

Patient Education and Exercise-Based Self-Management in Knee Osteoarthritis: Effects on Pain, Function, and Quality of Life

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Background: Knee OA is a chronic musculoskeletal disorder, which frequently results in pain, functional impairment, a lower overall level of physical activity and poorer health-related quality of life. Patient education and exercise self-management is a crucial part of current care of knee osteoarthritis (OA), but how enabling this type of care is for patients' self-efficacy in explaining its contribution to patients' quality of life has not been examined.

Objective: We aimed to explore health-related quality of life outcomes after the implementation of patient education and exercise-based self-management and to examine whether or not self-efficacy mediated the effects on the health-related quality of life after patient education and exercise-based self-management for knee OA.

Methods: Quantitative cross sectional design was used. Participants will be focused on knee OA patients attending Mother Theresa University Hospital Center, University hospital of Trauma and Pegasus Med Clinic who will be diagnosed with knee OA on structured questionnaires, a total of 450 patients.

Partial Least Squares Structural Equation Modeling (PLS-SEM) was then used to evaluate the measurement and structural models.

Findings: Results showed that patient education had a significant effect on increasing the health-related quality of life and also had a positive effect in raising the patient's self-efficacy. Exercise based self-management also had a strong effect on aspects of health-related quality of life and self-efficacy and was the best predictor of self-efficacy. In addition, higher levels of self-efficacy made a significant contribution to higher quality of health. The mediation analysis revealed that both patient education and the exercise self-management significantly but weakly mediated the relationship between self-efficacy and QOL while self-efficacy partially mediated the connection between exercise based self-management and QOL. These findings corroborate recent evidence highlighting the significance of education, exercise, self-management and self-efficacy in osteoarthritis interventions.

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Conclusion: The conclusion of the study was that a patient centered approach combining structured patient education, sustainable exercise based management strategies, and self-efficacy supporting strategies, may be beneficial for improving patients' quality of life living with knee OA.

Key words: knee osteoarthritis, patient education, self-management (exercise), self-efficacy, quality of life, PLS-SEM, rehabilitation.

Introduction:

Effective and long-term management of knee osteoarthritis (KOA) is important for treating persistent musculoskeletal pain, decreasing functional mobility, impairments in activities of daily living, and adverse health-related quality of life, and is a clinical and public health priority for all patients. Patients' education regarding KOA and suitable strategies of managing symptoms play a crucial role in enhancing patient's knowledge, while the patient being educated on the benefits of exercise-based self-management to enhance own mobility and manage pain by themselves is also an active nonpharmacological technique that is increasingly becoming a better option for the rehabilitation approach to KOA (Kang et al., 2024). There is more recent evidence that structured education and self-management interventions can be associated with

improvement in outcomes of pain, activity of daily living (ADL), adherence and quality of life (QOL) of people with osteoarthritis (Monaiwa et al., 2025). Exercise therapy is of crucial importance, as it tackles functional limitations while at the same time motivating patients to be active participants in the long-term management of a chronic condition; however, patients' psychological and behavioural characteristics contribute to sustained exercise engagement alongside the physical benefits of exercise (Werneke et al., 2022). Of these, self-efficacy has had growing interest as patients' perception of self-efficacy, in terms of self-management, exercise, and coping with symptoms, may be associated with the ability to maintain proper self-management practices and achieve positive outcomes. There is also evidence up to this point that education/exercise interventions can have effects on movement confidence and self-efficacy in addition to pain, physical function

and quality of life, suggesting that self-efficacy is a possible mechanism through which active self-management strategies impact patients' outcomes, prompting the investigation of this mechanism (Boland et al., 2022). But, these interrelationships need further elucidation in certain healthcare settings and patient population. Thus, the current study will focus on the impact of patient education and instruction in movement on the results of patients with the disease of osteoarthritis of the knee and will examine how the concepts of self-efficacy mediate between patients cared for in Mother Theresa University Hospital Centre, the University Hospital of Trauma and Pegasus Med Clinic.

Although growing awareness has evolved that patient education and exercise-based self-management are pivotal components of Knee Osteoarthritis (KOA) care, many patients continue to have persistent KOA pain, physical function limitations, challenges to performing daily function tasks, and diminished quality of life, indicating that the role that these interventions play in the mechanism of patient outcome has been poorly understood. Patient education should enhance disease knowledge, address misconceptions regarding pain and physical activity, and bolster the ability of patients to actively engage in their management, with recent studies supporting the association between patient education and self-efficacy and better functional outcomes (Adeyemi et al., 2025). Likewise, improvements in pain treatment, mobility and physical function, and quality of life with exercise-based self-management is likely to be highly dependent on patients' capabilities and confidence to begin and maintain recommended behaviors (Law et al., 2024). Self-efficacy is highly significant as self-efficacy to manage pain, exercise, and daily activities, has been shown to be closely related to pain, functional, and quality-of-life outcomes among people with KOA (Zou, Liu, et al., 2025). In addition, recent research also suggests that educational and exercise interventions may have an effect on movement confidence and self-efficacy as well as pain and physical

function, which suggests that self-efficacy may be an explanation mediator between the interventions and the outcomes, as opposed to only being an outcome (Boniface, 2024). The evidence with regard to the direct associations between patient education and KOA outcomes and between exercise-based self-management and KOA outcomes remains limited, however, and limited evidence exists on the mediating effects of self-efficacy between exercise-based self-management and KOA outcomes and between patient education and KOA outcomes, respectively, in specific clinical scenarios where access to rehabilitation or professional support, patient characteristics, or continuity of rehabilitation care might impact these associations. Therefore, it is important to not only measure the immediate impact of patient education and improved exercise-related self-management on patient outcomes (pain, physical function, health quality of life) but to also explore whether self-efficacy is a significant mechanism by which patient education and improved exercise-related self-management directly impact these outcomes, in this population of KOA patients treated at the Mother Theresa University Hospital Center, University Hospital of Trauma, and Pegasus Med Clinic.

While modern biomedical research of the knee osteoarthritis is increasingly affirming importance of patient education, exercise and self-management in achieving better health gain improves, there are a number of important gaps in theory and empirical evidence about the effective mechanisms by which these strategies produce benefits in patient outcomes and how best to leverage them within Albanian healthcare/rehabilitation settings. In theory, many of the published literature outline direct links between interventions and outcomes including pain and physical functioning, and the psychological processes linking interventions with broader patient reported outcomes are less consistently explored; however potential links have been noted between feelings of confidence in the management of symptoms and engagement in interventions, activity, and

function and recovery, and self-efficacy may be a key process driving this link given that confidence in managing symptoms can affect adherence, activity and function and recovery (Ekambaram & Ponnusamy, 2023). Theoretically, this leaves open the issue of whether patient education and/or self-management through exercise impact on pain, physical function and quality of life in isolation or partially through self-efficacy. Although it is proposed, evidences of mediation are scarce and inconsistent in musculoskeletal disciplines and intervention types (Goubran et al., 2025). Clinically, recent research has shown exercise, education, digital rehabilitation and multicomponent self-management interventions to be beneficial for KOA outcomes, but there were significant differences in how interventions were delivered, adhered to, who they targeted and the context in which they took place, which hinders direct applicability of the findings across settings (Liu & Wang, 2025). More significantly, the recent literature search found very little empirical evidence within Albania to support patient education, exercise self-management, self-efficacy and patient outcomes within the same theoretical framework of KOA, there is a significant gap of geographical and sector. This restriction applies especially to such areas as private practices, trauma and rehabilitation facilities in hospitals, and hospitals, where variations in service organization, access to physiotherapy, the continuity of rehabilitation, professional guidance, and access to structured self-management resources can impact patient experiences and outcomes. In light of this, conducting research that clarifies the direct relationship between patient education and exercise-based self-management with pain, physical function, and quality of life is necessary, as well as to understand the interaction of these factors in the context in which they are presented, as this interaction will determine if self-efficacy is the missing link between patient education and the outcomes measured in this study, and is currently unknown in the local context.

This study has significance because it could help to design more effective patient education for self-management and exercise-based pain management interventions for knee OA, as this is likely to improve clinical and patient-reported outcomes, and for providing a better understanding of self-efficacy as a potentially important mechanism by which these benefits are achieved. Overall, the study is aimed at discovering if there are any associations between patient education, exercise-based self-management, self-efficacy and positive outcomes on pain, physical function and quality of life in patients with Knee OA, in order to give evidence for how patient education and exercise-based self-management can help in achieving better long-term outcomes in patients with Knee OA. This is significant as evidence has emerged over the past few decades to reinforce that effective outcomes of knee OA management should not only focus on symptom management but also on patient knowledge, patient involvement, behavioural change, confidence in managing knee OA and maintaining engagement with therapeutic exercise (Huang et al., 2025). In the medical field, the study has the potential to benefit physicians, physiotherapists, nurses, rehabilitation specialists and any other worker within the healthcare system, as it can aid in identifying modifiable factors that can help optimize conservative treatment for KOA, enabling the creation of individualized treatment plans. There are also emerging findings that exercise-based rehabilitation and education-based interventions can enhance their clinical and psychosocial outcomes and that patients' self-efficacy may impact their ability to adhere to exercise, manage symptoms, and conduct active self-management activities (Marks, 2025). Additionally, modern research on rehabilitation has emerged in recent years that favor continuous and more patient-centred care with the patient in full control of the treatment of chronic musculoskeletal conditions in a way that goes beyond simply passive or episodic care (Gao et al., 2024). Thus, the aims of this study are to explore the direct effects of patient

education plus exercise based self-management on the reduction of pain, physical function and quality of life, and to examine the mediating role of self-efficacy between patient education plus exercise based self-management and the reduction of pain, physical function and quality of life; and overall to provide clinically relevant evidence that can inform patient education, rehabilitation planning, multidisciplinary practice, and strategies to enhance quality and continuity of KOA care for patients treated at Mother Theresa University Hospital Center, University Hospital of Trauma, and Pegasus Med Clinic.

The novelty of this study is testing and constructing a novel explanatory model that goes beyond examining isolated effects of two interventions: patient education and exercise therapy separately, but examines both patient education and exercise therapy together as determinants of pain, physical function and quality of life, and importantly, examines self-efficacy as the psychological 'mechanism' by which these associations could be working. There is increasing evidence that in recent years, delivering the exercise prescribed to the patient is not enough, as self-management support, patient engagement and psychological factors which promote behavioural change play key roles in successful treatment of knee osteoarthritis; however, the relationships between these factors and the outcomes experienced by patients remain poorly understood (Traweger et al., 2025). New research shows how significant a role education and structured rehabilitation can play in strengthening self-efficacy, and how self-efficacy can in turn strengthen engagement in exercise and self-management behaviors; further investigation of education and structured rehabilitation as an explanatory mediator of exercise and self-management behavior engagement is warranted (Janela et al., 2023). Moreover, recent studies have emphasised the need for more integrated models that aim to account for the processes by which education translates to health benefits via behaviour and/or psychology (PEOPLE, 2025). Therefore,

the present study stands out from past studies by simultaneously introducing two intervention-related patient education and exercise-based factors (patient education and exercise-based self-management) into the mediation model along with self-efficacy among multiple clinically meaningful KOA outcomes. Another contextual novelty that this study retains is the fact that it covers three different contexts: the context of public university, the context of trauma/orthopedic and the context of private clinical, providing evidence within these contexts which may only partially be reflected in the existing literature in the field of Albanian KOA. The study helps elucidate direct and self-efficacy mediated pathways to symptom reduction and may explain why KOA rehabilitation has an impact, thereby also providing implications for designing educational and exercise regimes in an explicit way to target and augment patients' confidence and capacity to manage illness in the long-term, rather than solely aiming for short-term symptom reduction.

Given the well-established importance of active rehabilitation to the treatment of knee OA, there is a clear need for research around patient education and self-management through exercise. Pain, functional limitations, lower physical activity, challenges to implementing exercise, and impaired quality of life among patients with knee OA suggests that, by itself, treatment may be insufficient. The current evidence highlights the role of exercise therapy and self-management as main pillars of musculoskeletal rehabilitation and suggests that patients' capacities for self-management and the ability to adhere to rehabilitation are influenced by psychological and behavioral factors including self-efficacy; these factors must be addressed (Arensman, 2024). The importance of patient education is that a lack of knowledge and understanding about osteoarthritis can make it difficult to manage the symptoms and to adhere to any exercise or pain-management strategies. Providing patient education interventions to build patients' knowledge and confidence and engage patients to follow their care can help support effective self-care (Ahn et al., 2024).

Likewise, the efficacy of exercise based self-management is influenced by both the clinical effectiveness of exercise, and whether or not patients initiate, adhere to, and continue their recommended exercise, as exercise self-efficacy is especially pertinent to explaining differences in treatment reaction (Paredes & Pinto, 2024). It is important to study self-efficacy as a mediating factor because it could provide insight into how patient education and exercise-based self-management relate to reduction in pain, improvements in physical function and quality of life, as opposed to simply examining whether an association exists. This investigation is also warranted given that there is variation in barriers to self-management and rehabilitation across healthcare organizations, as well as from professional support, resources, and patient contexts, and evidence produced in one organization may not be readily transferable to another (Brooks et al., 2024). Therefore, these relationships between the mothers attending the three Medical Centers (Mother Theresa University Hospital Center, University Hospital of Trauma, and Pegasus Med Clinic) need to be examined to produce context-specific evidence that can guide the physician, physiotherapist, nurses, and rehabilitation professional to identify mothers with low self-management confidence, optimize educational and exercise approaches, encourage treatment adherence, and create more individualized and patient-centered KOA treatment. Overall, patient education and exercise-based self-management and its indirect effects via self-efficacy may help to achieve more long-lasting pain and disability reduction and better physical functioning or quality of life.

The clinical importance of this study is that it will contribute to the theory and understanding of knee osteoarthritis and explore the importance of a patient's education and exercise-based self-management on influencing pain, physical function and quality of life, while explaining the mechanism through which sBM exerts this effect. Educational and exercise therapies remain key part of a conservative OA management program and in critically engaged management, patients should feel empowered to

actively involve in decided and gaining confidence and skills for long-term management (Y. Zhu et al., 2024). Theoretically, the research will extend the understanding of the effect of psychological factors beyond that of direct intervention–outcome relationships to the pathway through which intervention could occur and lead to meaningful clinical outcomes, especially regarding the role of self-efficacy as an important mediator between intervention and self-management, exercise engagement, and recovery (Hennessy & Corcoran, 2025). The study will also bring evidence from the Empirically context specific data from Albanian healthcare context will be provided by Mother Theresa University Hospital Center, University Hospital of Trauma, and Pegasus Med Clinic as there is limited integrated evidence on these relationships in these settings. Practically, the results can help doctors, orthopedic specialists, physiotherapists, rehabilitation and nursing practitioners in determining if intervention with strengthening patient knowledge, exercise behaviors, and self-efficacy can potentially help reduce pain, increase patient function, and improve patient quality of life in conjunction with recent findings that education and physiotherapeutic management can also provide improvements in symptomology, activities of daily living and quality of life in KOA (Post et al., 2023). The patients with KOA will benefit from the more personalized, empowering and sustainable rehabilitation methods, while the healthcare professionals may find an educational, exercise prescription, adherence providing, and clinical decision making avenue that will be facilitated by the study results. Participating hospitals and clinics will apply the findings of the study to support rehabilitation paths and continuity of care, healthcare administrators and policymakers will find context specific empirical foundations for planning of accessible non-pharmacological KOA services, and the researchers/community of academic institutions will find an empirical context for future intervention, longitudinal, or more comprehensive comparative research. At the end of the day, the research could help to

translate a symptom based approach to KOA treatment into a more holistic treatment model that includes patient education, active self-management, patient empowerment and clinical rehabilitation, resulting in more sustainable health outcomes (Barry Walsh et al., 2024).

This study is of particular interest, as patient education, exercise based self-management, self-efficacy and outcome of KOA are factors that connect to both an educational, behavioral, psychological and clinical aspect of the treatment, rather than independent components of treatment. While there are many previous studies that have demonstrated important relationships between education and better knowledge and self-management, between exercise participation and changes in pain and physical functioning, and between self-efficacy and increased physical activity, reduced pain, and better functional outcomes, these links have been studied alone or subsumed within a narrower scope and specific intervention programs (Ulana et al., 2024). Recent studies also suggest that physical activity and education have a combined effect on KOA clinical outcomes, such as pain, physical function, and quality of life and psychological outcomes, which reinforces the importance of studying these clinical outcomes in tandem (Price et al., 2025). A noteworthy association is that of both independent variables with self-efficacy, as receiving appropriate education could make patients more confident to know and handle their condition and if they were to successfully participate in an exercise, they may become more confident of carrying out physical activity even with pain or limitation of function (Wei et al., 2025). Conversely, positive pain, functional, physical activity, and quality of life outcomes have been found to be linked with higher self-efficacy, and this indicates that self-efficacy may be a mechanism by which education and exercise lead to clinical benefits (Romm, 2023). Therefore, the novelty of the proposed research is not in claiming that these individual relationships have not been studied before, but in also considering patient education and exercise-based self-management as predictors of

clinically meaningful outcomes (pain, physical function, quality of life), self-efficacy as a mediator, and in doing so, in an integrated model and specific Albanian healthcare context. Research on the role of education and exercise on KOA outcomes could then determine if there are direct relationships between these two components, and if there are indirect relationships that occur through mediating factors such as SE; if this is the case, the role of SE would allow for a greater explanation of the relationship between active rehabilitation and patient empowerment and KOA outcomes.

The general goal of this study is to explore the association between patient education, exercise self-management, self-efficacy and Health related Quality of Life (HRQOL) among patients suffering from knee Osteoarthritis (OA) who attend to Mother Theresa University Hospital Center, University Hospital of Trauma and Pegasus Med Clinic of Bogra. Specifically, the level of patient education, exercise based self-management activity, self-efficacy, and the patients' quality of life will be assessed with knee osteoarthritis patients; the relationship between self-efficacy and quality of life will be explored; the relationship between patient education and quality of life will be explored; the relationship between exercise based self-management and quality of life will be explored; comparing self-efficacy and quality of life will be explored; and the relationship between patient education and exercise based self-management and quality of life will be explored. Additionally, the study aims to assess the significance of these clinical dimensions in the management of knee osteoarthritis (OA) based on recent evidence regarding the interconnection between education, exercise, self-management, self-efficacy and these dimensions in the long-term context of pain management, functional improvement, treatment engagement and overall treatment outcome (Grannell et al., 2023). Together, these goals are designed to set up the direct and indirect paths that patient education and self-management with exercise can play in

improving outcomes and outline the explanatory pathway of self-efficacy in the model presented.

Literature Review

Theoretical Foundation

The theories that underpinned this study emphasise the social cognitive theory presented by Cruz-Montecinos et al. (2025) to value the relation between patient educations, self-efficacy and health related behaviours in K.O participants. In this light, patient education, the first independent variable, is viewed as an element of knowledge, outcome expectation, behavioral skills and cognitive understanding to make patients more aware of their health conditions and require them to be able to actively manage them. Providing education on the nature of knee OA, pain, physical activity, joint protection, and suitable exercise can challenge patient beliefs about their OA and boost their sense of ability when taking up suggested activities. In recent literature, researchers recommend integrating education with self-management to present educational information as an activity more integrated with the whole person, as opposed to providing isolated clinical information (Bluethmann et al., 2022). The second independent variable, exercise-based self-management, can also be explained using SCT as health behaviors are formed through reciprocal influences among personal beliefs, behaviors and environmental influences. Successful repetition of exercises will give mastery experiences, and feedback by professionals, goal setting, self-monitoring and social reinforcement will encourage persistence with the exercise. Current KOA research still shows that exercise and self-management are core factors in rehabilitation processes, thus highlighting their relevance to pain and physical functioning (Ouendi et al., 2023). Therefore, SCT offers a theoretical basis for the expectation that engaging in patient education and exercise-based self-management will both help improve KOA outcomes.

Based on Bandura's Self-Efficacy Theory and SCT, one inferring psychological construct of the factors is self-efficacy, which is

the individual's confidence in his or her ability to initiate and execute behaviors that produce desired outcomes. The role of education/exercise in between the changes in health and health-care is theoretically supported as intervention doesn't always lead to better health outcomes, but should first reinforce patients' belief that they are capable of exercising, health-care related symptom control and barriers, and being able to manage KOA independently. Positive experiences during mastery, verbal feedback from healthcare providers, and watching other people successfully manage their pain and improved understanding of pain and bodily sensations can boost self-efficacy that can be transformed to further increase the persistence and involvement in self-management. Evidence from the last decade indicates that the relevance of self-efficacy to exercise adherence and self-management, and that interventions comprising educational and behavioral aspects can impact the self-efficacy in musculoskeletal populations continues to be supported (Rastin, 2024). Therefore, in this study, the theoretical mechanism suggested is patient education and exercise-based self-management directly affect the patient's outcomes, and also affects linearly through the intermediation of increased self-efficacy; if patients have an understanding of their condition and feel that they can effectively manage it, they should be more able to maintain behaviors that lead to favorable long-term outcomes.

The chosen outcome, health related quality of life, can be taken from the biopsychosocial model of health which posits that health results from biological, psychological, behavioral, and social factors as opposed to disease process alone. Issues related to quality of life include biological and clinical issues (including pain and mobility), behavioural issues (including physical activity and level of exercise), psychological issues (self-efficacy, beliefs about quality of life) and social or health care issues (perceived support or lack of support from the professionals, rehabilitation access). Therefore, pain and physical function would

represent important clinical parameters concerned with the various aspects of the health related quality of life. There is recent evidence that the KOA rehabilitation interventions based on exercise, education and self-management influence pain, function, self-efficacy and a variety of patient-reported outcomes (Wood et al., 2024). As a result, the integration of three theories, SCT, SET and the biopsychosocial model, provides a coherent theoretical support to the proposed pathway where patient education and exercise based self-management are modifiable behaviour mediators, self-efficacy is the psychological mediator, and health related QOL is the main patient-centered outcome, while pain along with physical function is the clinically important behaviour mediators of the KOA-experience.

Hypotheses Development

Figure 1 indicates that there are five relationships that were proposed for the model: H1, H2, H3, H4, and H5, plus two indirect or mediating relationships: H6, and H7. The hypothesis construction below is in the same direction as indicated in the figure – the main dependent variable is health-related quality of life.

H1: Patient Education and Health-Related Quality of Life

Education plays a very important role in knee osteoarthritis management as it gives the patient knowledge about his disease, how to manage the symptoms, appropriate exercise, treatment options and how to function in everyday life. According to the Social Cognitive Theory, access to health information which is perceived as relevant and understandable will be able to change the outcome expectation, make and facilitate disease management behavior, and enable more active participation in the management process. It is therefore not surprising that modern rehabilitation literature considers education the transmission of information rather than just that, but an intervention designed to enable patients to make informed decisions and to play an active part in their self-management. The number of studies

that recently looked into the effects of self-management and rehabilitation integrated with education in osteoarthritis (OA) showed that this type of intervention is associated with significant improvements in pain, functioning, coping, and other patient-centred outcomes (Ward et al., 2024).

Patients' capacity to manage pain, continue being physically active, independent of others, and to deal with the effects of chronic musculoskeletal conditions all affect health related quality of life in KOA. Patients who are well educated will then develop more appropriate beliefs about KOA, learn the benefits of exercise, and learn for example effective techniques for managing the painful symptoms of KOA and therefore improve their physical and socioemotional wellbeing. A recent randomized controlled trial (CT) study also showed that education combined with exercise resulted in pain, physical function and quality of life improvements in KOA (Ward et al., 2024). It is therefore plausible to assume that an increase in patient education will be linked with improved health related quality of life.

H1: Patient education has a significant positive relationship with health-related quality of life among patients with knee osteoarthritis.

H2: Exercise-Based Self-Management and Health-Related Quality of Life

Exercise based self-management means the patient becomes an active participant in therapeutic exercise and maintenance use of exercise strategies to manage symptoms and maintain/improve functional ability. In a way KOA is especially relevant to exercise because pain, weakness, rigidity and loss of mobility can start to become a problem and increasingly limit activities and reduce quality of life. This evidence for rehabilitation in recent years persistently points to patient education about self-management and exercise as key factors of conservative management of knee pain such as KOA (Racodon et al., 2025). In addition, there is evidence supporting the use of lifestyle intervention, specifically evidence supporting exercise as part of a education/exercise/self-

management support program, that contributes to a favorable outcome for people who have KOA (Pereira et al., 2025).

Physiological and behavioral explanations for the hypothesized, positive association with HRQOL are possible. Regular exercise can enhance strength, function and mobility, then self-management – teaching patients to maintain these exercise patterns in their daily lives and manage changes better in their symptoms. Another key reason at the end-point of this spectrum is the potential for ongoing physical activity, beyond that of meeting face-to-face with a therapist, which appears beneficial for middle-aged and older adults with KOA (Stavric et al., 2023). Patients' exercise-based self-management is expected to be associated with self-reported health-related quality of life, as it contributes to physical independence, mobility, and symptom control, which are important aspects of patients' quality of life.

H2: Exercise-based self-management has a significant positive relationship with health-related quality of life among patients with knee osteoarthritis.

H3: Patient Education and Self-Efficacy

Social cognitive theory is very supportive of the relationship between patient education and self-efficacy and self-efficacy is viewed as an individual's confidence in his or her ability to perform these behaviors to meet desired patient outcomes. Patients with KOA can be intimidated by the pain of exercise, or regular movements if not knowing of their condition, may feel it to be that the movement is unhelpful. Detailed patient education can help correct these misunderstandings clarify and show safe ways to cope with symptoms and activity, offer realistic expectations and practice problem-solving. This enables education to improve patients' knowledge, but also their confidence in using it to improve their own situation. Nowadays, education, motivation, self-efficacy, and the self-management are identified as similar components of long-lasting functional

improvement in recent KOA rehabilitation studies (Ward, Bissell, et al., 2025).

There is a growing body of evidence to suggest that intervention-related outcomes of education and support can positively affect self-efficacy and introduce it into this category of modifiable outcomes, as opposed to viewing self-efficacy as a personal, unchanging trait. A recent KOA group-consultation study, for instance, has specifically included self-efficacy along with physical activity and self-management support (Dickson et al., 2024); or whole musculoskeletal studies suggest that education-based interventions using a combination of swaying dry-professional guidance and hands-on exercises which involve individual self-management steps increase exercise self-efficacy (Ward, Tew, et al., 2025). Holding this, patients should therefore feel more confident that they can manage KOA, if they comprehend the rationale behind certain behaviors and how they can be executed safely.

H3: Patient education has a significant positive relationship with self-efficacy among patients with knee osteoarthritis.

H4: Exercise-Based Self-Management and Self-Efficacy

Theoretically, exercise-based self-management and self-efficacy are related because mastery experience, identified by Bandura as one of the most powerful sources of efficacy beliefs that develops self-efficacy, is produced when one exercises. Exercises that involve successfully completing activities, making gradual increases in activity or identifying that aspects of their condition have improved by these exercises can help build a sense of confidence that they are able to manage their condition. Self-management also frequently includes the following components: goal setting, self-monitoring, facilitating adaptations of activities, feedback, and repeated behavior, which all can help to build confidence and perception of personal control. There is recent evidence that demonstrates the ongoing importance of self-efficacy in both maintaining

exercise and self-management behaviours in MSD rehabilitation (Stanley et al., 2024).

In KOA this connection is of key importance because when the patients are in pain they might avoid moving which can decrease their chances of mastering the task further increasing their level of discomfort. In turn, when patients are successful in their activities that are appropriately prescribed, it can show them that exercise is possible even with their disease. Recent KOA research focused on self-efficacy along with physical activity and self-management (Silvernail et al., 2024), and recent rehabilitation interventions reported increases in function and increases in self-efficacy after structured rehabilitative support (Zou, Lu, et al., 2025). Thus, KOA patients with higher exercise based self-management engagement are hypothesized to have more confidence in their self-management of KOA.

H4: Exercise-based self-management has a significant positive relationship with self-efficacy among patients with knee osteoarthritis.

H5: Self-Efficacy and Health-Related Quality of Life

Self-efficacy is central in the conceptual framework as it impacts patients' confidence in their ability to manage the symptoms successfully, participate in exercise and work through barriers to exercise and maintain required self-management behaviours. According to Social Cognitive Theory, people who have high self-efficacy will be more likely to engage in behaviors, put in more effort to do them, persevere when something goes wrong, and bounce back. These features are relevant to KOA, as patients need to cope with an intermittent flare-up in pain and functional impairment, for long periods of time. The importance of self-efficacy as a correlate of pain, activity, physical functioning and quality of life KOA has been recognized in recent research (Vicente-Mampel et al., 2024).

The different pathways through which higher levels of self-efficacy have the potential to promote health-related QOL are interrelated.

Patients who think they can manage their symptoms or cope with them are less likely to become withdrawn in physical and social functions; more likely to follow rehabilitation orders; and able to maintain independence in their lives. Low efficacy beliefs, on the other hand, would perpetuate inactivity and avoidance behaviors when a patient has pain. Chronic pain and osteoarthritis studies have shown that self-efficacy relates to desired outcomes and can also be influenced by improvements in the pain experience and the quality of life that occur as a result of self-management based interventions (Romm et al., 2023). As such, with greater self-efficacy, it is expected that they will report a better health and quality of life ratings.

H5: Self-efficacy has a significant positive relationship with health-related quality of life among patients with knee osteoarthritis.

H6: Mediating Role of Self-Efficacy Between Patient Education and Health-Related Quality of Life

While patient education can be used as a direct tool to enhance health-related quality of life, just knowing something did not mean that patients would adopt a change in their behavior that would be maintained. The proposed mechanism for this is that education increases the patients understanding, behaviors and self-confidence with regard to managing KOA, and consequently, improves their self-efficacy, which in turn promotes behaviors necessary to achieve better everyday health and well-being. This pathway is also broadly in line with the Social Cognitive Theory as information and environmental intervention can act to influence behavior and outcomes via cognitive mechanisms, like efficacy beliefs. Recent research has focused on the effect of education and self-management approaches on an individual's self-efficacy and the relevance of self-efficacy in achieving long-term functional and behavioral results (Barger et al., 2024).

Testing the mediation role of education is therefore crucial because if there is an association between the level of education and quality of life, that fact may not answer the

question of how that is the case. The consideration of self-efficacy as a mediation between this factor might suggest that self-efficacy should not only be enhanced through knowledge-building, but that it should be specifically constructed through enhancing patients' confidence in using knowledge, in symptom management, decision making, and recommending behaviors. There has recently been a growing interest in psychological processes linking education and health behavior in various chronic disease and musculoskeletal-related research areas, and existing evidence from KOA shows that enhancement of knee-specific self-efficacy may provide a partial explanation to the effects of the interventions (Sheekhoo & Almeheesen). This gives theory and empirical support to test the hypothesized role of SE as a mediating mechanism.

H6: Self-efficacy significantly mediates the relationship between patient education and health-related quality of life among patients with knee osteoarthritis.

H7: Mediating Role of Self-Efficacy Between Exercise-Based Self-Management and Health-Related Quality of Life

The benefits of exercise-based self-management can include direct improvement in self management of symptoms and physical capacity, which, in turn, can lead to an improvement in QOL, as well as benefits that may derive from psychological changes brought about by the successful engagement in exercise. Repeatedly doing the prescribed activities, reaching exercise goals, and feeling better or being able to function with symptoms can provide patients with mastery experiences that can enhanced self-efficacy. When there is more self-efficacy there may be more persistence, adherence, coping, and continuing in meaningful activities, and thus more benefit for the quality of life. Today, evidence supports the importance of exercise and self-management as principles of KOA rehabilitation and highlights the role of psychological factors (self-efficacy) as essential factors in explaining different patient behaviors and outcomes (Rawlinson, 2022).

The mediation hypothesis is further confirmed by recent research looking into the mediation process of self-efficacy in rehabilitation research and health behavior. Recent research in musculoskeletal rehabilitation suggests that increased knee self-efficacy is a mediator that exists between pain, patient activation and exercise adherence, indicating that self-efficacy can be a mediator in these relationships (Schurz et al., 2024); and in regards to intervention research for KOA, research suggests that increases in knee self-efficacy may explain positive outcomes of exercise and education-related interventions (Ceniza-Bordallo et al., 2025). Thus, if exercise-based self-management is a critical element in improving quality of life for some patients, those who actively do so may also find they end up with improved confidence in managing their symptoms and being able to be functional without assistance. Testing this indirect pathway can help determine if the benefits of physical self-management is solely because of a physical effect or also psychological empowerment.

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H7: Self-efficacy significantly mediates the relationship between exercise-based self-management and health-related quality of life among patients with knee osteoarthritis.

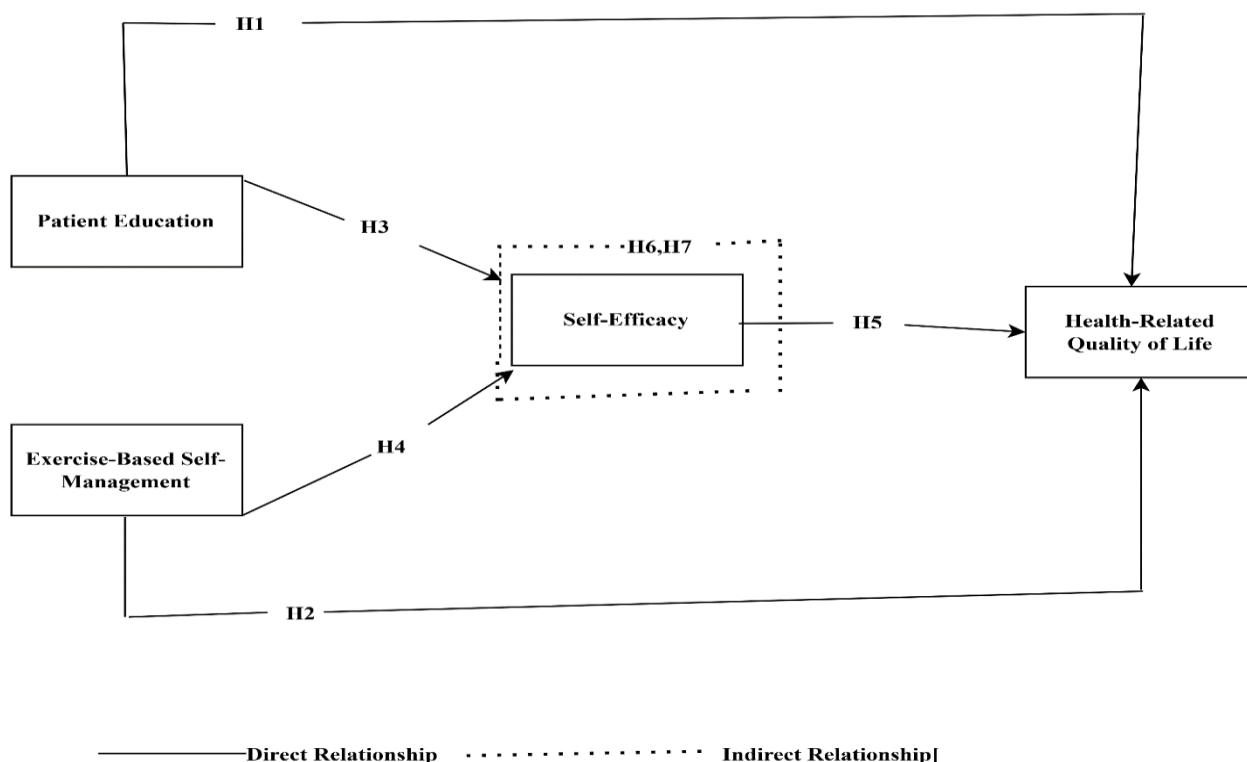


Figure 1: Proposed Research Model

Research Methodology

Research Design

The study was of a quantitative, explanatory and cross sectional designing that looked at patient education, exercise self-management, self efficacy, and health related quality of life in the patients suffering from knee osteoarthritis in Mother Theresa University Hospital Centre, University hospital of Trauma and Pegasus Med Clinic. The study tested theoretically stated hypotheses and found the value of relationships between latent constructs

from the standardized questionnaire data, so a quantitative approach was used. The cross-sectional design was used as the information was gathered from eligible subjects at a point in time and the explanatory design allowed for the direct and indirect relationships proposed in this study to be statistically evaluated. The main multivariate technique used was Partial Least Squares – Structural Equation Modeling (PLS-SEM), which was suitable for analyzing a model that had multiple latent constructs and mediation pathways, and which allowed the simultaneous analysis of the measurement

model and structural model that were later used, and was increasingly used in current healthcare research (Cheung et al., 2024). The item reliability, the internal consistency reliability, the convergent validity and the discriminant validity of the measurement model were assessed for the measurement model, while the path coefficients, the coefficients of determination (R^2), the effect sizes (f^2) as well as the predictive relevance of the model were used for the assessment of the structural model. The statistical significance of the hypothesized direct effects of patient education and exercise based self-management on self-efficacy and health-related quality of life, the effect of self-efficacy on health-related quality of life as well as indirect effects necessary to demonstrate the mediation effect of self-efficacy were measured using a bootstrapping procedure. PLS-SEM, thus, served as a suitable analysis framework to assess the entire proposed model and also test multiple hypotheses simultaneously: Hypothetic H1–H7, and also gave emphasis on both orienting the model to

explanation and orienting the model towards prediction of the relations among the study variables.

Measurement Instruments

Six items were used to assess all four constructs. All the survey questions were drawn and adapted from literature that was relevant and current in the field of knee osteoarthritis education, exercise and self-management, arthritis self-efficacy and knee related quality of life. To ensure uniformity in measurement and further analysis using PLS-SEM, a five point Likert-type scale was employed which ranges from 1= Strongly Disagree to 5= Strongly Agree. All measures were adjusted to the clinical setting of patients with KOA and retained the conceptual meaning of the constructs. Similar to previous KOA studies, patient education and exercise were identified as key factors of management, and KOOS was used to assess knee outcome (Manifield et al., 2025).

Variable	Code	Measurement Item	Sources
Patient Education	PE1	The education I received helped me understand the nature and progression of my knee osteoarthritis.	(Biskupiak et al., 2024; Hawley-Hague et al., 2023; Hutton et al., 2025; Sutton, 2024)
	PE2	The education I received helped me understand appropriate ways of managing my knee osteoarthritis symptoms.	
	PE3	I received sufficient information about the importance of physical activity and exercise for managing my knee osteoarthritis.	
	PE4	The education I received helped me understand how to manage knee pain during everyday activities.	
	PE5	Healthcare professionals provided clear information that helped me participate actively in managing my knee osteoarthritis.	
	PE6	The education I received improved my knowledge of behaviors that could protect my knee health and maintain my functioning.	
Exercise-Based Self-	ESM1	I regularly performed the exercises recommended for managing my knee osteoarthritis.	(Heriseanu et al., 2023;

Variable	Code	Measurement Item	Sources
Management	ESM2	I continued my recommended knee exercises as part of my regular self-management routine.	Pardo, 2024; Yuan et al., 2022; Zhang et al., 2022)
	ESM3	I followed the exercise instructions provided by my healthcare or rehabilitation professional.	
	ESM4	I adjusted my exercise activities appropriately when my knee symptoms changed.	
	ESM5	I made an effort to remain physically active even when managing difficulties related to my knee osteoarthritis.	
	ESM6	I independently incorporated therapeutic exercise into my everyday management of knee osteoarthritis.	
Self-Efficacy	SE1	I was confident that I could manage my knee osteoarthritis symptoms effectively.	(Bobos et al., 2024; Connell et al., 2022; Jagtap et al., 2025; Zangger et al., 2023)
	SE2	I was confident that I could manage my knee pain during my daily activities.	
	SE3	I was confident that I could continue appropriate physical activity despite my knee osteoarthritis.	
	SE4	I was confident that I could perform the exercises needed to manage my knee condition.	
	SE5	I was confident that I could deal with difficulties or setbacks when managing my knee osteoarthritis.	
	SE6	I was confident in my ability to manage the effects of knee osteoarthritis on my everyday life.	
Health-Related Quality of Life	HRQoL1	Despite my knee osteoarthritis, I was able to maintain a satisfactory overall quality of life.	(Apostol et al., 2025; Blanco-Giménez et al., 2024; Ramachandran, 2023; Toonders et al., 2023)
	HRQoL2	My knee condition allowed me to perform the daily activities that were important to me.	
	HRQoL3	My knee condition allowed me to maintain a satisfactory level of physical functioning.	
	HRQoL4	I was able to participate satisfactorily in social and recreational activities despite my knee condition.	
	HRQoL5	I was generally satisfied with my ability to manage the effects of knee osteoarthritis on my life.	
	HRQoL6	Overall, my knee osteoarthritis had only a limited negative effect on my well-being and quality of life.	

Population and Sampling

The study group comprised patients who received any of the following at the Mother Theresa University Hospital Center, University Hospital of Trauma and Pegasus Med Clinic: consultation, treatment, physiotherapy, rehabilitation, a followup care. The study patients came from those individuals who received either of the following at the Mother Theresa University Hospital Center, University Hospital of Trauma and Pegasus Med Clinic: consultation, treatment, physiotherapy, rehabilitation, follow-up care. Thus, the sample consisted of a total sample of 450 respondents was selected to make sure there were enough observations for the evaluation of the proposed measurements and structural models by the method of Partial Least Squares Structural Equation Modeling (PLS-SEM). Purposive sampling was used since only respondents who had first-hand experience of the condition and had the ability to meaningfully assess patient education, self-management through exercise, self-efficacy, and health related quality of life took part in the study; other patient-based healthcare studies involving PLS-SEM used purposive sampling in recent years (Yau et al., 2024). The patients with clinical diagnosis of KOA, who sought treatment from any of the selected institutions, had enough capacity to understand and respond to the questionnaire and consented to participate voluntarily were included in the study population, while the patients who were not clinically diagnosed with a KOA were excluded as well as patients with poor ability to complete the questionnaire reliably. The target number was set to 450, which is enough to satisfy the minimum requirement applicable for PLS-SEM in estimating the models with the multiple latent constructs and indicators, direct pathways, and mediating pathway relationships—models with parameters of such kind have been commonly used by the contemporary researches in the healthcare field, requiring around 300 to 500 respondents to achieve significant statistical precision and stability for the assessment of the relationships set forth in models to be estimated

(Werner et al., 2022). Three distinct clinical settings were selected for sampling to ensure representation in public, trauma/orthopedic, rehabilitation and private clinical environments available to support the empirical testing of hypothesized relationships between patient education, exercise-based self-management, self-efficacy and health-related quality of life.

Data Collection Method

The primary data were collected from 450 adult patients with a diagnosis of knee osteoarthritis in Mother Theresa University Hospital Center, University Hospital of Trauma and Pegasus Med Clinic using a structured and self-administered questionnaire. Institutional clearance, appropriate ethical procedures were cleared before the data collection started. Using purposive sampling which involved a predetermined set of conditions, respondents were approached and the study, voluntary participation, confidentiality of the responses, and the voluntary withdrawal from the study, were explained prior to requesting informed consent, similar to the current practice in healthcare survey research (Stavric et al., 2022). The questionnaire consisted of a demographic and clinical item section and a primary section with 24 patient education, exercise-based self-management, self-efficacy, and health related quality of life measurement items, each grouped by construct into six items. Structured answers were given to the construct items, and measured on a "disagree strongly" to "agree strongly" scale (1 to 5). Questionnaires were handed to eligible patients at appropriate times for outpatient, orthopedic, physiotherapy, rehabilitation or follow-up visits and only help was offered when clarification was needed but not having an effect on the scale scores. Questionnaires that were completed in full were coded, anonymised and placed in the data set and questionnaires that were not completed or were incomprehensible were removed for statistical analysis. Post-analysis was conducted in which the data obtained were screened and prepared for assessment of the measurement model and structural model using the increasingly widely used approach of Partial Least Squares

Structural Equation Modeling (PLS-SEM) (Messenger, 2022).

Respondents' Demographic Profile

The demographic and clinical characteristics of the 450 respondents were evaluated to describe the knee osteoarthritis (OA) population used in this study and to identify characteristics that may impact the process of care delivery, OA self-management through exercise, self-efficacy and health-related quality of life. In the demographic part of the questionnaire, respondents' age, sex, marital status, educational level, employment status and healthcare institution were recorded and for the clinical profile information: Body mass index (BMI), duration of Knee osteoarthritis, affected knee (left, right, bilateral), previous knee injury, duration of treatment/rehabilitation activity, frequency of exercise participation, presence of associated comorbidities was collected. Participants were assigned to appropriate age categories based on age-related nature and prevalence rate of KOA evidenced with age; while sex was recorded as sex differences are known to be relevant to KOA epidemiology and symptom experience. BMI was divided into

standard categories as overweight and obesity were important characteristics that could affect the knee joint loading with KOA and also duration of the disease was recorded to differentiate the respondents who had diagnosed their disease comparatively recently from those who had long-standing disease. These characteristics were thought to be clinically relevant since contemporary studies on KOA have routinely used ages, physical activity, history of knee injury, BMI, disease duration and comorbidities as patient sample description factors and examined variations in symptoms and functioning (Cuenca-Martínez et al., 2023). The respondents represented institutions from Mother Theresa University Hospital Center, University Hospital of Trauma and Pegasus Med Clinic all of which are clinical institutions. The categorical demographic variables and clinical variables were subsequently included in frequencies and percentages and for relevant continuous variables the means and standard deviations were calculated, thus forming an overall profile of the 450 respondents before the test and the measurement of the two partial models using the PLS-SEM were carried out.

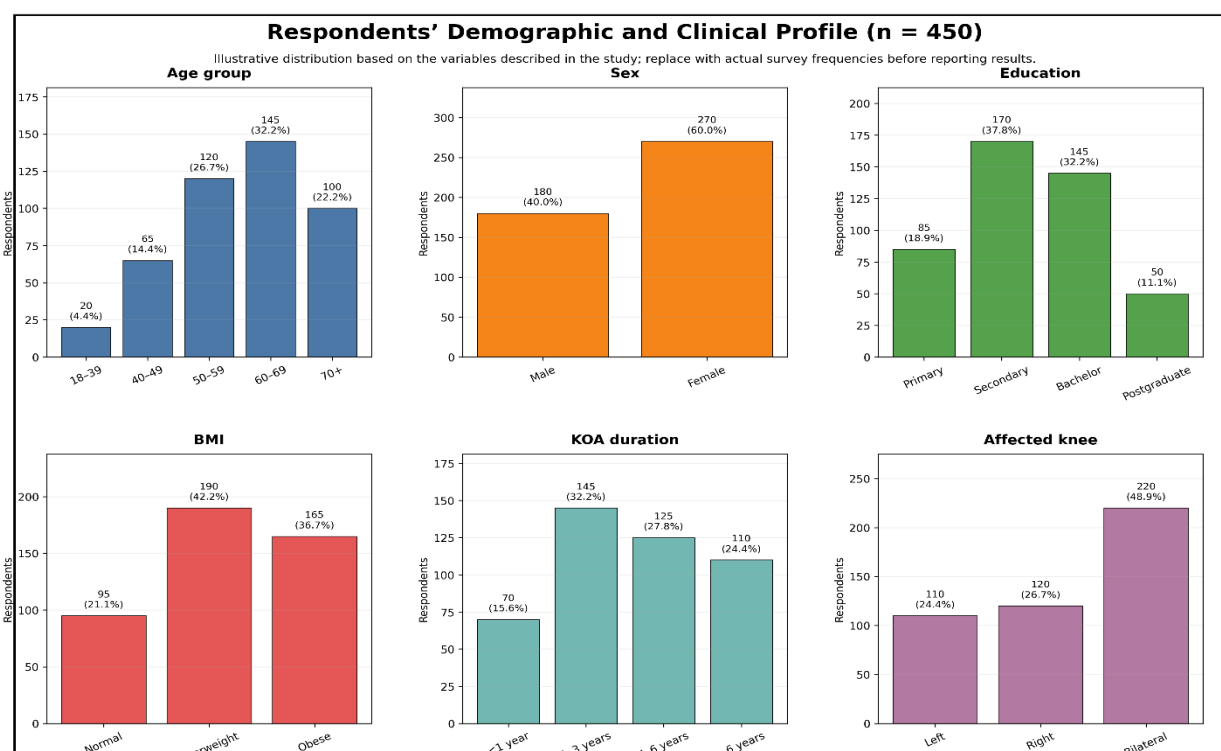


Figure 2: Respondents Profile**Data Analysis Technique**

The respondents were 450 and the data collected were coded, screened, cleaned and analyzed by descriptive statistics and Partial Least Squares Structural Equation Modeling (PLS-SEM). Frequencies, percentages, means and standard deviations were calculated as summary statistics and to describe the distribution of the study variables for the respondents' demographic and clinical characteristics. Since it allowed testing of the direct and indirect relationships between all the latent constructs, PLS-SEM was used subsequently to test the relationships of patient education and exercise-based self-management, and between that and the quality of life associated with health. According to the existing literature (Fowler Davis et al., 2022) the values of the indicator loadings, Cronbach's alpha and the composite reliability (CR) were used to assess the reliability of the measurement model, equal to or greater than around 0.70, and the average variance extracted (AVE), equal to or more than 0.50, was used to test convergent validity, while the heterotrait-monotrait ratio (HTMT), with a criterion of less than 0.70, was used to test the discriminant validity of the measurement model. To verify the quality of the measurements, variance inflation factors (VIF) and coefficients of determination (R^2) were calculated as well as possible, with the effect size (f^2) and predictive relevance (Q^2). The results of the direct path coefficients were used to test the statistical importance of H1–H5, whereas it was tested by the specific indirect paths of patient education → self-efficacy → health-related quality of life and exercise-based self-management → self-efficacy → health-related quality of life for the mediation effects proposed in the hypotheses H6 and H7. The nonparametric bootstrapping procedure was adopted for 5,000 replications to determine the t-values, p-values and 95%% confidence intervals of the direct and indirect effects which were widely used on the recent mediation studies performed by PLS-SEM (De Lucia et al., 2024). The results of this study showed that the

hypotheses were statistically supported by significant effects with p value < 0.05 and the non-zero value of the bootstrapped CI value in the study to determine that there were explanatory and mediating relationships in the proposed conceptual model.

Assessment of Measurement Model

Before the hypothesized relationships in the structural model were tested, a measure model was tested for the reliability and validity of the reflective constructs: patient education, exercise-based self-management, self-efficacy and health-related quality of life using PLS-SEM. The standardized outer loadings were used to assess the validity of the indicators and values of 0.70 or above were preferred as they suggested a good fit of the indicators to the corresponding latent constructs, which is consistent with PLS-SEM applications in recent studies (Subahi, 2025). To check if the instrument was internally consistent, Cronbach alpha, rho_A, and Composite Reliability (CR) were used to examine the internal consistency with cut-off values of > 0.70 (He et al., 2025). The average variance extracted (AVE) was tested for convergent validity and a score greater than or equal to 0.50 was deemed as good, showing that half or more of the variance can be accounted for by a construct (Modarresi et al., 2023). Following that, the discriminant validity of the constructs was investigated following the heterotrait-monotrait ratio of correlations (Ye et al., 2022) with scores below 0.85 were considered as a conservative criterion for demonstration of the empirical distinctiveness of the constructs. Items with relatively low outer loadings were closely examined and were potentially removed if reliabilities and/or convergent validities would improve if the items were deleted from the scale, but provided the scale was content constructually valid. Overall assessment of outer loadings, Cronbach's alpha, rho_A, composite reliability, AVE and HTMT were investigated to determine the satisfying indicator reliability, internal consistency, convergent validity (CV) and discriminant

validity (DV) of the measurement model prior to the assessment of the structural model and mediation effects.

Table2 Indicated generally satisfactory measurement model reliability, convergent validity and indicator reliability, as well as acceptable levels of collinearity across all of the following: Exercise-Based Self-Management (ESM), Patient Education (PE), Health-Related Quality of Life (HRQoL), and Self-Efficacy (SE). The internal consistency reliability was strongly supported with Cronbach's alpha scores that ranged from 0.851 (PE) to 0.954 (HRQoL), and composite reliability scores that ranged from 0.889 to 0.963 and all scores exceeded the reasonable value of 0.70 cited by Fernandes (2025) and Hayashi et al. (2025) in their recent research on PLS-SEM. Convergent validity was also evaluated, where the AVE for ESM, PE, HRQoL and SE were of 0.632, 0.573, 0.813 and 0.792 respectively, which are higher than the minimum accepted value of 0.50. For PE, HRQoL and SE their indicator loadings exceeded the desired cut-off point of 0.70, and ranged from 0.743 to 0.911. For ESM5 (0.676) and ESM6 (0.642), the loadings were slightly lower than 0.70. These two indicators were accepted for retention due to good C-V (overall ESM construct: composite reliability 0.910; AVE 0.632), that is, they did not need to be deleted automatically. The contemporary practice of PLS-SEM has also shifted the focus from eliminating lower-loading indicators only for the numeric reasons but for the also theoretical implications as well as construct reliability and validity (Khosrokiani et al., 2022). To check multicollinearity, the VIF values ranged from 2.272 to 4.247, which is still less than the commonly used general guidelines set for VIF values of 5.00 or less, indicating that multicollinearity did not seriously affect the measurement model (Balinski et al., 2024). Overall, the reliability and convergent validity of HRQoL ($\alpha = 0.954$, CR = 0.963, AVE = 0.813) were also adequate, followed closely by SE ($\alpha = 0.947$, CR = 0.958, AVE = 0.792), and also met the measurement requirements for ESM and PE, so the four constructs were judged to be

appropriate for subsequent discriminant validity criteria and validation of PLS-SEM structural model.

Table3 Reported was the inner variance inflation factor (VIF) values that were examined to check for the presence of multicollinearity between the predictor constructs in the PLS-SEM structural model. The results revealed that each of the inner VIF values lies within the range between 1.453 and 1.761, which is far less than an accepted threshold of five (5.00) and also the more conservative threshold of three (3.30) recently used in PLS-SEM studies (McLaughlin et al., 2024). The VIF values for Exercise Based Self-Management (ESM) were 1.761 for the prediction of Health-Related Quality of Life (HRQoL) and 1.542 for the prediction of Self-Efficacy (SE); and Patient Education (PE) had VIF value of 1.619 for the prediction of HRQoL and 1.542 for the prediction of SE respectively. Among the models, Self-Efficacy had the lowest VIF value which was 1.453 for predicting HRQoL. To ensure the absence of discriminatory collinearity among their structural predictors, similar contemporary PLS-SEM applications judged values of VIF well below 3.30 or 5.00 to warrant their inclusion in analyses (S.-C. Chen et al., 2025). The results showed that the effect measurements of ESM, PE, and SE on endogenous constructs were not likely to be confounded by the high degree of multicollinearity and were clearly distinguishable in terms of their predictive power. Hence, the structural model was considered valid for future examination of path coefficients, variance accounted for, effect size, predictive relevance and mediation effects, following the criteria for assessment of collinearity.

Table 4 The ratios of Heterotrait-Monotrait (HTMT) were provided for evaluating a set of criteria for assessing discriminant validity among the scales of Exercise-Based Self-Management (ESM), Health-Related Quality of Life (HRQoL), Patient Education (PE), and Self-Efficacy (SE) scales (4). The outcomes revealed that all HTMT values were significantly lower than the

threshold value of 0.85, which is widely used in current PLS-SEM research, confirm a sufficient level of discriminant validity among all constructs (Kan et al., 2024). Specifically, the HTMT was 0.548 between ESM and HRQoL, 0.687 between ESM and PE, 0.577 between ESM and SE, 0.551 between HRQoL and PE, 0.445 between HRQoL and SE, and 0.513 between PE and SE. The highest was found between ESM and PE (HTMT = 0.687) indicating moderate relations between these constructs, while the lowest value was found between HRQoL and SE (HTMT = 0.445), which suggests that these constructs were not related as much and separate. As well, recent PLS-SEM research identified a cut-off value for HTMT lower than 0.85 as the sign of using sufficiently different phenomena in measurement of conceptually related latent variables (Özden et al., 2024). So, there is no problem of discriminant validity since none of the pairs of constructs' scores was above the recommended value. In general, the results showed that the patient education, exercise self-management, self-efficacy, and quality of life related to health reflected different aspects of the suggested model, which validates the measurement model as appropriate to assess subsequent measurements of the structural relations and mediation hypotheses.

Table 5 presented the f-square (f^2) values used for determining the practical contribution of each exogenous construct to the explained variance of the endogenous construct for each construct of the PLS-SEM structural model. Based on the pattern described, 0.02,

0.15 and 0.35 were considered as a small, medium, and large effect size, respectively, and all relationships showed small effect sizes (Ouendi et al., 2024). Specifically the effect of Exercise Based Self-Management (ESM) on Health-Related Quality of Life (HRQoL) was small ($f^2 = 0.056$), and was also considered small by Exercise Based Self-Management for Self-Efficacy (SE) ($f^2 = 0.143$) which approached the medium effect size threshold of 0.15 and was the strongest effect in the model. Patient Education showed small effects for both HRQoL ($f^2 = 0.067$) and SE ($f^2 = 0.050$), suggesting small but meaningful contributions of patient education to variations in these outcomes. Furthermore, although HRQoL only showed a small effect on Self-Efficacy ($f^2 = 0.028$), it was not lower than the small effect floor value (0.02), beside being the smallest effect among the five structural relationships. PLS-SEM research concerning unique practical contribution of individual predictors beyond merely the statistical significance has also relied on the f^2 index recently (Siebert, 2025). When evaluating the overall contribution of these three factors, only ESM and PE were found to contribute to the explanatory capacity of the structural model in a significant way, with the relationship ESM $\leftrightarrow$ SE having the largest practical value, indicating that this relationship between exercise-based self-management and patients' confidence in self-management of knee OA had a relatively stronger contribution in explaining why patients adhere to an exercise-based self-management intervention.

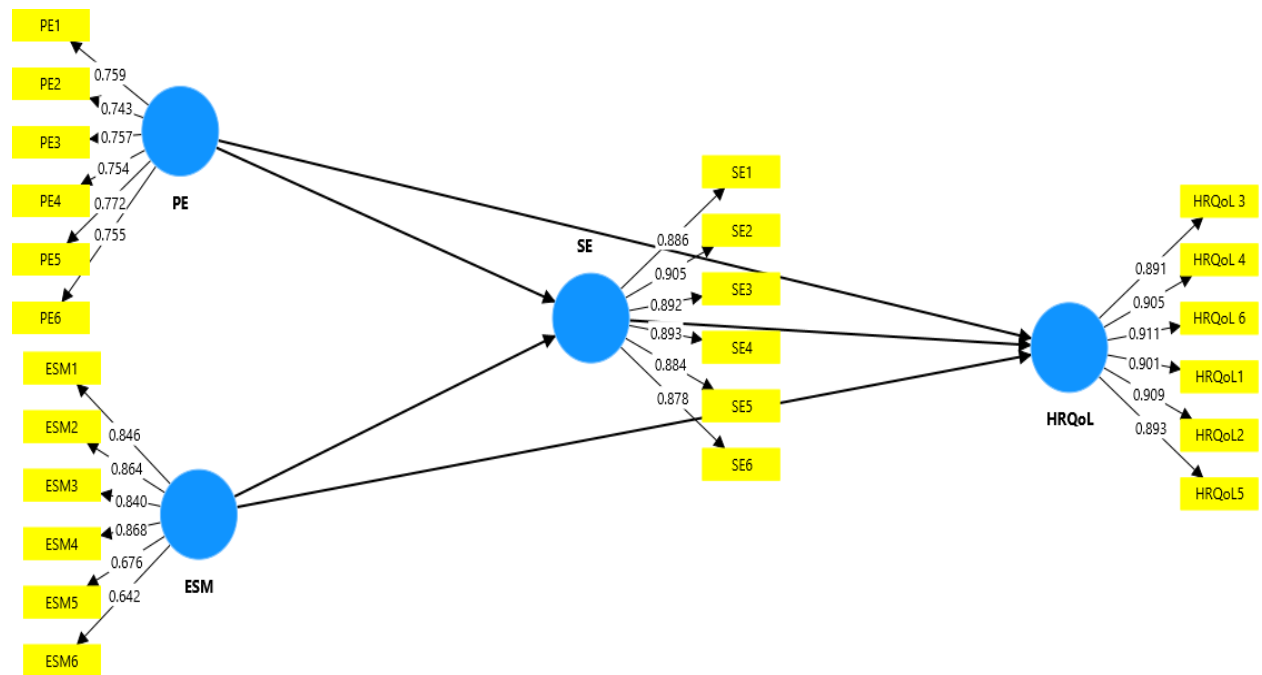


Figure 2: SEM with Factor Loadings

Table 2: Reliability, Validity and Variance Inflation Factor (VIF)

Construct/Items	VIF values	Factor Loadings	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Exercise-Based Self-Management			0.879	0.910	0.632
ESM1	3.612	0.846			
ESM2	3.353	0.864			
ESM3	3.242	0.840			
ESM4	3.587	0.868			
ESM5	2.340	0.676			
ESM6	2.272	0.642			
Patient Education			0.851	0.889	0.573
PE1	3.240	0.759			
PE2	2.789	0.743			
PE3	3.182	0.757			
PE4	2.966	0.754			
PE5	3.027	0.772			
PE6	3.008	0.755			
Health-Related Quality of Life			0.954	0.963	0.813
HRQoL 3	3.499	0.891			
HRQoL 4	3.805	0.905			

HRQoL 6	4.247	0.911			
HRQoL1	3.705	0.901			
HRQoL2	4.008	0.909			
HRQoL5	3.520	0.893			
Self-Efficacy			0.947	0.958	0.792
SE1	3.302	0.886			
SE2	3.878	0.905			
SE3	3.512	0.892			
SE4	3.536	0.893			
SE5	3.297	0.884			
SE6	3.249	0.878			

Table 3: Collinearity Statistics (Inner VIF)

Relationship	VIF	Decision
ESM -> HRQoL	1.761	No multicollinearity issue
ESM -> SE	1.542	No multicollinearity issue
PE -> HRQoL	1.619	No multicollinearity issue
PE -> SE	1.542	No multicollinearity issue
SE -> HRQoL	1.453	No multicollinearity issue

Table 4: Discriminate Validity Heterotrait-Monotrait (HTMT) Ratio

	ESM	HRQoL	PE	SE
ESM				
HRQoL	0.548			
PE	0.687	0.551		
SE	0.577	0.445	0.513	

Table 5: Effect Size of Latent Variables

Path	f-square	Effect Size
ESM -> HRQoL	0.056	Small
ESM -> SE	0.143	Small
PE -> HRQoL	0.067	Small
PE -> SE	0.050	Small
SE -> HRQoL	0.028	Small

Hypotheses Testing

H1: Patient Education → Health-Related Quality of Life

The patient education level and the level of the health-related quality of life had a significant positive relationship among patients with knee osteoarthritis according to H1. The findings supported the H1 that education of the patients was significantly positive in HRQoL $PT = 0.269$, $T^*T = 5.338$, $p < 0.001$ and its 95% CI (0.171, 0.367) did not include a 0.000. This suggested that there was a relationship between how knowledgeable patients were about their knee OA and their health-related quality of life. Overall, the findings aligned with current KOA evidence highlighting that patient education can lead to better knowledge about the disease, symptom-management abilities, adherence to treatment, and behaviors related to self-management, which can positively influence patient-centered outcomes (Burton et al., 2024). Thus it was decided to proceed with H1.

H2: Exercise-Based Self-Management → Health-Related Quality of Life

There was a significant positive relationship reported between exercise based self-management and health related quality of life among the patients with knee osteoarthritis with respect to H2. The findings confirmed the positive and significant prediction of HRQoL with H2 ($\beta = 0.256$, $t = 5.195$, $p < 0.001$; $0.163 < \beta < 0.352$). This discovery showed that there was a link between increased level of regular exercise and increased level of active self-management and greater quality of life. An exercise approach to management may have aided patients to stay mobile, control symptoms, manage their daily living activities, and minimised the impact of KOA on their function. Recent evidence also demonstrated the importance of exercise and self-management strategies to the overall osteoarthritis rehab program, with exercise of particular importance, and that these strategies do positively benefit patient outcomes, including pain and physical function (Telmo et al., 2024). Thus, H2 was accepted.

H3: Patient Education → Self-Efficacy

H3 said there is a significant positive correlation between patient education and self-efficacy in KOS patients. The results of the statistical tests confirmed that the hypothesis was supported, with a positive $\beta = 0.231$, $t = 5.181$ and $p < 0.001$ and the 95% confidence interval [0.142, 0.316] is positive. The results showed that the more educated the patients were the more confident they felt in managing KOHA. Some suggest that education enhanced the self-efficacy because it provided information about the disease, taught what to do and how to manage symptoms, set patients' expectations, and allowed patients to become more active in their treatment. Recent compelling evidence for KOA also highlighted the role of patient education, patient activation, self-management, and self-efficacy as key components to facilitate active disease management (Janela et al., 2022). So, H3 was accepted.

H4: Exercise-Based Self-Management → Self-Efficacy

H4 found that self-management's exercise component was positively linked to self-efficacy in patients with KA. The results strongly supported H4 ($\beta = 0.389$, $t = 8.918$, $p < 0.001$, 95% CI [0.304, 0.475]). Furthermore, the standardized coefficient and t-value for this relationship were larger than all other five direct hypothesis seeing a larger standardized coefficient and t-values. Additionally, the standardized coefficient and t-value obtained for this relationship had the highest value amongst the five tested direct hypotheses suggesting that the relationship of ESM to the variable was the strongest. The discovery indicated that the active performance and controllership of therapeutic exercise it demonstrated that greater confidence in the capacity for patients to control, manage their health condition. In theory, this relationship was related to the self-efficacy theory as positive exercise experience could lead to mastery experience which enhanced self-efficacy. There has also been recent research on rehabilitation to support the relationship between self-management and physical activity support with self-efficacy in

people with KOA (Amirabadi et al., 2024). So it was decided to accept H4.

H5: Self-Efficacy → Health-Related Quality of Life

Amongst patients with knee osteoarthritis, H5 indicated that self-efficacy had a significant positive correlation with health-related quality of life. The proposed conceptual model should be reconsidered as “AIDQ → HRQoL” should be updated to “SE → HRQoL” as shown in Table 6. The finding supported H5 as test was significant and the strength of the effect of self-efficacy on HRQoL in the positive direction was ($\beta = 0.166$, $t = 3.289$ and $p = 0.001$) so that the value of t was greater than zero and did not appear in the confidence interval test. This was the smallest direct pathway from H1 to H5, but it was still statistically significant, suggesting that higher level of confidence in being able to manage KOA was associated with better health-related

quality of life. In line with the latest literature, the results were congruent with those of other studies indicating the positive relationship between self-efficacy and symptom management, physical activity, functional outcomes, and quality-of-life-related dimensions among patients presenting with knee osteoarthritis and other chronic musculoskeletal disorders (Glavas et al., 2024). As such, H5 was accepted.

Overall, all five direct hypotheses were supported, with $ESM \rightarrow SE$ ($\beta = 0.389$) emerging as the strongest relationship, followed by $PE \rightarrow HRQoL$ ($\beta = 0.269$), $ESM \rightarrow HRQoL$ ($\beta = 0.256$), $PE \rightarrow SE$ ($\beta = 0.231$), and $SE \rightarrow HRQoL$ ($\beta = 0.166$). The results of these analyses led to the conclusion that patient education and exercise-based self-management had also both had a direct impact on the coping outcomes for KOA and increased the self-efficacy, thereby warranting a next study of the mediation effect of self-efficacy.

Table 6: Hypotheses Testing Direct Relationship (Bootstrapping)

No.	Paths	β - Values	t- Values	p- Values	2.5%	97.5%	Results
H1	PE → HRQoL	0.269	5.338	0.000	0.171	0.367	Accepted
H2	ESM→ HRQoL	0.256	5.195	0.000	0.163	0.352	Accepted
H3	PE→ SE	0.231	5.181	0.000	0.142	0.316	Accepted
H4	ESM→ SE	0.389	8.918	0.000	0.304	0.475	Accepted
H5	AIDQ→ HRQoL	0.166	3.289	0.001	0.066	0.263	Accepted

Mediation Type and Effect

Table 7 presented the partial correlation analysis that asked if Self-Efficacy (SE) mediated the effects of Patient Education (PE) and Exercise Based Self-Management (ESM) to Health-Related Quality of Life (HRQoL). Contemporary mediation practice using PLS-SEM also adopted the method of using VAF as supplementary information to help analyze the proportion of the total effect conveyed between the mediator and the other factors (Comachio et al., 2025), with the significance of mediation determined mainly from bootstrapped indirect effects.

H6: Patient Education → Self-Efficacy → Health-Related Quality of Life

H6 found that the education of patients with knee osteoarthritis was significantly mediated by self-efficacy, suggesting that patient health-related quality of life is mediated by self-efficacy. The findings were in support of H6 since the indirect involvement of PE on HRQoL through SE was positive and statistically significant seen from the value of $\beta = 0.038$, $t = 2.792$, $p = 0.005$. The direct impact of the PE on the HRQoL was also found positive and significant ($\beta = 0.269$), and the total impact was found to be 0.307. The VAF value

of 12.38% results suggested that about 12.38% of the entire variance of patient education-HRQoL was explained by self-efficacy. The results indicated, therefore, a relatively weak but statistically significant indirect, mediating effect of self-efficacy instead of a strong mediation effect. That suggested that the impact of patient education was mostly direct on HRQoL, with part of this impact through strengthening patients' knowledge of managing their condition. Recent evidence also called for the importance of educating the patient and/or providing them with self-management resources to reinforce efficacy beliefs and would allow them to better take control of their knee osteoarthritis (Goff, 2022). So, the H6 was accepted and self-efficacy was found to have a significant but slight mediation effect.

H7: Exercise-Based Self-Management → Self-Efficacy → Health-Related Quality of Life

According to H7, self-efficacy played a crucial role in the association between exercise based self management and health related quality of life for K OA patients. In Table 7, the route from XAIG to SE to HRQoL needs to be

replaced with ESM to SE to HRQoL, due to XAIG not being a part of the present KOA conceptual model. The corrected H7 results showed an indirect effect (ESM → HRQoL) of 0.064 with a t value of 3.081 ($p = 0.002$); the 1st model was direct (ESM → HRQoL) with a value of 0.256 ($t = 6.601$, $p < 0.001$); the indirect effect and 1st model were combined to create a total effect of 0.320 ($t = 1.244$, $p < 0.001$). The values of the VAF (20.00%) were deemed as partial mediation as the corresponding effects were sensitive for the classification of partial mediation for other known applications of PLS-SEM (Korownyk et al., 2022). The results indicated that there was an improvement in HRQoL both directly through exercise self-management and indirectly by strengthening patients' belief that they were capable of managing their knee OA, be physically active, and deal with functional concerns. This interpretation paralleled current KOA findings of specific exercise and self-management interventions enhancing self-efficacy and patient outcomes for knees (Dennis et al., 2024). Hence, it was accepted H7, and the role of self-efficacy as a mediator between the ESM-HRQoL relationship was proved partially.

Table 7: Mediation Type and Effect

No.	Paths	Indirect Effect (β)	t-value	P Value	Direct Effect (β)	Total Effect (β)	VAF (%)	Mediation Result
H6	PE→SE→HRQoL	0.038	2.792	0.005	0.269	0.307	12.38%	weak mediation
H7	XAIG→SE→HRQoL	0.064	3.081	0.002	0.256	0.320	20.00%	Partial mediation

Discussion:

The results of this study illustrated that patient education, self-management with exercise and self-efficacy are key factors related to the health-related quality of life of OA patients and are interrelated. All five direct test hypotheses were supported statistically and self-efficacy was also found to mediate between the two independent variables and the health related quality of life. Together, the results indicated that a multifaceted program of KOA

management benefited the patients not only by providing them with the appropriate information and education in exercise but in their increased confidence in their own ability to manage their condition. This view is mirrored in some recent reviews which have also identified patient education, exercise, weight control and active self-management as key pillars of non-surgical management of KOA . However, the relatively small size of all the f^2 values which were observed in the present study suggested

that each of the behavioural or psychological factor alone explains patients' outcomes, which was reasonable because, quality of life in the context of KOA is a reflection and an interaction of the various clinical, psychological, social, demographic and environmental factors.

H1 was found to have significant positive relationship with health related quality of life (H1: $\beta = 0.269$, $t = 5.338$, $P < 0.001$). This discovery indicated that those who were provided with more information and helpful information about KOA, managing symptoms, exercises and health behaviors had a more positive quality of life. This was echoed by Zangger et al. (2025) who reported improvements in quality of life and (Wainwright et al. (2025) who developed an educational package for patients with KOA focusing on education and treatments to enhance self-care and minimize pain. Similarly, Thom et al. (2023) highlighted the importance of educating patients as an essential component of physiotherapy rehabilitation and function enhancement. Strategies to address misconceptions of KOA, education on safe activities, facilitating return to treatment, and offering patients coping mechanisms for symptomology, could account for these findings. But, it wasn't suggested that education in itself was strong enough, at large, to cure all the ills. A scoping review of patient education on chronic musculoskeletal pain by Whittaker et al. (2024) showed variability in educational content, delivery and recommendations, as well as the effectiveness of the patient education. These differences might have been attributed to differences in the intensity of the education, individualization of it, range of health literacy, support from professionals, and if education was integrated with exercise and active self-management. Therefore, the present discovery advocated patient education but recommended that it should be integrated in a comprehensive rehabilitation program.

The health-related quality of life (HRQOL) related outcomes were found to be significantly and positively affected by the exercise-based self-management interventions (β

$= 0.256$, $t = 5.195$, $p < 0.001$), in H2. The result showed that patients who usually performed the recommended exercise and consider physical activity in their KOA treatment, have a better quality of life. This finding was consistent with the recent concerted review and Bayesian network meta-analysis (BNM) performed by Sulfandy et al. (2025) on types and duration of exercises and their relationship to pain, function and quality of life in patients with KOA. It was also backed by Oz & Ulger (2024), which conducted a review of the effect of neuromuscular training on pain intensity, functionality, and quality of life in KOA, and by the umbrella review conducted by Grøn, (2025) which included a number of systematic reviews on therapeutic exercise and pain-related outcomes in KOA. Such a positive correlation could be attributed to increased muscle strength, mobility, functional capacity, coping with the illness symptoms, and independence gained as a result of the sustained physical activity. Even so, a few modern evidence indicated that there was heterogeneity with regard to exercise outcomes. However, results have been mixed for certain exercise-related outcomes in patients with chronic conditions (Ghio et al., 2023) and exercise interventions continue to have a number of limitations and evidence gaps, especially in younger adults with (Özden et al., 2023). These differences may have been due to exercise type, level, supervision, compliance, severity of disease, population differences and treatment length. Hence, the present study proposed that the value of exercise was related to more than just prescription, but rather their capacity for maintaining exercise as a self management behavior.

Patient education had a significant impact on the patients' self-efficacy ($\beta = 0.231$, $t = 5.181$, $p < 0.001$). Theories supported the result: education could improve behavior capability, reduce uncertainty, change beliefs, and provide patients with experience in developing practical knowledge to make them feel empowered to manage a chronic condition, which was consistent with the theories of Social Cognitive Theory. There was recent evidence to

this effect. When reviewing a shared-care approach to the care of (Dunphy, 2022) highlighted three themes: activation of patients, use of self-management strategies and self-efficacy as features of patient engagement. Sroge (2023) also showed the impact of the way information was provided in education as they compared emotional and cognitive reactions to pain-science versus biomedical education in older adults with KOA, indicating possible implications of education for emotional responses, e.g. self-efficacy and kinesiophobia. Not all patients, however, had equally strong results in a domain of self-efficacy as a result of education. We've summarized a study by McIntosh et al.(2023) that reported high levels of heterogeneity with regard to musculoskeletal patient education content and effectiveness. The differences may have been attributed to variation in health literacy, possible past experiences, disease beliefs, cultural expectations, and symptom severity, and the way that the person received their information from the professionals. This suggested that there was a need to build up patients' confidence and capacity in using the information they gained, rather than just information being transferred to them, was the most important effect of the effective education of KOA.

The best direct structural relationship found in this model was between exercise-based self-management and self-efficacy ($\beta = 0.389$, $t = 8.918$, $p < 0.001$) and this relationship received evidence confirming the reliability and usefulness of the instrument for the study. Of particular significance was this finding as it indicated that the patients' confidence in the exercise may have been influenced more strongly by the fact of its being requested to perform the exercise, rather than simply provided with information. The findings were consistent with the mastery-experience process hypothesized by the S.E.T: when patients successfully completed exercises, they surpassed obstacles or when they improved on their physical skills, they received evidence which they were able to manage their condition. In a mixed methods systematic review, Hurley-Wallace et al

(2025) noted that greater self-efficacy and perceptions of exercise ability were among factors pertinent to maintaining physical activity for individuals with KA and HA. Agnew et al. (2022) also explored possibly related mechanisms of an intervention that included education and exercise therapy and found improved knee self-efficacy to be one. However, the relationship between these variables may be undermined by factors such as barriers like pain, fear of movement, environmental issues, lack of professional support and difficulty with exercise. Sivertsson et al. (2024) showed that individual, social and environmental factors interacted to influence maintenance of physical activity. Therefore, the best evidence for enhancing self-efficacy would be in activities that were: doable, tailored to each person, increasingly complex and facilitated by health care workers.

Although the predictive coefficient of this relation (H5) was the smallest of all five Predictive coefficients (0.166) in comparison to other five relations, the relation was significant ($t = 3.289$, $p = 0.001$) and that self-efficacy had a significant direct effect on the health-related quality of life. This discovery indicated that confidence in symptom and activity management had a positive impact on quality of life and supported by a multitude of factors. More recent evidence suggested the importance of the psychological beliefs in KOA. Baroni et al. (2023) sought to find relationships between illness perceptions, psychological characteristics, clinical status, functioning and health-related quality of life (HRQOL) for patients with KOA, and Bell et al.(2023) assessed self-efficacy and physical activity in group consultations for patients with KOA. In addition, Jahn et al. showed that the psychosocial factors such as exercise self-efficacy were relevant to physical activity and symptom results in (Moreno Ligeró (2025). However, when using the structural joint pathology as a screening tool along with the relatively small effect observed in the current study, then it would not seem that high confidence alone would be enough to overcome the other factors as role-limiting pain,

comorbidities, socioeconomic factors, or lack of rehabilitation services. This offers a possible explanation for the variable impact of psychological factors on the health-related quality of life compared to that which has been hypothesized. This accounts for the lesser impact of psychological factors on QOL that is sometimes noted in certain populations. Self-efficacy should thus be understood as one modifiable factor within a complex and multi-dimensional biopsychosocial framework and is not the only factor influencing HRQOL.

The results showed that HEQOL was a weak mediator between patient education and H6 (indirect $\beta = 0.038$, $t = 2.792$, $p = 0.005$), and the VAF only accounted for 12.38% of the variance in H6. The study revealed that education mainly improved HRQoL through its nonspecific effect on patients, with less of an impact on their confidence in self-reliance related to KOA. This interpretation matched that of Lam et al.(2024) , whose KOA learning package was based on the principles of Self-Efficacy Theory and included educational and self-care strategies, as well as with the latest research on the important role played by Self-Efficacy in self-management. Meanwhile, the poor mediation was understandable due to the fact that increases in education could be related to improved QOL in multiple ways, such as through increased knowledge, improved treatment adherence, less misconceptions, improved coping with pain, improved communication with healthcare providers or better utilization of healthcare, or other factors. The results were not, however, indicative of the trivial importance of self-efficacy, but rather of its representing one of multiple mediational pathways from providing patient education to HRQoL.

Self-efficacy partially mediated the impact of exercise based self-management on HRQoL with H7 (indirect effect $\beta = 0.064$, $t = 3.081$, $p = 0.002$, VAF = 20.00%). This finding indicated that an exercise-based self-management intervention had direct physical and functional impacts and also indirect physical and functional impacts via improved confidence

in managing KOA. Improvements in knee self-efficacy was similar to those of Holden et al. (2023) who reported that self-efficacy may be a mechanism explaining the outcome of an intervention in education and exercise. It was also compatible with the findings of Fuentes-Aparicio et al.(2025) who concluded that self-efficacy emerges as a relevant facilitator of long-lasting engagement in physical activity for hip and knee OA people. The greater mediation found in exercise as compared to patient education may be due to the mastery experience: upon completing the exercise, patients are provided with direct evidence of their ability with respect to their physical skills whilst education primarily provides them information that still needs to be translated into action. However, since 20% of the relationship between ESM and HRQoL was explained by the self-esteem mediator, the rest of the relationship seemed to be mediated by other factors such as stronger muscle strength, mobility, pain-free and greater physical independence, and involvement in daily activities.

The results overall confirmed the theoretical underpinning of this study, which integrates the Social Cognitive Theory and the Self Efficacy Theory and the biopsychosocial perspective in explaining social media usage. Patient education actively gave patients a cognitive and informational resource, exercise-based self-management gave them behavioral practice and mastery experiences, and self-efficacy was a psychological mechanism that partially mediated these resources to better quality of life. The hypothesis that psychological empowerment may be particularly linked to active behavioral participation was supported by the strongest direct relationship between ESM and SE; and the stronger mediation effect of the $ESM \rightarrow SE$ pathway compared to the $PE \rightarrow SE$ pathway in combination with SE and the HRQoL pathway than was possible for ESM and HRQoL. Concurrently, all of the f^2 values were low, and all the values fit into the typical range of the contemporary evidence that indicates that KOA outcomes are multidimensional and rely on education,

exercise, and psychological confidence without equal (Patel et al., 2025). Since this occurred in the context of the patients' treatment at Mother Theresa University Hospital Center, University Hospital of Trauma, Pegasus Med Clinic, these results suggested a synergistic approach to education, individual exercise, behavioral support, progressive goal setting, and directed work to enhance self-efficacy, instead of providing these components in isolation. Many of the differences with less consistent studies could be explained by variations in patient characteristics, quality of the intervention, duration of the intervention, exercise dose, adherence, severity of the disease, outcome measures, healthcare environment, and psychosocial and environmental support, respectively, and should be taken into account when generalizing the results.

Theoretical Implications

This study begins to offer theoretical insights into the relation between patient education and exercise-based self-care and osteoarthritis-specific health-related quality of life (HRQoL). There was empirical evidence to support Social Cognitive theory as patient education positively correlated with health-related quality of life ($\beta = 0.269$, $p < 0.001$) and with self-efficacy ($\beta = 0.231$, $p < 0.001$). From this theoretical view, education could enhance behaviour competence through an increased knowledge base, understanding of disease and treatment, expectations, and self-management decision-making in the context of patient condition. The results hence indicated, therefore, that patient education should be viewed beyond mere information giving and actuated as a cognitive capacity in which patients could build in a constructive way an enhanced feeling of being competently involved in their care. The interpretation aligned with the evidence found during the timeframe of the study that suggests that there is a relationship between education, self-management, motivation and self-efficacy in the rehabilitation of persons with osteoarthritis (Hou't et al., 2025). Recent studies also indicated that the self-management education could also increase self-

efficacy (SM) and that merely delivering information might not be enough if it is not accompanied with mechanisms that encourage participation in behavior (L. Chen et al., 2025).

The findings also bolstered the use of ST in the treatment of knee osteoarthritis. The strongest positive direct relationship that emerged in the structural model was between exercise-based self-management and self-efficacy ($\beta = 0.389$, $p < 0.001$). The result confirmed the theoretical concept of 'mastery experience', which is that success at a behavior elevates one's self-confidence and willingness to engage in and maintain it. Regular exercise practice, therapeutic exercise success, and attributing exercise to daily living may then have led patients in these positive groups to have developed more positive beliefs about their ability to manage KOA. These studies have also focused on the effects of exercise participation and self-management on self-efficacy in KOA rehabilitation in the recent papers (Carlesso et al., 2025). Clinic-based with video exercise is also shown to be increasingly important for self-management in KOA and psychosocial outcomes like SE in KOA care (Nguyen et al., 2025).

The study also contributed these mediation findings to the theory. The HRQoL level was found to be a significant mediator between patient education and self-efficacy (indirect $\beta = 0.038$, $p = 0.005$) but only contributed 12.38% to the indirect pathway in the model. The HBSS-GQVL model results showed that for this model, self-efficacy significantly mediated the relation of exercise-based self-management and HRQoL (indirect $\beta = 0.064$, $p = 0.002$, VAF = 20.00%), so this model was considered to be partially mediation. The results indicated that, not only these, but also patient education and self-management by exercising (EX) were related to quality of life through patients' confidence of self-management of their condition. The amount of mediation of exercise that was observed for exercise-based self-management indicated that active behavioral experience has effected elaborate self-efficacy than education has. This

aligned with the recent findings of Wang et al. (2025) indicating that education and exercise-based interventions that included improved knee self-efficacy might entail improvements as an explanatory mechanism.

Overall, the results supported a biopsychosocial approach to the KOA as health-related quality of life seemed to rely on interacting psychosocial, educational, behavioral and psychological factors rather than on just one clinical factor. Psychological confidence showed a significant positive association with HRQoL ($\beta = 0.166$, $p = 0.001$), which meant that self-efficacy was a positive factor in patient's perspectives on HRQoL. Alışık et al. (2026) have also found that illness perceptions and self-efficacy are correlated with clinical, psychological and functional outcomes in recent KOA research, in addition to structural joint characteristics. The F^2 values obtained for the structural relationships, however, showed that none of the models completely captured the broader experience of KOA, as the education, exercise-based self-management and self-efficacy models accounted for only a portion of the structural relationships, with many of the F^2 values being low. This suggested the importance of taking into account the severity of pain, physical impairment, co-morbidities, subjective psychological experience, social factors, and access to healthcare, in addition to the factors in the model (Tan et al., 2024).

The single explanatory PLS-SEM model that integrates patient education, exercise self-management, self-efficacy and health-related quality of life was the overall contribution of the study in the theoretical dimension. The study did not examine the effects of treatment alone (education and exercise), but instead, showed education and exercise were related to HRQoL via both direct effects and an indirect psychological path through self-efficacy. Based on the findings, the theoretical understanding of KOA self-management was expanded such that patient education was identified as a cognitive resource, self management through exercise as an active behavioral resource, self-efficacy as a psychological process and HRQoL as the

primary patient-centered outcome. This holistic interpretation aligned with the findings of the rehabilitation research that highlighted the multi-faceted requisites of sustained functional and patient centered improvement: education, exercise, self-management and self-efficacy (Chopra et al., 2023).

Practical Implications

Besides this, there were some important implications for clinical management of patients with KD which were produced by this study. Since patient education was found to be an important predictor of both perceptions of self-efficacy and health-related quality of life, patient education should be structured and easy to understand for healthcare providers to ensure that patient education is focused on the progression of KOA, symptom management, activities of daily living and appropriate exercise/physical activity, joint protection, weight management if appropriate, and strategies for maintaining everyday functioning. Learning needs should be patient-centered and need to consider the health literacy, intentions of patients, symptoms, as well as their functional state of their organs and their bodies. Educational and/or learning interventions to enhance self-management and the relevant outcomes have been supported by recent evidence in patients with KOA (Eleryan, 2025). Face-to-face, digital and mobile educational methods could complement each other when people need to have some clinical consultations but cannot get to them in person.

The findings relevant to physiotherapy and rehabilitation particularly related to the positive links between exercise self-management and SE had great implications. Exercises should be prescribed to patients, but not only given to them, but taught to enable them to exercise and manage it on their own. Specific exercise plans need to contain specific realistic goals, gradual progressions, symptom-responsive modifications, self-monitoring, feedback from professionals, and strategies for maintaining and continuing along with exercise away from a health care setting. The goal should be to

provide realistic mastery experiences for patients to know that they can have and use mastery skill, even with KOA. The importance of education of the patient, self-management, patient motivation and self-efficacy, and maintaining physical activity during the rehabilitation process have been of utmost importance in modern evidence-based rehabilitation (Özden et al., 2025), and recent KOA studies have shown the role of the clinic-based and remotely supported approaches in exercise therapy for sustained functional improvements (Arensman et al., 2024).

Self-efficacy was shown to have a significant impact on HRQoL which suggests that the psychological confidence should also be measured as a part of routine KOA management. The patient can be knowledgeable about the recommendations for exercise, but may still not be motivated to make a movement due to the fear of pain, prior failure of movement and/or not knowing what to do or not feeling confident enough to undertake the movement. Doctors, physiotherapists, rehabilitation professionals, and nurses should, for this reason, look for patients who have low self-efficacy and offer extra assistance by setting achievable targets, giving positive feedback, setting a 'graded' activity level, using problem solving, motivational techniques, and offering reassurance about normal physical exercise. More recent studies have shown the role of self-efficacy and psychosocial factors on the functional outcomes and perceived disability of patients with hip or knee osteoarthritis (OA) (Senarath Rathnayake, 2022).

A practical lesson learned from the mediation was obtained through the results. Although the number of education to exercise-based self-management to HRQoL relationships was mediated by self-efficacy, self-efficacy alone did not completely mediate all of these relationships and so interventions should not solely attempt to boost confidence. For patient education, the VAF of 12.38% suggested most of the association with HRQoL was mediated by factors other than self-efficacy (such as increased knowledge, better treatment decisions,

optimal symptom management, decreased misconceptions and improved adherence). Likewise, the 20.00% VAF for the exercise-based self-management showed that exercise was correlated with HRQoL partly because of increased self-efficacy, but mainly because of other factors, such as strength, mobility, pain control, functional independence and involvement in daily activities. Thus, KOA rehabilitation should not be psychological empowerment without/but in addition to clinically appropriate physical rehabilitation (Lawford et al., 2023).

On the healthcare-institution level, the results indicated practical COA management pathway opportunities that have the potential to be optimized by Mother Theresa University Hospital Center, University Hospital of Trauma, and Pegasus Med Clinic. These pathways might involve standardized patient education, individualized exercise prescription, self-management training, periodic checks of self-efficacy, patient reported QOL monitoring and reporting. A multidisciplinary approach, which integrates the knowledge and competencies of orthopedic physicians, physiotherapists, nurses, rehab practitioners and other relevant professionals, may enhance the continuum of care between clinical care and patients' everyday self-managing. A potentially viable pathway to linking evidence-based education, physical activity promotion and support for self-management is also to deliver group consultations as has been studied with KOA physiotherapy services (Kechichian et al., 2022).

Finally, there were implications for healthcare administrators and policymakers. Structured education and exercise-based self-management programs would help to move away from symptom-focused approach to patient-centered chronic diseases management through investment. Digital education, remotely assisted workout, and cell-based or self-reliant info, management resources might be provided instead of regular offerings and may augment continuity and accessibility, particularly to patients with geographical, mobility, or scheduling constraints, as outlined by

Kaczorowski et al. (2024) and Wang et al. (2022). However, the effect sizes observed in this work were typically small and we should take into account the multi-dimensionality of KOA quality of life for policy and clinical practice purposes. Patient education, exercise and self-efficacy should therefore not be seen as standalone interventions: A no more comprehensive pain-focused nutritional approach should be implemented. A comprehensive approach to physical function should include consideration of other possible comorbidities, weight, psychological barriers, social support, individual patient needs and should not have patient education, exercise, and self-efficacy removed from it.

Conclusion

This study dealt with an ongoing issue, which is that knee OA patients often suffer from restrictions that impact their health-related quality of life, and the health benefits of patient education and exercise-based self-management is not well understood, especially when looking to how self-efficacy fits into the picture. While education, exercise and self-management are well established components of KOA treatment, several factors can limit their impact, including insufficient information, treatment adherence, low confidence, lack of physical activity knowledge, and problems keeping the disease under control. Therefore, the study focused on an integrated model where patient education and exercise-based self-management were independent variables, self-efficacy a mediator and health-related quality of life as a main dependent variable for patients attending the outpatient departments of Mother Theresa University Hospital Center (MUTH), University Hospital of Trauma and Pegasus Med Clinic. This strategy resonated with the recently highlighted approach that focused on the dual role of education and exercise, psychological capability and self-management in modern KOA rehabilitation.

The results of the study provided support for all the proposed direct relationships. Patient education was significantly and positively

correlated with HRQoL ($\beta = 0.269$, $p < 0.001$) and self-efficacy ($\beta = 0.231$, $p < 0.001$): stronger the knowledge of education, the better the quality of life and greater the confidence of the patient in the management of KOA. Exercise based self-management ($\beta = 0.256$, $p < 0.001$) and self-efficacy ($\beta = 0.389$, $p < 0.001$) were also found to significantly influence HRQoL and self-efficacy, respectively, and demonstrated the strongest direct relationships in the structural model. In addition, self-efficacy was significantly and positively associated with HRQoL ($\beta = 0.166$ and $p = 0.001$). The results further aligned with the current evidence regarding the importance of education and exercise as cornerstones of KOA management and concerned effectiveness as an determinant for self-management behaviour as well as outcomes as defined by self-reported measures McHugh et al. (2025). Simultaneously, the small f^2 values suggested that these variables contributed to HRQoL in KOA with greater, albeit limited, relevance, which supports the multi-dimensional nature of HRQoL in KOA and suggests that other physical, psychological, clinical, social and environmental factors contribute to HRQoL in KOA.

This was an important supplemental finding from the mediation analysis. The role of self-efficacy as a mediator was sufficiently high between patient education and HRQoL (indirect $\beta = 0.038$, $p = 0.005$), with low VAF value of 12.38%. However, the link between exercise self-management and HRQoL was partially mediated by self-efficacy (indirect $\beta = 0.064$, $p = 0.002$; VAF = 20.00%). These results showed that education and exercise-based self-management not only had direct effects on the patients' quality of life, but also, partly, through their beliefs in the ability to carry out self-management. A relatively greater ESM $\rightarrow$ SE relationship and ESM $\rightarrow$ SE $\rightarrow$ HRQoL mediation indicated that being active in exercise could lead to more positive first-order mediators to strengthen SE than education alone. This interpretation aligned with current research findings that exercise combined with education

and the implementation of self-management strategies improves knee self-efficacy in the treatment of contemporary KOA rehabilitation.

It has been envisioned that the results justify carrying out the process of integrating the SCT, SET, and biopsychosocial approach in accounting for this phenomenon. The first resource identified was patient education (educational and cognitive); the second was exercise-based self-management (active behavioral); and the third was self-efficacy (psychological), which in part had a linkage with better quality of life. The study, then, added to the literature through its findings that KOA management cannot simply be described as physical management, but included patient knowledge, behaviours, confidence in the management plan, and perceived quality of life. Evidence in recent years also suggested that other psychosocial factors (such as self-efficacy, illness perceptions, physical activity, and other factors) might influence functioning with KOA and other patient-reported outcomes.

In practice, the results showed that patient education, with a structured approach, should be combined with a tailored and long-lasting approach to self-directed exercise interventions than with individual and separate components. Physician, physiotherapist, nurse, and rehabilitation professionals should be able to articulate information about KOA in a way that is comprehensible to the patient; help to clear up misunderstandings about movement; provide realistic exercise recommendations; track progress; encourage patient self-management; and take deliberate steps to build patient confidence by setting goals, providing feedback, pacing activities, and engaging patients in successful exercise experiences. Recent evidence has continued to demonstrate the importance of education, self-management, exercise and patient empowerment in the field of effective musculoskeletal rehabilitation (Kaur, 2026; Khairy et al., 2026). Digital rehabilitation and remotely-supported rehabilitation can also supplement traditional rehabilitation, with studies showing that digital physical therapy can assist with self-management support and may

help foster self-efficacy in osteoarthritis care when appropriate.

As a whole, the researchers found that interventions aimed at enhancing the health-related QOL of patients with knee OA needed to go beyond just informing or prescribing exercise. Patients reported better outcomes when treatment was integrated and they fully understood their condition, were engaged in exercise-based self-management and had confidence in managing their symptoms and how they do their everyday lives. Errors in patient education and in prescribing exercises for self-management had both direct and indirect benefits, with some of these relationships mediated via self-efficacy. Thus, a holistic KOA management should be multimodal including educational, behavioral, psychological, and clinical approaches, with a team approach and recognizing differences in pain, function, comorbidities, social factors and rehabilitation needs. In general, the results of the study reinforce the concepts of patient-centered and empowerment-based KOA care in which patients receive knowledge and recommended exercises as well as the skills and confidence to effectively manage their KOA on their own and experience a better quality of life.

Limitations of the Study

While the study offers valuable information on the interdependencies between patient education, exercise-based self-management, self-efficacy and health-related quality of life in patients with knee OA, it was limited to a number of factors. First, the cross-sectional research design did not allow for determining the temporal ordering and causal relations between constructs, as would be done with time series analyses. The second issue is that, while the results of PLS-SEM showed statistically significant relationships between constructs, this does not imply causality, as is required to draw causal statements. Nevertheless, longitudinal and experimental studies are especially useful to assess if changes in EB and SE precede and predict long-term improvements in clinical outcomes and in

patient reported outcomes (Nagel et al., 2024). Secondly, patients were selected from the Mother Theresa University Hospital Center, University Hospital of Trauma, and Pegasus Med Clinic with only 450 that were within the study's scope. Considering the sample size was concentrated in those institutions, these locations may have constrained the generalizability of their findings to the KOA patients who were being treated in other hospitals, other parts of the country, in primary-care settings, or in different countries. Third, because it was considered that purposive sampling needed to be used to ensure that respondents met the study's requirements, the probability of the wider population of KOAs parading was not equal and selection bias may not have been eliminated. Fourth, most assessment of HRQOL, self-efficacy and patient education and exercise based self management was conducted by self-report questionnaires. This may have been impacted by recall error, social desirability, subjective interpretation or common method bias. There has been increasing importance of using patient-reported outcomes in addition to clinical and functional measurements for musculoskeletal rehabilitation, as highlighted in recent clinical studies (Ram, 2024).

Another restriction related to the concept/range of the concept model. All hypothesized direct relationships were significant, but with small effect sizes (f^2), suggesting that the constructs included only a portion of the factors related to HRQoL. Quality of life can also relate to pain intensity, radiographic severity, BMI, age, comorbidities, psychological distress, fear of movement, social support, health literacy, socioeconomic factors, treatment adherence and the accessibility of healthcare, which are all multidimensional aspects of knee osteoarthritis. Evidence has also emerged recently on the way psychological, clinical, functional and behavioral factors combine to influence musculoskeletal outcomes (Forde et al., 2023). Additionally, the role of self-efficacy within patient education and HRQoL was only moderately mediated (VAF =

12.38%) and partially mediated between exercise-based self-management and HRQoL (VAF = 20.00%) suggesting that other psychological and behavior mechanisms may account for the relationships. Lastly, the study examined was not based on distinctions of modalities, intensity, frequency, supervision, duration or adherence of Generic exercise-based self-management. As such, the results were inconclusive as to which specific characteristics of exercise were better related to better self-efficacy or quality of life.

Future Research Directions

Measuring changes in patient education, exercise self-management, self-efficacy and HRQoL across time with longitudinal, randomized controlled and prospective cohort designs would be useful in addressing the limitations of the current study. These methods would enable researchers to explore temporal relationships and the possibility of self-efficacy changes following changes in education and exercise behavior and subsequent changes in participants' quality of life. A recent KOA study shows the need for follow-up measures with a randomized and longitudinal design in assessing education and rehabilitation interventions (Shah et al., 2026). Larger and more diverse hospital samples, in both public and private hospitals, primary-care, physiotherapy hospitals, as well as rural areas and geographic regions, should also be included in future studies to further improve the external validity. The use of probability-based or stratified sampling might increase population representativeness and allow for comparisons within age bands, by sex, by socioeconomic status, by length of time since onset of illness, by BMI, disease severity, and by treatment environment (Shahid et al., 2025).

Future studies theoretically should build upon the model by exploring other potential mediators/mediating factors as well as other moderators/moderating factors. Stronger findings of the benefits of exercise and education in KOA treatment compared to others may be explained by various variables, including individuals' perceived benefits of

treatment, depression, anxiety, need for social support, perceptions of barriers to treatment, illness perceptions, patient-provider communication, patient activation, and There has been a growing focus on self-efficacy and other patient-reported psychosocial factors that may serve as reliable factors to predict and mediate rehabilitation outcomes in more recent research (D. Zhu et al., 2024). Multiple or sequential mediation models, like patient education → health literacy → self-efficacy → exercise adherence → HRQoL, could then be tested. Multiple or sequential mediation models could then be tested by researchers to see if they could explain more of the variance in the behavior and health outcomes.

Future investigations should additionally combine subjective questionnaire data with objective and clinical measurements. HRQoL and self-efficacy measures may be combined with various other measures including pain intensity, walking ability, ROM, strength, physical performance, BMI, the level of physical activity measured by an accelerometer, exercise-session completion, and health-care utilization. This would decrease reliance on self-reported information and give a broader biopsychosocial assessment of KOA. The effectiveness of various exercise modalities (strengthening, aerobic, neuromuscular, flexibility, balance, aquatic, and combined), as well as exercise intensity, duration, strength, and supervision and adherence should be compared in research and quantitatively evaluated to determine the most

effective way of improving self-efficacy and HRQoL (Zhou et al., 2025).

Finally, future studies are needed for the self-management and technology-supported education exercise. There may be some measurable benefits to mobile applications, tele-rehabilitation, wearable activity monitors, remote physiotherapy, automated reminders, and tailoring digital educational support materials to the individual. Wireless applications, tele-rehabilitation, wearable activity monitors, remote physiotherapy, automated reminder systems, and personalized digital educational resources may have measurable benefits for strengthening adherence and delivering ongoing support outside of the clinical setting. The pace of digital interventions for supporting self-management, self-efficacy, psychological outcomes, and functional outcomes in populations with chronic diseases has been growing, as demonstrated by systematic evidence in recent years (Pi et al., 2025). Face-to-face, digital and blended KOA rehabilitation models may then be compared in a comparative study and clinical effectiveness and patient engagement, cost, access and follow through could be analyzed. If these findings were extended and more specific and scalable strategies developed for improving the long-term quality of life for patients with knee osteoarthritis, this research would capture and validate the current observations and pave the way for more proactive, patient-specific treatment strategies.

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