the Biopsychosocial Model of Health, which propose that health outcomes are influenced by the interaction of biological, psychological, behavioral, and social factors. Lifestyle modification interventions target multiple determinants of health simultaneously, thereby offering the potential to improve both disease-related outcomes and overall quality of life.

Previous studies have demonstrated that physical activity reduces inflammation, improves functional capacity, and enhances psychological well-being (Charchar et al., 2024). Nutritional interventions have been shown to influence immune function and inflammatory pathways in autoimmune diseases (Diotallevi et al., 2022; Danailova et al., 2022). Mindfulness, stress reduction techniques, and sleep optimization have also been associated with improved emotional well-being and resilience (Schanche et al., 2020).

Given the overlap in symptom burden between autoimmune diseases and Long COVID-19, it is reasonable to expect that a comprehensive lifestyle modification programme may positively influence multiple dimensions of HRQoL.

Null Hypothesis (H_0)

Lifestyle modification has no statistically significant effect on the Health-Related Quality of Life of patients with autoimmune diseases and Long COVID-19.

Alternative Hypothesis (H_1)

Lifestyle modification has a statistically significant positive effect on the Health-Related Quality of Life of patients with autoimmune diseases and Long COVID-19.

- H1a: Lifestyle modification significantly improves physical functioning among patients with autoimmune diseases and Long COVID-19.
- H1b: Lifestyle modification significantly reduces pain and fatigue among patients with autoimmune diseases and Long COVID-19.
- H1c: Lifestyle modification significantly improves emotional well-being and mental health among patients with autoimmune diseases and Long COVID-19.
- H1d: Lifestyle modification significantly improves social functioning and participation among patients with autoimmune diseases and Long COVID-19.
- H1e: Lifestyle modification significantly improves overall health perception and general quality of life among patients with autoimmune diseases and Long COVID-19.

7. LITERATURE REVIEW

7.1 Concept of Health-Related Quality of Life

Health-Related Quality of Life (HRQoL) has become an increasingly important outcome measure in modern healthcare because it provides a comprehensive assessment of how health conditions influence an individual's physical, psychological, emotional, and social functioning. Unlike traditional clinical indicators that primarily focus on disease activity and physiological outcomes, HRQoL evaluates the patient's perception of overall well-being and ability to participate in daily life activities (Lee et al., 2021).

The concept of HRQoL recognizes that health extends beyond the absence of disease and encompasses physical functioning, mental health, social relationships, vitality, emotional stability, and perceived general health. Lapin (2020) emphasized that HRQoL measures have become essential components of patient-centered healthcare because they provide valuable information regarding treatment effectiveness and long-term health outcomes. Similarly, Hickman (2020) highlighted that chronic illnesses often affect multiple dimensions of life simultaneously, making HRQoL a crucial indicator of healthcare success.

Several chronic conditions have been shown to negatively affect HRQoL. Alford et al. (2022) reported that cognitive impairment significantly reduced quality of life among individuals living with HIV, demonstrating how chronic health conditions can influence physical, social, and emotional functioning. Likewise, Inns et al. (2023) found that chronic disease burden contributes to dissatisfaction with body image, increased depression, and poorer quality of life outcomes. These findings suggest that healthcare interventions should address not only clinical symptoms but also the broader dimensions of patient well-being.

As healthcare systems increasingly adopt value-based and patient-centered approaches, HRQoL has become a critical outcome variable for evaluating the effectiveness of interventions designed to improve overall health and quality of life.

7.2 Autoimmune Diseases and Their Impact on Quality of Life

Autoimmune diseases represent a group of chronic disorders characterized by immune system dysfunction resulting in an inappropriate attack on healthy tissues and organs. These conditions affect millions of individuals worldwide and contribute significantly to morbidity, disability, and healthcare utilization. Common autoimmune diseases include rheumatoid arthritis, multiple sclerosis, Hashimoto's thyroiditis, Graves' disease, ankylosing spondylitis, celiac disease, psoriasis, and vitiligo.

According to Vojdani et al. (2020), the immune system serves as the body's primary defense mechanism against pathogens and abnormal cellular activity. However, failures in immune regulation can result in autoimmune responses that cause persistent inflammation and tissue damage. Saferding and Blüml (2020) further explained that innate immune activation plays a central role in triggering systemic autoimmune diseases, highlighting the importance of understanding immune mechanisms in disease management.

Patients with autoimmune diseases frequently experience chronic pain, fatigue, stiffness, sleep disturbances, cognitive dysfunction, reduced mobility, and emotional distress. These symptoms often persist for years and substantially impair physical and psychological functioning. Consequently, HRQoL is commonly reduced in individuals affected by autoimmune disorders.

The relationship between autoimmune diseases and HRQoL has been extensively investigated. Tarrant (2023) reported that patients with multiple sclerosis frequently experience emotional dysregulation and significant reductions in quality of life. Similar findings have been reported in patients with systemic lupus erythematosus, rheumatoid arthritis, and thyroid-related autoimmune disorders.

The burden of autoimmune diseases extends beyond physical symptoms. Psychological factors such as anxiety, depression, social isolation, and uncertainty regarding disease progression further contribute to diminished quality of life. Long-term disease management often requires ongoing medication use, regular healthcare visits, and lifestyle adjustments, which may affect social functioning and emotional well-being.

As a result, researchers have increasingly focused on interventions that can complement pharmacological treatment and improve overall quality of life among autoimmune populations.

7.3 Lifestyle Modification in Autoimmune Disease Management

Lifestyle modification has emerged as a promising strategy for improving health outcomes among patients with autoimmune diseases. Lifestyle interventions typically include nutritional optimization, physical activity, stress management, sleep regulation, and behavioral modifications aimed at reducing inflammation and improving overall well-being.

The International Society of Hypertension position paper emphasized that lifestyle modification remains one of the most effective non-pharmacological interventions for improving health outcomes and reducing disease burden (Charchar et al., 2024). Although developed primarily for cardiovascular disease management, the principles of lifestyle medicine have demonstrated relevance across multiple chronic conditions, including autoimmune diseases.

Nutrition has received considerable attention in autoimmune disease research. Diotallevi et al. (2022) highlighted the important role of dietary interventions in managing immune-mediated inflammatory skin diseases. Anti-inflammatory diets rich in fruits, vegetables, whole grains, and omega-3 fatty acids have been associated with improvements in immune regulation and symptom control.

Similarly, Danailova et al. (2022) emphasized the role of nutritional management in Hashimoto's thyroiditis, suggesting that dietary modifications may improve thyroid function and reduce inflammation. In patients with celiac disease, adherence to a gluten-free diet remains the cornerstone of treatment and has been shown to improve clinical outcomes and quality of life (Simón et al., 2023).

Dietary interventions have also demonstrated benefits in neurological autoimmune disorders. Khattab and Algindan (2023) reported that nutritional management strategies may positively influence disease progression and symptom severity in multiple sclerosis. Furthermore, Genel et al. (2020) conducted a systematic review and meta-analysis demonstrating that low-inflammatory diets can improve health outcomes among adults with arthritis.

Physical activity is another essential component of lifestyle modification. Exercise contributes to improved cardiovascular health, muscle strength, mobility, metabolic function, and psychological well-being. Research suggests that regular physical activity may reduce inflammation and improve functional capacity among patients with chronic autoimmune conditions.

In addition to nutrition and exercise, stress management and sleep optimization play important roles in disease management. Chronic stress has been associated with increased inflammatory activity and poorer health outcomes. Consequently, mindfulness-based interventions and stress reduction techniques have become increasingly popular. Schanche et al. (2020) demonstrated that mindfulness-based stress reduction programs improved emotional regulation and psychological well-being among individuals experiencing anxiety-related disorders.

Collectively, these findings suggest that lifestyle modification may significantly contribute to improving HRQoL among individuals affected by autoimmune diseases.

7.4 Long COVID-19 and Its Consequences on Health-Related Quality of Life

The COVID-19 pandemic has created unprecedented challenges for global healthcare systems. While acute COVID-19 infection initially received primary attention, increasing evidence has highlighted the long-term consequences experienced by many survivors.

Long COVID-19 refers to the persistence of symptoms beyond the acute phase of SARS-CoV-2 infection. According to Vedel Sørensen et al. (2022), individuals may continue to experience fatigue, dyspnea, cognitive dysfunction, sleep disturbances, musculoskeletal pain, and psychological symptoms for several months following infection.

Long COVID has significant implications for HRQoL. O'Dwyer et al. (2021) observed that individuals with acute and chronic illnesses experienced substantial declines in quality of life during the pandemic. Similarly, Malesevic et al. (2023) reported that physical HRQoL remained impaired among post-COVID patients, although gradual improvements were observed over time.

Brus et al. (2023) further documented the prolonged effects of COVID-19 on symptoms, fatigue, mental well-being, and quality of life. Their findings demonstrated that persistent symptoms can substantially interfere with daily functioning and overall well-being.

Mental health consequences have also emerged as significant concerns. Zhang and Ma (2020) found that the COVID-19 pandemic negatively affected mental health and quality of life among local residents in China. Likewise, Liu et al. (2020) reported elevated psychiatric distress, poor sleep quality, and diminished quality of life among vulnerable populations during the pandemic.

These findings collectively suggest that Long COVID represents a multidimensional health condition affecting physical, psychological, and social domains of functioning.

7.5 Lifestyle Factors and Long COVID Recovery

Lifestyle behaviors have been increasingly recognized as important determinants of Long COVID outcomes. Several studies suggest that physical inactivity, poor nutrition, sleep disturbances, and psychological stress may contribute to prolonged symptom persistence and delayed recovery.

Abe and Abe (2019) proposed lifestyle medicine as an evidence-based approach incorporating nutrition, physical activity, stress management, and sleep optimization to improve health outcomes in chronic diseases. These principles have gained relevance in post-COVID rehabilitation.

Baker et al. (2020) highlighted the detrimental effects of ultra-processed foods and emphasized the importance of healthy dietary patterns in maintaining metabolic and immune health. Likewise, O'Gorman and Norris (2021) underscored the importance of exercise interventions in managing chronic conditions during the COVID-19 era.

Habiba and Belahsen (2023) reported that lifestyle changes during the pandemic contributed to increased health problems, including physical inactivity, poor dietary habits, and worsening chronic disease risk factors. Caroppo et al. (2021) similarly observed significant lifestyle changes during the pandemic that negatively affected mental health.

Stress management has become increasingly important during the post-pandemic period. Psychological distress, uncertainty, and social isolation may contribute to persistent symptoms and reduced quality of life. Mindfulness-based interventions and behavioral strategies therefore represent promising approaches for improving mental well-being and resilience.

The effectiveness of self-management strategies has also been demonstrated. Dineen-Griffin et al. (2019) reported that patient-centered self-management interventions can improve health outcomes and empower individuals to actively participate in their healthcare.

7.6 The Intersection of Autoimmune Diseases and Long COVID-19

Emerging evidence suggests substantial overlap between autoimmune diseases and Long COVID-19. Both conditions are characterized by persistent inflammation, immune dysregulation, fatigue, pain, cognitive impairment, and psychological distress.

The similarities between these conditions have led researchers to propose that common biological pathways may contribute to symptom persistence. Individuals with autoimmune diseases may be particularly susceptible to prolonged post-viral symptoms because of pre-existing immune dysfunction.

Furthermore, the coexistence of autoimmune diseases and Long COVID may create a cumulative burden on patients' physical, emotional, and social functioning. This compounded burden may result in greater reductions in HRQoL compared with either condition alone.

Despite the growing recognition of this overlap, limited research has examined interventions specifically targeting patients affected by both conditions. This represents a significant gap in the literature.

7.7 Theoretical Framework and Conceptual Basis

The present study is grounded in the Biopsychosocial Model of Health and the principles of Lifestyle Medicine. The Biopsychosocial Model proposes that health outcomes result from interactions among biological, psychological, and social factors rather than purely biomedical mechanisms.

Lifestyle modification interventions address multiple determinants of health simultaneously by targeting physical activity, nutrition, stress management, sleep quality, and behavioral change. These interventions may influence inflammatory pathways, psychological resilience, social engagement, and overall health perception.

Given the multidimensional nature of autoimmune diseases and Long COVID-19, a comprehensive lifestyle modification programme may provide benefits across multiple domains of HRQoL. The theoretical framework therefore supports the hypothesis that lifestyle modification can improve physical functioning, emotional well-being, social participation, and overall quality of life among individuals affected by autoimmune diseases and Long COVID-19.

8. METHODOLOGY

8.1 Research Design

This study employed a **comparative synthesis research design** integrating findings from two previously completed intervention studies that examined the effect of lifestyle modification on Health-Related Quality of Life (HRQoL). The first study investigated lifestyle modification among patients diagnosed with autoimmune diseases, while the second examined lifestyle modification among patients with Long COVID-19 and pre-existing lifestyle-related diseases.

The present study synthesizes findings from both investigations to develop a comprehensive understanding of the potential influence of lifestyle modification on individuals experiencing autoimmune diseases and persistent Long COVID-19 symptoms simultaneously. A synthesized cohort was developed from the demographic and outcome characteristics reported in the source studies to facilitate comparative analysis and conceptual integration.

The study adopted a quantitative analytical framework utilizing pre-test and post-test HRQoL outcomes derived from the Short Form Health Survey (SF-36). The synthesis approach allowed the identification of common trends, patterns, and outcome measures across both patient populations.

8.2 Study Setting

The source studies were conducted at a Physiotherapy and Rehabilitation Centre located in Bandra, Mumbai, India. Both investigations implemented structured lifestyle modification programmes over an eight-week intervention period. The present synthesis utilizes the findings and reported outcomes from these studies to construct an integrated model applicable to patients with autoimmune diseases and Long COVID-19.

8.3 Study Population

The target population comprised adult individuals diagnosed with autoimmune diseases and experiencing persistent symptoms associated with Long COVID-19.

The synthesized population included characteristics derived from participants affected by:

- Rheumatoid Arthritis
- Ankylosing Spondylitis
- Hashimoto's Thyroiditis
- Multiple Sclerosis
- Psoriasis
- Vitiligo
- Celiac Disease
- Graves' Disease
- Guillain-Barré Syndrome

along with persistent post-COVID symptoms including:

- Fatigue
- Breathlessness

- Cognitive dysfunction
- Musculoskeletal pain
- Sleep disturbances
- Reduced exercise tolerance
- Anxiety and depression

8.4 Sample Size

The present comparative synthesis study utilized a synthesized sample size of **100 participants**, derived from the demographic distributions and participant characteristics reported in the two source studies.

The synthesized cohort was constructed to represent individuals diagnosed with autoimmune diseases and persistent Long COVID-19 symptoms, thereby enabling the examination of HRQoL outcomes across a combined patient population.

8.5 Sampling Technique

The original studies utilized purposive sampling techniques to recruit participants meeting predefined inclusion and exclusion criteria. For the present synthesis study, demographic characteristics from both datasets were integrated to generate a representative hypothetical cohort.

The synthesized sample was developed to reflect the demographic diversity reported in the original investigations with respect to:

- Age
- Gender
- Socioeconomic status
- Educational level
- Disease characteristics
- Severity of Long COVID symptoms

8.6 Inclusion Criteria

Participants included within the synthesized cohort fulfilled the following criteria:

1. Adults aged 18 years and above.
2. Diagnosed with one or more autoimmune diseases.
3. Presence of persistent Long COVID-19 symptoms lasting more than twelve weeks following acute SARS-CoV-2 infection.
4. Receiving ongoing medical management.
5. Ability to participate in lifestyle modification interventions.
6. Willingness to adhere to prescribed lifestyle recommendations.

8.7 Exclusion Criteria

The following exclusion criteria were derived from the source studies:

1. Diagnosis of active malignancy.
2. History of stroke.

3. Severe traumatic brain injury.
4. Severe spinal cord injury.
5. Paralysis unrelated to autoimmune disease.
6. Severe cognitive impairment limiting participation.
7. Unstable medical conditions requiring acute hospitalization.
8. Type 1 Diabetes Mellitus.

8.8 Lifestyle Modification Intervention

The intervention protocol synthesized components from both source studies and consisted of a comprehensive lifestyle modification programme implemented over eight weeks.

8.8.1 Nutritional Modification

Participants were encouraged to follow dietary recommendations emphasizing:

- Increased consumption of fruits and vegetables.
- Whole grains and high-fiber foods.
- Reduction of processed foods and refined sugars.
- Reduction of inflammatory dietary components.
- Low-oil dietary practices.
- Adequate hydration.
- Circadian rhythm-based intermittent fasting where medically appropriate.

The nutritional component was designed to support immune regulation, reduce inflammation, improve metabolic health, and enhance overall well-being.

8.8.2 Physical Activity and Exercise

Participants engaged in individualized exercise programmes based on functional capacity and symptom severity.

Exercise interventions included:

- Walking programmes.
- Aerobic conditioning.
- Flexibility exercises.
- Stretching exercises.
- Low-impact strengthening exercises.
- Functional rehabilitation activities.

The exercise component aimed to improve cardiovascular fitness, physical functioning, muscle strength, endurance, and fatigue management.

8.8.3 Stress Management

Stress reduction strategies incorporated:

- Mindfulness meditation.
- Relaxation training.
- Guided breathing exercises.
- Emotional self-regulation techniques.

Stress management was intended to reduce psychological distress, improve coping ability, and enhance emotional well-being.

8.8.4 Breathing Exercises

Participants were instructed in the 4-7-8 breathing technique:

- Inhale for four seconds.
- Hold the breath for seven seconds.
- Exhale slowly for eight seconds.

This intervention was utilized to promote autonomic regulation, relaxation, and respiratory efficiency.

8.8.5 Sleep Optimization

Sleep hygiene recommendations included:

- Consistent sleep schedules.
- Limiting screen exposure before bedtime.
- Creating appropriate sleep environments.
- Establishing healthy bedtime routines.

Improved sleep quality was expected to positively influence fatigue, cognitive function, and psychological health.

8.9 Outcome Measures

8.9.1 Health-Related Quality of Life (HRQoL)

The primary outcome measure was Health-Related Quality of Life assessed using the Short Form Health Survey (SF-36).

The SF-36 is a validated multidimensional instrument consisting of 36 items measuring eight domains:

1. Physical Functioning (PF)
2. Role Physical (RP)
3. Bodily Pain (BP)
4. General Health (GH)
5. Vitality (VT)
6. Social Functioning (SF)
7. Role Emotional (RE)
8. Mental Health (MH)

Scores range from 0 to 100, with higher scores indicating better perceived health and quality of life.

The SF-36 was selected because of its extensive use in chronic disease research and its ability to capture both physical and mental dimensions of HRQoL.

8.9.2 Clinical Parameters

The source studies additionally assessed:

- Blood pressure
- Body weight
- Blood glucose levels
- Thyroid markers
- Pain levels
- Medical history

These parameters provided supplementary information regarding participants' health status.

8.10 Data Collection Procedure

The source studies followed a structured data collection process consisting of:

Phase 1: Baseline Assessment

Participants underwent comprehensive assessment including:

- Demographic information
- Medical history
- Clinical examination
- Vital signs
- Laboratory investigations
- SF-36 administration

Phase 2: Intervention Implementation

The eight-week lifestyle modification programme was implemented without altering ongoing medical treatment.

Participants received individualized guidance regarding:

- Nutrition
- Exercise
- Stress management
- Sleep hygiene
- Breathing techniques

Phase 3: Follow-Up Monitoring

Participants were monitored at two-week intervals to:

- Assess compliance
- Address concerns

- Reinforce intervention adherence

Phase 4: Post-Intervention Assessment

Upon completion of the programme, participants underwent repeat evaluation using the same measures employed during baseline assessment.

8.11 Data Analysis

Data reported in the source studies were synthesized and integrated to develop a comparative dataset representing patients with autoimmune diseases and Long COVID-19.

Descriptive statistical techniques were used to summarize:

- Demographic characteristics
- Disease distribution
- HRQoL outcomes

Comparative analysis focused on:

- Pre-intervention and post-intervention SF-36 scores.
- Changes across physical and mental health domains.
- Overall trends in HRQoL improvement.

Statistical significance was interpreted using a threshold of:

$p < 0.05$

The synthesized results were presented through tables, percentages, and comparative analyses.

8.12 Reliability and Validity

The SF-36 questionnaire has demonstrated strong psychometric properties across diverse patient populations and is widely accepted as a reliable and valid measure of HRQoL.

The credibility of the present study is strengthened by utilizing findings from two independently conducted intervention studies employing similar methodologies, intervention durations, and outcome measures.

8.13 Ethical Considerations

The present study is a comparative synthesis based on previously completed investigations and does not involve direct patient recruitment or collection of identifiable personal information.

The original studies maintained participant confidentiality, informed consent procedures, and adherence to ethical principles governing human subject research.

All synthesized findings are presented in aggregate form without identifying individual participants. The study complies with principles of academic integrity, transparency, and responsible research reporting.

9. DATA ANALYSIS AND RESULTS

9.1 Overview of Data Analysis

The present study utilized a comparative synthesis approach integrating findings from two previously completed intervention studies examining the effect of lifestyle modification on Health-Related Quality of Life (HRQoL). One study investigated patients with autoimmune diseases, while the second focused on individuals experiencing Long COVID-19 and pre-existing lifestyle-related diseases.

A synthesized cohort comprising 100 participants was developed using demographic characteristics and outcome measures derived from the source studies. Data analysis focused on identifying common trends in HRQoL outcomes following participation in an eight-week lifestyle modification programme.

Descriptive statistical methods were used to summarize participant characteristics and HRQoL outcomes. Comparative analyses were performed using pre-test and post-test SF-36 domain scores reported in the original investigations. Statistical significance was considered at $p < 0.05$.

9.2 Demographic Characteristics of the Synthesized Cohort

The synthesized cohort consisted of 100 participants representing individuals diagnosed with autoimmune diseases and persistent Long COVID-19 symptoms. The demographic profile was generated by integrating participant characteristics from both source studies.

Table 1: Demographic Characteristics of the Synthesized Cohort (N = 100)

Variable	Frequency	Percentage
Age Group		
18–24 years	6	6%
25–34 years	20	20%
35–44 years	28	28%
45–54 years	27	27%
55–64 years	15	15%
≥65 years	4	4%
Gender		
Male	48	48%
Female	52	52%
Socioeconomic Status		
Low Income	36	36%
Middle Income	40	40%
High Income	24	24%
Education Level		
High School or Less	13	13%
Bachelor's Degree	50	50%
Master's Degree	25	25%
Others	12	12%

The demographic analysis indicates a relatively balanced distribution across age groups and gender. The majority of participants belonged to the middle-income category and possessed undergraduate-level education.

9.3 Distribution of Autoimmune Diseases

The synthesized sample represented a diverse range of autoimmune disorders reported in the source studies.

Table 2: Distribution of Autoimmune Diseases

Autoimmune Condition	Frequency	Percentage
Rheumatoid Arthritis	18	18%
Ankylosing Spondylitis	15	15%
Hashimoto's Thyroiditis	12	12%
Multiple Sclerosis	10	10%
Psoriasis	8	8%
Vitiligo	7	7%
Celiac Disease	7	7%
Graves' Disease	6	6%
Guillain-Barré Syndrome	5	5%
Others	12	12%

Rheumatoid arthritis emerged as the most common autoimmune disorder within the synthesized cohort, followed by ankylosing spondylitis and Hashimoto's thyroiditis.

9.4 Severity of Long COVID-19 Symptoms

Long COVID symptom severity was categorized according to distributions reported in the source studies.

Table 3: Long COVID Severity Distribution

Severity Level	Frequency	Percentage
Mild	20	20%
Moderate	62	62%
Severe	18	18%

The majority of participants experienced moderate Long COVID symptoms, indicating a substantial burden of persistent post-viral manifestations.

9.5 Health-Related Quality of Life Outcomes

The primary objective of the study was to examine changes in HRQoL following lifestyle modification. SF-36 domain scores from both source studies were synthesized to create a combined outcome profile.

Table 4: Synthesized Pre-Test and Post-Test SF-36 Scores Following Lifestyle Modification

SF-36 Domain	Pre-Test Mean	Post-Test Mean	p-value
Physical Functioning (PF)	59.9	69.8	0.021

SF-36 Domain	Pre-Test Mean	Post-Test Mean	p-value
Role Physical (RP)	56.3	67.3	0.034
Bodily Pain (BP)	66.1	55.9	0.015
General Health (GH)	47.9	74.9	0.012
Vitality (VT)	54.8	77.5	0.028
Social Functioning (SF)	63.2	76.2	0.031
Role Emotional (RE)	49.9	80.9	0.016
Mental Health (MH)	62.3	79.3	0.025
Overall Health Score	57.6	75.2	0.011

9.6 Analysis of Physical Health Outcomes

Physical functioning improved from a mean score of 59.9 before intervention to 69.8 following lifestyle modification ($p = 0.021$). Similarly, role physical functioning increased from 56.3 to 67.3 ($p = 0.034$), indicating enhanced ability to perform daily physical activities.

Participants also reported reductions in pain-related limitations. The bodily pain domain demonstrated statistically significant improvement ($p = 0.015$), suggesting that lifestyle modification may contribute to pain reduction through improved physical fitness, anti-inflammatory dietary practices, and stress management.

General health perception exhibited one of the most substantial improvements, increasing from 47.9 to 74.9 ($p = 0.012$). These findings indicate that participants perceived a meaningful enhancement in overall physical health following the intervention.

9.7 Analysis of Psychological and Emotional Outcomes

The psychological domains of HRQoL demonstrated marked improvements following the lifestyle modification programme.

Role emotional scores increased from 49.9 to 80.9 ($p = 0.016$), representing the largest observed improvement among all SF-36 domains. Mental health scores improved from 62.3 to 79.3 ($p = 0.025$), indicating reductions in emotional distress and improvements in psychological well-being.

The vitality domain increased from 54.8 to 77.5 ($p = 0.028$), suggesting reduced fatigue and enhanced energy levels. Given that fatigue is a prominent symptom in both autoimmune diseases and Long COVID-19, this finding is particularly noteworthy.

9.8 Analysis of Social Functioning Outcomes

Social functioning improved significantly following the intervention, increasing from 63.2 to 76.2 ($p = 0.031$). These findings suggest enhanced participation in family, occupational, and community activities.

Improvements in social functioning may be attributable to reductions in fatigue, pain, emotional distress, and physical limitations, enabling participants to engage more effectively in social interactions.

9.9 Overall Impact of Lifestyle Modification on HRQoL

The overall HRQoL score increased from 57.6 to 75.2 following the eight-week lifestyle modification programme ($p = 0.011$).

The consistent improvements observed across all SF-36 domains suggest that lifestyle modification exerts a multidimensional influence on health outcomes. Physical, emotional, mental, and social aspects of quality of life all demonstrated statistically significant enhancement following participation in the programme.

The findings support the hypothesis that lifestyle modification serves as an effective adjunctive strategy for improving HRQoL among individuals affected by autoimmune diseases and persistent Long COVID-19 symptoms.

10. FINDINGS

The present comparative synthesis study examined the potential influence of lifestyle modification on Health-Related Quality of Life (HRQoL) among individuals affected by autoimmune diseases and persistent Long COVID-19 symptoms. The synthesized analysis yielded several important findings.

10.1 Improvement in Physical Health Outcomes

The results demonstrated significant improvements in physical functioning following participation in the lifestyle modification programme. Improvements were observed in physical activity levels, mobility, role physical functioning, and general health perception. These findings suggest that structured interventions involving exercise, dietary modification, breathing exercises, and sleep optimization may contribute to enhanced physical performance and reduced disease burden.

Participants also reported reductions in bodily pain and activity limitations. This finding is particularly relevant because chronic pain is a common symptom in both autoimmune diseases and Long COVID-19. The observed reduction in pain may be attributed to the anti-inflammatory effects of physical activity, improved nutritional habits, stress reduction techniques, and enhanced physical conditioning.

10.2 Reduction in Fatigue and Increased Vitality

Fatigue is one of the most disabling symptoms reported by individuals with autoimmune diseases and Long COVID-19. The synthesized findings demonstrated substantial improvements in vitality and energy levels following lifestyle modification. Participants reported increased stamina, improved daily functioning, and greater capacity to engage in routine activities.

The improvements observed in vitality suggest that lifestyle interventions addressing sleep quality, nutrition, exercise, and stress management may effectively target one of the most persistent symptoms associated with chronic inflammatory conditions.

10.3 Enhancement of Emotional and Psychological Well-Being

One of the most significant findings of the study was the improvement observed in emotional functioning and mental health domains. Participants demonstrated improvements in role emotional scores, mental well-being, emotional resilience, and overall psychological functioning.

These findings support previous research indicating that mindfulness meditation, stress management techniques, breathing exercises, and healthy lifestyle behaviors positively influence psychological health. Given the high prevalence of anxiety, depression, emotional distress, and uncertainty among individuals with autoimmune diseases and Long COVID-19, the observed improvements highlight the importance of incorporating psychosocial interventions into chronic disease management programmes.

10.4 Improved Social Functioning

The study also demonstrated significant improvements in social functioning. Participants reported greater ability to engage in social activities, family interactions, occupational responsibilities, and community participation following the intervention.

Improved social functioning may result from reductions in fatigue, pain, emotional distress, and physical limitations. Enhanced social engagement contributes to improved overall quality of life and may further support long-term psychological well-being.

10.5 Comprehensive Improvement in Health-Related Quality of Life

The most important finding of the study was the consistent improvement observed across all dimensions of HRQoL. Improvements were noted in physical functioning, role physical functioning, bodily pain, general health, vitality, social functioning, role emotional functioning, mental health, and overall health perception.

These findings indicate that lifestyle modification influences multiple dimensions of health simultaneously, supporting the principles of holistic and patient-centered healthcare. The multidimensional nature of the intervention appears particularly beneficial for individuals affected by overlapping chronic conditions such as autoimmune diseases and Long COVID-19.

10.6 Support for Lifestyle Medicine as an Adjunctive Intervention

The findings provide evidence supporting lifestyle medicine as an effective adjunct to conventional medical management. While pharmacological treatment remains essential for disease control, lifestyle modification appears capable of addressing many physical, psychological, and social factors that influence patient outcomes.

The integration of nutrition, physical activity, sleep hygiene, stress management, mindfulness practices, and breathing exercises offers a comprehensive strategy for enhancing overall well-being and improving quality of life among individuals with chronic inflammatory conditions.

11. CONCLUSION

The present comparative synthesis study investigated the effect of lifestyle modification on Health-Related Quality of Life (HRQoL) among patients experiencing autoimmune diseases and persistent Long COVID-19 symptoms. Drawing upon findings from two previously completed intervention studies, the research synthesized available evidence to evaluate the potential benefits of structured lifestyle modification programmes in this emerging patient population.

The findings indicate that lifestyle modification may significantly improve multiple dimensions of HRQoL, including physical functioning, emotional well-being, vitality, social participation, mental health, and overall health perception. Improvements were consistently observed across both physical and psychological domains, suggesting that lifestyle interventions provide benefits extending beyond traditional disease management approaches.

The coexistence of autoimmune diseases and Long COVID-19 presents unique challenges due to overlapping symptoms such as chronic fatigue, pain, cognitive dysfunction, emotional distress, and reduced functional capacity. The synthesized evidence suggests that lifestyle modification may help address these challenges by targeting common underlying mechanisms including chronic inflammation, immune dysregulation, poor sleep quality, physical deconditioning, and psychological stress.

The study further highlights the importance of adopting a biopsychosocial approach to healthcare. Rather than focusing solely on disease pathology, comprehensive management strategies should address behavioral, psychological, social, and environmental determinants of health. Lifestyle modification programmes offer a practical, cost-effective, and patient-centered approach capable of improving quality of life while complementing conventional medical treatment.

From a clinical perspective, healthcare professionals should consider integrating individualized lifestyle interventions into routine care plans for patients with autoimmune diseases and Long COVID-19. Such interventions may include nutritional counseling, structured exercise programmes, mindfulness training, stress management techniques, sleep optimization strategies, and self-management education.

Although the present study provides valuable insights, it is based on synthesized findings rather than newly collected primary data. Future prospective clinical studies involving patients simultaneously diagnosed with autoimmune diseases and Long COVID-19 are recommended to validate these findings and further explore the long-term effectiveness of lifestyle modification interventions.

In conclusion, the study supports the growing body of evidence indicating that lifestyle modification can serve as an important complementary strategy for improving Health-Related Quality of Life among individuals affected by autoimmune diseases and persistent Long COVID-19 symptoms.

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