

ORIGINAL ARTICLE

Demographics-Related Utilization Patterns of Therapeutic Interventions in Knee Osteoarthritis Rehabilitation at a Malaysian Tertiary Hospital: A Retrospective Analysis

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ABSTRACT

Background & Objectives: Effective management of knee osteoarthritis (KOA) requires an understanding of treatment patterns across age groups. This study examines the use of therapeutic exercise and electrophysical agents (EPAs) in KOA rehabilitation across different age groups. **Methods:** A retrospective medical record review of physiotherapy records was conducted for KOA patients treated at Hospital Canselor Tuanku Muhriz, Malaysia, between January 2022 and April 2023. Sequential sampling identified 331 eligible cases from 2,404 records, excluding those with over 10 percent missing data. Sociodemographic and treatment details were collected using a structured form and analyzed using descriptive and inferential statistics to assess associations between age groups and variables such as ethnicity, gender, and intervention types. **Results:** An analysis of 331 medical records revealed a universal prescription of lower-limb strengthening exercises. Additionally, stretching exercises were recommended in 89.1% of cases. A significant association was identified between age groups and the use of balance exercises ($P = 0.030$), with lower utilization rates observed among middle-aged (45-64 years) and elderly (>65 years) patients, at 14.4% and 13.0%, respectively. Among EPAs, hot packs were the most frequently employed (93.7%). In contrast, cryotherapy (9.3%), transcutaneous electrical nerve stimulation (3.7%), and therapeutic ultrasound (1.9%) were less commonly utilized. Overall, treatment patterns were largely similar across age groups, with limited and inconsistent age-related differences. **Conclusions:** This retrospective utilization analysis found lower prescription of balance exercises and selected EPAs in KOA rehabilitation. Age-related differences were limited, with significance observed only for balance exercise use, highlighting the need for future prospective studies incorporating clinical outcomes.

Keywords: Demographics; electrophysical agents; knee osteoarthritis; physiotherapy; therapeutic exercise.

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INTRODUCTION

Knee osteoarthritis (KOA) represents a pressing global health challenge (Ji et al., 2023), with its prevalence rising and affecting approximately 650 million individuals worldwide (Cui et al., 2020). This condition presents a challenging healthcare obstacle (Munoz et al., 2023), characterized by persistent knee pain, functional limitations, and disability (Ahmad et al., 2018), necessitating lifelong rehabilitative measures. The contemporary standard of care for KOA underscores therapeutic rehabilitation exercises, encompassing strengthening, stretching, and low-impact aerobic activities to improve joint stability, flexibility, and overall knee function (Brophy & Fillingham, 2022; Overton et al., 2022). Complementary to these exercises, electrophysical agents (EPAs) are frequently employed by physiotherapists to augment clinical outcomes (Peat & Thomas, 2021; Watson, 2000). Commonly utilized

EPAs include hot packs, transcutaneous electrical nerve stimulation (TENS), therapeutic ultrasound (US), and cryotherapy (Watson, 2000; Wu & Zhu, 2022).

The significance of therapeutic exercises and EPAs in KOA management is firmly established and reinforced by clinical practice guidelines (Bannuru et al., 2019; Brophy & Fillingham, 2022). A substantial body of evidence underscores the efficacy of combining therapeutic exercise with EPAs in alleviating pain, lessening disability, and enhancing physical function among KOA patients (Ahmad et al., 2022; Peat & Thomas, 2021). However, despite these reported benefits, research has highlighted the suboptimal utilization of these interventions in routine clinical practice (Collins et al., 2019; Dziedzic & Allen, 2018), which may contribute to limited improvements in clinical outcomes. Studies indicate that while a significant proportion (64%) of KOA patients acknowledge the importance of exercise in managing their condition, a much smaller percentage

(36%) actively engage in exercise, with an even smaller fraction (10%) receiving physical therapy prior to knee arthroplasty (Conaghan et al., 2015). Furthermore, physiotherapy management is often perceived as a form of secondary prevention rather than a curative strategy (Ahmad et al., 2018). Although several studies have described overall utilization patterns of physiotherapy interventions in KOA, limited attention has been given to how these patterns vary across different age groups in routine clinical settings. Thus, addressing the underutilization of therapeutic exercise and EPAs remains a crucial challenge in harnessing their benefits.

In addition to the underutilization of these physiotherapeutic interventions (Collins et al., 2019; Dziedzic & Allen, 2018), previous research underscores the influence of age-related treatment preferences and engagement (Kanavaki et al., 2017). Several studies have documented that older individuals with KOA exhibit reduced physical activity levels (Zampogna et al., 2020), resulting in diminished interest in actively participating in therapeutic exercises (Chmelo et al., 2013; Kanavaki et al., 2017). This lack of engagement in exercise can adversely impact patients' self-management capabilities (Kamsan et al., 2020). Age-related differences in functional capacity, comorbidity burden, balance confidence, and rehabilitation tolerance may therefore influence both the selection and delivery of therapeutic interventions in KOA. Understanding whether and how rehabilitation practices differ across age groups is clinically relevant, as age-specific needs may warrant tailored intervention strategies to optimize safety, adherence, and functional outcomes.

Therefore, it is imperative to evaluate current therapeutic intervention practices for KOA and to explore potential age-related variations in treatment utilization. Recognizing treatment patterns across different age cohorts is crucial, as tailored modifications can profoundly influence patient care planning and resource allocation. By specifically examining age-related differences in the utilization of therapeutic exercises and EPAs, this study adds practical insight beyond existing utilization studies by highlighting how routine rehabilitation practices may vary across the adult lifespan. Hence, this study aims to examine the use of therapeutic exercises and EPAs in KOA management across various age groups.

MATERIALS & METHODS

Study design and ethical approval

This study was a retrospective medical record review involving the collection of secondary data from the medical records of KOA patients undergoing treatment at the Physiotherapy Department of Hospital Canselor Tuanku Muhriz (HCTM), Malaysia. Ethical clearance was obtained from the Research Ethics Committee of

Universiti Kebangsaan Malaysia (Approval No.: UKM PPI/111/8/JEP-2023-138).

Target population

This study included the medical records of Malaysian individuals aged 18 years and above who were diagnosed with KOA based on the American College of Rheumatology's clinical or radiographic criteria and underwent rehabilitation at HCTM's Physiotherapy Department from January 2022 to April 2023. Diagnoses were confirmed by attending physicians prior to referral for physiotherapy treatment. Patients undergoing perioperative physiotherapy for total knee replacement (TKR) were excluded.

Procedures

A master record list encompassing cases documented at HCTM from January 2022 to April 2023 was obtained from the Physiotherapy Department. Screening of this comprehensive database adhered to predefined inclusion criteria, specifically targeting patients diagnosed with KOA and aged 18 years or older. Initial consensus within the department's database revealed a cohort of 2,404 KOA patients who sought conservative management services at the physiotherapy department during the specified timeframe. Due to practical constraints, the requisite number of medical records for secondary data extraction was estimated utilizing the Krejcie and Morgan Table (Bujang, 2021). Consequently, a minimum sample size of 331 subjects was determined for a known population size of 2,400-2,600. A sequential sampling approach was employed, in which records were screened in chronological order by clinic attendance. Within this process, every third eligible record was selected for inclusion until the target sample size of 331 was achieved. This approach ensured systematic coverage of the study period while minimizing selection bias.

Medical records with over 10% missing data were deemed ineligible and replaced with new records to maintain sample integrity. Each individual case in the sample was assigned an anonymous identifier to safeguard patient confidentiality. Oversight of the sampling process was provided by an author not involved in the initial data collection. The data extraction phase was independently executed by two authors, with any disparities resolved through mutual discussion. Sociodemographic data, including age, gender, ethnicity, and visit frequency, were extracted.

Age categories were defined as young adults (<44 years), middle-aged (45–64 years), and older adults (>65 years) (Plotnikoff et al., 2015). These age groupings were selected based on their clinical relevance, reflecting differences in disease burden, functional capacity, and rehabilitation needs across the adult lifespan, particularly during the transition to older age, when functional decline, balance impairment, and comorbidity prevalence become more prominent (Plotnikoff et al., 2015). Additionally, therapeutic

interventions such as lower limb strengthening, stretching, balance exercises, and various modalities, including hot packs, cryotherapy, TENS, and US, were documented.

Data analysis

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) software. Descriptive statistics and cross-tabulations were generated for ethnic groups, gender, use of EPAs, and therapeutic exercises across different age groups, with results expressed as frequencies and percentages. Associations between age groups and other variables were assessed using the chi-square test of independence, with a significance level set at $P < 0.05$.

Where expected cell counts were less than five, results were interpreted cautiously, and categories were examined descriptively to avoid overinterpretation of sparse data.

RESULTS

Medical records were reviewed between April and June 2023. The mean (SD) age of patients with KOA was 63.44 (10.62) years, with the majority being female ($n = 250, 75.5\%$). The largest age category comprised older adults (>65 years) at 48.9%, followed by middle-aged adults (46.2%), and young adults (<44 years) at 4.8%. The distribution of participants across age groups was therefore uneven, with fewer young adults. Ethnically, Malays were the predominant group across all age categories, representing 87.5% of young adults, 68.0% of middle-aged individuals, and 49.4% of older adults. A statistically significant association was observed between age and ethnic groups ($\chi^2(8, n = 331) = 18.806, P = 0.001$), whereas no significant association was found between age group and gender. Detailed demographic characteristics are presented in Table 1.

Table 1. Demographic characteristic of the knee osteoarthritis population ($n = 331$).

Variables	Age groups (years): n (%)			P-value
	18 - 44 (n = 16)	45 - 64 (n = 153)	> 65 (n = 162)	
Age, mean \pm SD	39.44 \pm 4.52	57.22 \pm 5.55	71.69 \pm 6.15	
Ethnicity				
Malay	14 (87.5)	104 (68.0)	80 (49.4)	0.001*
Chinese	1 (6.3)	30 (19.6)	61 (37.7)	
Indian	1(6.3)	19 (12.4)	21 (13.0)	
Gender				
Male	4 (25.0)	31 (20.3)	46 (28.4)	0.244
Female	12 (75.0)	122 (79.7)	116 (71.6)	

Note: Statistically significant, $P < 0.05$.

All KOA cases received therapeutic exercises, with 93.4% receiving combinations of exercise modes, including stretching, strengthening, and balance; only 0.6% received prescriptions for a single mode. Lower limb strengthening and stretching were the most commonly employed treatments. Strengthening exercises were administered to all age groups, while stretching exercises were provided to all young adult KOA patients and to 88.2% of middle-aged and 88.9% of older adults. No statistically significant association was found between age groups and the prescription of strengthening and stretching exercises. Balance exercises were prescribed in 37.5% of young adults, 14.4% of middle-aged adults, and 13.0% of older adults. A statistically significant association was found between age groups and the prescription of balance exercises ($\chi^2(2, n = 331) = 6.992, P = 0.030$). These comparisons should be interpreted in the context of unequal age-group sizes, particularly the smaller number of young adults. Detailed therapeutic exercise interventions across different age groups are shown in Table 2

Of the 331 cases, 48.6% ($n = 161$) documented the receipt of single or combined EPAs. Hot packs were the

most commonly used EPA across all age groups (Figure 1), with 100% of young adults, 98.7% of older adults, and 86.8% of middle-aged individuals utilizing them. Cryotherapy was recorded in 16.7% of older adults and 13.2% of middle-aged individuals. TENS was documented in 6.3% of older adults and 4.0% of middle-aged individuals. Therapeutic ultrasound was recorded in 4.0% of middle-aged patients. Given the small number of young adults, comparisons involving this group should be interpreted cautiously. No statistically significant association was found between age groups and the utilization of different EPAs in KOA management.

DISCUSSION

This study aimed to examine the use of therapeutic exercises and EPAs in the management of KOA and to identify variations in their use across age groups in Malaysia. In this retrospective medical record review, 331 medical records of patients with KOA who underwent physiotherapy were reviewed. This study found that therapeutic exercises were prescribed in all cases (100%), whereas the use of EPAs was relatively

Table 2. Utilization of therapeutic exercises and electrophysical agents in knee osteoarthritis management (n = 331).

Variables	Age groups (years): n (%)			P-value
	18 - 44 (n = 16)	45 - 64 (n = 153)	> 65 (n = 162)	
Therapeutic exercises				
Strengthening (Yes)	16 (100.0)	153 (100.0)	162 (100.0)	1.0
Stretching (Yes)	16 (100.0)	135 (88.2)	144 (88.9)	0.352
Balance (Yes)	6 (37.5)	22 (14.4)	21 (13.0)	0.030*
Electrophysical agents				
EPA's (No)	10 (62.5)	77 (50.3)	83 (51.3)	0.502
EPA's (Yes)	6 (37.5)	76 (49.7)	79 (48.7)	0.462
Hot pack	6 (100.0)	66 (86.8)	78 (98.7)	0.546
Cryotherapy	0 (0.0)	10 (13.2)	5 (16.7)	0.227
TENS	0 (0.0)	3 (4.0)	3 (6.3)	0.854
US	0 (0.0)	3 (4.0)	0 (0.0)	0.236
Total no of sessions, mean ± SD	4.50 ± 3.81	4.82 ± 3.27	4.43 ± 2.85	0.529

Note: EPA, electrophysical agent; TENS, transcutaneous electrical nerve stimulation; US, therapeutic ultrasound. Statistically significant, P < 0.05.

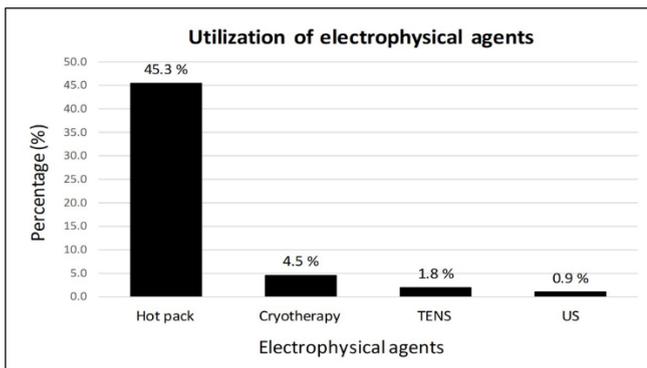


Figure 1. Utilization of electrophysical agents in the management of knee osteoarthritis.

less common (48.6%). In particular, exercises targeting lower-limb strengthening and stretching were the dominant interventions, and age demographics did not significantly affect their use. However, balance exercises were less frequently employed, particularly among older patients. As for EPAs, hot packs were the most commonly used, and their use showed no significant variation across age groups. In contrast, modalities such as cryotherapy, TENS, and US were employed to a lesser degree across all age groups. These findings describe observed rehabilitation practice patterns rather than evidence-based recommendations or treatment effectiveness, and highlight the need for further research to investigate factors influencing treatment preferences and the underutilization of specific modalities, such as balance exercises and individual EPAs. These insights can inform clinicians when considering treatment selection in routine KOA rehabilitation.

The study identified a higher prescription rate for lower-limb strengthening and stretching exercises than for

balance exercises. This pattern is consistent with current KOA clinical practice guidelines, given the established efficacy of these exercises in addressing key KOA symptoms, including pain, stiffness, limited joint mobility, and muscle weakness (Brophy & Fillingham, 2022; Overton et al., 2022). Research consistently demonstrates that strengthening exercises targeting knee muscles, such as the quadriceps and hamstrings, enhance joint stability and mechanical support (Neelapala et al., 2020; Varbakken et al., 2019; Zhang et al., 2020). Additionally, stretching exercises, whether used alone or in combination with other exercises, improve joint flexibility (Law et al., 2009; Suzuki et al., 2019). These combined effects contribute to reductions in KOA symptoms, including pain and stiffness, as well as improvements in joint function (Suzuki et al., 2019; Yeap et al., 2021). Furthermore, beyond physical outcomes, a meta-analysis of five trials by Hall et al. (2021) reports beneficial effects of supervised strengthening exercises on psychological well-being, particularly depressive symptoms, among individuals with KOA (Hall et al., 2021).

Interestingly, this study identified a significant association between balance exercise prescription and age group. It is concerning that middle-aged and older individuals received fewer balance exercise prescriptions compared to younger adults, given their higher risk of age-related muscle mass loss, balance impairment, and reduced mobility (Liao et al., 2021; Volpi et al., 2004). Balance impairment in individuals with KOA has important clinical implications, as it is closely linked to reduced functional mobility, increased risk of falls, and diminished confidence during daily activities such as walking, stair negotiation, and transfers. Muscle mass decline typically begins around age 30 and accelerates at 3–8% per decade, with a

steeper decline after age 60 (Volpi et al., 2004). In the context of KOA, pain, joint instability, and altered proprioception may further exacerbate balance deficits, thereby increasing fall risk and functional dependence, particularly among middle-aged and older adults.

Several factors may contribute to the lower prescription of balance exercises in KOA management. Firstly, balance exercises may be perceived as more challenging for older patients due to higher coordination demands and perceived fall risk (Ponvel et al., 2019). Secondly, physiotherapists may prioritize strengthening and stretching exercises, which are widely recognized as core components for improving joint stability and flexibility (Collins et al., 2019). Notably, strengthening exercises may also indirectly improve balance through enhanced muscle strength (Neelapala et al., 2020; Suzuki et al., 2019; Zhang et al., 2020). In addition, balance training receives comparatively less emphasis in current KOA guidelines, which may further contribute to its lower incorporation into routine practice (Brophy & Fillingham, 2022; Yeap et al., 2021). Beyond guideline influence, therapist-related factors, such as competing clinical priorities within limited treatment sessions, concerns about patient safety during balance tasks, and the need to manage high caseloads, may further reduce the routine prescription of balance exercises. In public hospital settings, system-level constraints including time-limited appointments, staffing shortages, space constraints, and high service demand may also restrict the implementation of balance-specific training despite its recognized clinical importance. However, balance-specific training plays a distinct role beyond strength gains, particularly in improving postural control, movement confidence, and fear of falling, which are critical determinants of participation in physical activity and rehabilitation adherence in older adults with KOA.

These findings underscore the importance of age-specific exercise prescription, where balance training is deliberately integrated alongside strengthening and stretching exercises to address functional mobility limitations and fall risk in middle-aged and older individuals with KOA. From a practical perspective, progressive and safety-adapted balance exercises may be feasible within routine clinical settings and could enhance the overall functional value of KOA rehabilitation programmes. Such an approach may enhance not only physical function but also confidence and independence in daily activities.

Meanwhile, less than half of KOA patients received either single or combined EPAs as part of their treatment regimen. The lower utilization of EPAs observed in this study reflects current clinical practice and should not be interpreted as an assessment of their

effectiveness or lack thereof, given the variability in evidence across modalities (Gomes et al., 2020; Overton et al., 2022). Hot packs emerged as the most frequently used EPA across all age groups. This observation may be explained by practical factors such as ease of use, accessibility, and patient acceptability, rather than superiority over other modalities (Brosseau et al., 2003; Ochiai et al., 2014). Heat therapy is also commonly described in the literature as a self-management option for pain relief in KOA (Anwer et al., 2016; Kamsan et al., 2020). In contrast, cryotherapy, TENS, and US were sparingly used across all age groups. Although prior studies have reported potential benefits of these modalities, including cryotherapy (Brosseau et al., 2003), TENS (Bruce-Brand et al., 2012; Osiri et al., 2000; Wu & Zhu, 2022), and US (Morishita et al., 2014; Welch et al., 2001; Wu et al., 2019), their lower utilization in this study likely reflects pragmatic considerations such as resource availability, time constraints, and clinical prioritization rather than alignment with evidence-based recommendations alone.

In this study, physiotherapists were observed to utilize EPAs more frequently among older patients than younger patients. This pattern may be influenced by factors such as a higher prevalence of comorbidities (Kamsan et al., 2021), increased pain sensitivity, and age-related physiological changes that may limit exercise tolerance (Ponvel et al., 2019). Additionally, older patients may express a greater preference for passive treatment modalities (Cheah & Meltzer, 2020; Sun et al., 2019). These observations describe utilization trends and should not be interpreted as endorsement of specific modalities, particularly as the present study did not assess patient preference, pain severity, or functional limitations directly. Nonetheless, the findings suggest that EPAs are often incorporated as adjunctive modalities in older adults, potentially to facilitate symptom relief and participation in rehabilitation programs.

Limitations

Several limitations should be acknowledged. First, the retrospective medical record review design limits causal interpretation and relies on the completeness and accuracy of existing clinical documentation. Second, information on KOA disease severity, radiographic grading, pain intensity, and functional outcomes were unavailable, which may have influenced treatment selection. Third, this study was conducted at a single tertiary centre, potentially limiting generalizability to other clinical settings. Finally, the small proportion of younger adults may have reduced the statistical power to detect age-related differences. These limitations highlight the need for future prospective, multi-centre studies incorporating standardized clinical outcomes to better understand

treatment decision-making in KOA rehabilitation.

CONCLUSION

This study reports service utilization patterns of therapeutic exercises and electrophysical agents in knee osteoarthritis rehabilitation across age groups. Lower limb strengthening and stretching exercises were commonly prescribed, whereas balance exercises and selected electrophysical agents (cryotherapy, TENS, and therapeutic ultrasound) were less frequently utilized. Age-related differences were limited, with most intervention patterns showing no significant variation. These findings reflect current practice rather than treatment effectiveness and highlight the need for prospective studies incorporating clinical outcomes to guide age-appropriate KOA rehabilitation.

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Competing Interest

The authors report no conflict of interest.

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