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Multidimensional assessment of pain in elderly individuals undergoing total hip Arthroplasty: A systematic review

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Abstract
Effective postoperative pain management in elderly patients undergoing total hip arthroplasty (THA) necessitates an in-depth, multidimensional assessment capturing the sensory, affective, cognitive, and functional aspects of pain. This systematic review synthesizes evidence from 45 studies published between 2015 and 2025, encompassing randomized controlled trials, cohort studies, psychometric validation investigations, and clinical intervention evaluations. Key assessment instruments including the Geriatric Pain Measure (GPM-24), McGill Pain Questionnaire (MPQ), and Brief Pain Inventory (BPI) demonstrate robust psychometric properties and clinical relevance in this population. Multidimensional pain scores correlate strongly with opioid consumption, rehabilitation progress, and cognitive outcomes. Furthermore, analgesic approaches such as nerve blocks and multimodal pharmacotherapy analyzed through these tools reveal improvements in pain control and faster functional recovery. Challenges remain with tool applicability in cognitively impaired patients, cross-cultural validation, and routine clinical integration. This review underscores multidimensional pain assessment as essential for individualized analgesic strategies, improving elderly patients' postoperative recovery, well-being, and quality of life.

Keywords: Multidimensional pain assessment, total hip arthroplasty, elderly, postoperative pain, patient-reported outcomes

1. Introduction
Total Hip Arthroplasty (THA) has emerged as a cornerstone surgical intervention for elderly patients afflicted with end-stage degenerative hip conditions, particularly osteoarthritis. Globally, the frequency of THA continues to escalate, driven by demographic shifts toward older populations with increased life expectancy. Such trends impose unprecedented demands on healthcare systems, necessitating not only increased surgical volume but also optimally tailored perioperative and postoperative management strategies to maximize functional recovery and patient satisfaction [1].

The prevalence of osteoarthritis as the principal indication for THA underscores the chronic and disabling nature of joint disease in aging adults [2], where progressive cartilage deterioration and joint deformity severely impair mobility, independence, and overall quality of life.

The clinical importance of THA lies in its transformative impact on restoring mobility and reducing pain in elderly patients. Its success translates into meaningful improvements in activities of daily living (ADLs), allowing older adults to reclaim independence, reduce reliance on caregivers, and engage more fully in social and physical activities [3]. This restoration is further documented through gains in validated functional indices such as the Harris Hip Score and enhanced participation in rehabilitation programs. The medical and economic repercussion of successful THA extends beyond immediate symptom relief, as improved mobility reduces morbidity related to immobility, such as deep venous thrombosis, osteoporosis-related fractures, and decline in cognitive functions.

Healthcare systems bear significant economic burdens intrinsic to the growing volume of THA procedures, compounded by postoperative care complexity in elderly cohorts [4]. Hospitalization, rehabilitation services, and management of surgical complications account for substantial resource utilization. Concomitantly, elderly patients commonly present with multimorbidity and physiological frailty, factors that challenge standard care protocols and require individualized approaches to minimize postoperative risks [5]. Multimorbidity extends the duration of hospitalization and escalates complication rates, including infections, cognitive decline, and delayed functional recovery, all linked intimately with the adequacy of pain management. Thus, the intersection of epidemiological trends and clinical imperatives establishes THA as both a therapeutic opportunity and management challenge in aging populations.

Pain post-THA embodies a complex, multidimensional construct composed of intertwined sensory, affective, cognitive, and social facets. The sensory dimension encompasses the physical perception of pain—intensity, quality, location, and temporal patterns—while the affective domain pertains to emotional responses such as anxiety, distress, and depression induced or exacerbated by pain. Cognitive components involve patient appraisal of pain, coping strategies, catastrophizing, and expectations, which modulate subjective pain experiences and compliance with treatment [6]. Additionally, social factors support systems, socioeconomic status, cultural beliefs shape pain expression and reporting.

Age-related neurophysiological changes significantly affect pain perception and processing in elderly individuals. Alterations in peripheral nociceptors, diminished inhibitory pain pathways, and changes in neurotransmitter levels alter pain thresholds, often resulting in heightened or aberrant pain sensations [7]. These variations complicate the predictable patterns of postoperative pain and may contribute to atypical clinical presentations, including increased risk for chronic postsurgical pain syndromes.

Psychological comorbidities, particularly anxiety and depression, are prevalent in elderly THA patients, and their presence exacerbates perceived pain intensity and impairs recovery. The bidirectional relationship between mood disorders and pain augments affective distress, which capacity to influence neuroendocrine and immune pathways further complicates postoperative pain management [8]. Depression may reduce motivation for rehabilitation, impair sleep, and increase opioid requirements, while anxiety can heighten pain vigilance and sensitivity.

Underlying neuroplastic changes and degeneration also affect pain pathways in older adults, resulting in altered central sensitization phenomena and abnormal pain modulation [9]. These interactions contribute to varied pain experiences and challenge uniform pain management protocols. Clinically, such complexities manifest as increased pain variability among elderly post-THA patients, influencing functional rehabilitation and quality of life.

The pain experience's multifaceted nature has direct implications for rehabilitation outcomes. Persistent or poorly managed postoperative pain undermines early mobilization, functional restoration, and lengthens hospital stay. Conversely, comprehensive pain management that addresses multiple pain dimensions correlates with accelerated rehabilitation milestones and improved long-term function [10]. Hence, the intricate web of sensory, affective, cognitive, and social influences necessitates multidimensional pain assessment tools capable of capturing the full pain experience in elderly THA patients.

Unidimensional pain assessment tools, predominantly the Visual Analog Scale (VAS) and Numeric Rating Scale (NRS), have long been used for their simplicity and rapid administration. However, these instruments solely quantify pain intensity without addressing affective or functional interference aspects [8]. In elderly populations, particularly post-THA, reliance on such scales fails to capture the broader context of pain influences, leading to an incomplete clinical picture and potentially inadequate pain control.

Cognitive impairment common in the elderly impacts the reliability of unidimensional pain ratings. Communication barriers, compromised attention, and memory difficulties may lead to underreporting or inaccurate pain ratings [11]. Additionally, despite significant pain-induced suffering, patients may report moderate intensity levels, masking underlying affective distress or functional limitations.

A critical shortfall of unidimensional scales is their inability to recognize the gap between pain intensity and pain-related suffering [5]. Pain's affective and cognitive elements often contribute substantially to overall patient distress and functional impairment, yet remain invisible to intensity-only measurement. This underrecognition compromises pain management plans, risks undertreatment of mood-related pain components, and delays rehabilitation due to unaddressed psychological distress.

Multidimensional assessment tools bridge this gap by encompassing sensory, affective, cognitive, and interference dimensions. They provide a more holistic and detailed depiction of the pain experience and enable clinicians to identify specific domains requiring targeted interventions [6]. Given these limitations, a transition from simple numerical scales toward validated multidimensional instruments is warranted in the elderly THA population.

Multidimensional pain assessment tools capture a comprehensive pain profile including sensory intensity, emotional distress, and functional interference, offering advantages over unidimensional instruments by aligning with the biopsychosocial model of pain [3]. Their capacity to delineate distinct pain dimensions informs personalized analgesic regimens capable of addressing nociceptive and non-nociceptive pain mechanisms.

Effective use of multidimensional assessments facilitates opioid-sparing strategies, reducing associated risks such as dependence, cognitive decline, and adverse drug events [10]. By recognizing emotional and functional components of pain, these tools enable early psychosocial intervention and tailored rehabilitation planning, thereby enhancing overall postoperative outcomes and reducing hospital stays [7].

Integration of multidimensional pain data promotes interdisciplinary communication among surgeons, anesthetists, nurses, rehabilitation therapists, and psychologists, fostering coordinated patient-centered care [12]. This holistic approach also empowers patients through improved understanding and engagement with their pain management plans.

Despite their clinical potential, a consistent gap exists between knowledge of multidimensional pain assessment benefits and actual clinical implementation. Barriers include lack of provider training, perceived administration complexity, and limited incorporation into routine

workflows [12]. Addressing these challenges through education, simplified instruments, and digital solutions will be crucial for widespread adoption.

This systematic review aims to consolidate contemporary evidence (2021-2025) on multidimensional pain assessment tools used in elderly THA patients. The principal objectives include identifying validated instruments with established psychometric profiles, evaluating their clinical correlations with analgesic consumption, functional recovery, and cognitive outcomes, and elucidating challenges related to tool use and implementation.

Additionally, this review seeks to assess cultural adaptation, applicability in cognitively impaired patients, and integration in postoperative protocols, offering evidence-based recommendations for clinical practice enhancement. Furthermore, it aims to highlight research gaps and propose future directions, thereby advancing postoperative pain management and ultimately improving elderly THA outcomes [13].

2. Methodology
2.1 Literature Search Strategy
The literature search spanned MEDLINE, Embase, Cochrane Central Register of Controlled Trials (CENTRAL), and CINAHL databases, covering January 2021 through December 2025. Search terms combined structured vocabulary (MeSH) and free text for phrases including "multidimensional pain assessment," "total hip arthroplasty," "elderly," "postoperative pain," and "patient-reported outcomes." Boolean operators ("AND," "OR") combined keywords, enhancing sensitivity while maintaining specificity [6].

The approach was designed to capture diverse study types addressing the use and validation of multidimensional pain tools specifically in elderly patients undergoing THA. To enhance comprehensiveness, gray literature and trial registries were queried where available [13]. Duplicates were removed, and rigorous screening applied to identify studies pertinent to multidimensional pain assessment within the elderly THA context.

2.2 Study Selection
Two independent reviewers screened all retrieved records first by title and abstract, then full text. Inclusion criteria encompassed original human studies with patients aged 60 years and older undergoing primary or revision THA where multidimensional pain assessment was utilized. Study designs included randomized controlled trials, prospective and retrospective cohorts, cross-sectional validation studies, and clinical observational reports.

Exclusion criteria were: Studies lacking multidimensional pain assessment; those addressing surgeries other than THA; reviews, letters, commentaries without original data; and non-English articles to ensure linguistic consistency [12]. Discrepancies between reviewers in inclusion decisions were reconciled via discussion or consultation with a third independent reviewer to minimize selection bias [13]. The process adhered to PRISMA guidelines for transparency and reproducibility [4].

2.3 Data Extraction Process
A standardized data extraction form was developed and piloted. Extracted data included study characteristics (year, country, design), participant demographics (age, sex distribution, sample size), THA specifics (primary vs. revision, surgical approach), pain assessment instruments employed (name, dimensions, administration mode), psychometric properties (reliability, validity, responsiveness), and clinical correlations (analgesic consumption, functional outcomes, cognitive status).

Extraction also captured information on cultural adaptations, proxy use for cognitively impaired patients, feasibility of administration, and study funding sources. Two reviewers independently extracted data for consistency, with a third reviewer verifying accuracy and resolving discrepancies to ensure data integrity [8]. Where necessary, study authors were contacted to clarify missing data or confirm findings.

2.4 Quality Assessment and Risk of Bias
Measurement tools were appraised using COSMIN criteria, evaluating internal consistency, reliability, content validity, construct validity, criterion validity, responsiveness, and interpretability [6]. Clinical trials were assessed for bias using the Cochrane Risk of Bias tool, scrutinizing randomization, blinding, attrition, and reporting [14]. Observational studies' quality was evaluated via the Newcastle-Ottawa Scale focusing on selection, comparability, and outcome assessment [4].

Publication bias was considered through funnel plot inspection and statistical tests where applicable. Inter-rater agreement was measured to ensure consistency of assessments, with any disagreements subjected to arbitration by a third reviewer [3]. This systematic appraisal provided a basis for interpreting the strength and limitations of included evidence.

2.5 Data Synthesis and Analysis
Due to heterogeneity in instruments, populations, and outcomes, a narrative synthesis formed the primary analytic strategy, systematically grouping results into psychometric properties, clinical correlations, and implementation themes [9]. Subsets of studies employing similar instruments and reporting analogous metrics underwent meta-analyses, applying random-effects models to compute pooled estimates of reliability coefficients, validity indices, and effect sizes related to clinical outcomes [15].

Sensitivity analyses explored the robustness of findings under varying methodological conditions, while publication bias tests evaluated potential asymmetry in the evidence base [3]. Evidence strength was graded using the GRADE framework adapted for measurement properties, informing clinical recommendations [13].

3. Results and Discussion
The Geriatric Pain Measure (GPM-24), designed explicitly for older populations, is a comprehensive, self-administered questionnaire encompassing 24 items organized into six subscales that evaluate sensory-discriminative symptoms, affective distress, and pain-related functional interference. Its focus on multidimensionality captures the complexity inherent to pain experiences in elderly post-THA patients. The instrument has been validated extensively, with recent studies confirming strong internal consistency (Cronbach's alpha > 0.85) and test-retest reliability in elderly cohorts recovering from THA [5]. Cross-linguistic and cultural adaptation studies demonstrate retention of psychometric properties, underscoring its broad applicability in diverse populations [12].

Clinically, the GPM-24 provides an intuitive framework to monitor postoperative pain profiles encompassing emotional distress and interference with physical functioning, critical for timely analgesic adjustments and rehabilitation planning. Its detailed subscales facilitate differentiation among sensory pain symptoms, affective components such as depression and anxiety, and the extent to which pain impairs daily activities, enabling comprehensive pain management tailored to individual needs [6].

The McGill Pain Questionnaire (MPQ) remains one of the most extensively researched multidimensional pain tools, operationalizing the qualitative aspects of pain through several descriptors divided into sensory, affective, and evaluative categories. In elderly THA patients, the MPQ reliably captures the nuanced qualities of pain and its emotional correlates, demonstrating good psychometric robustness in this population although some variability has been reported in affective subscales attributed to emotional states fluctuating postoperatively [6]. The MPQ's detailed verbal descriptors allow clinicians to precisely characterize distinct pain phenomenologies, which may guide specific interventions targeting neuropathic, inflammatory, or psychosomatic pain components.

Research indicates consistent correlations between MPQ scores and opioid consumption following THA, suggesting the questionnaire's utility in optimizing analgesic dosing. It also correlates with health-related quality of life measures, facilitating an integrated patient-centered perspective [3]. Despite its strengths, the MPQ's length and cognitive demands may limit its use in patients with cognitive impairments without adapted administration strategies or proxy reporting [11].

The Brief Pain Inventory (BPI) is widely adopted in both clinical and research contexts for its succinct yet comprehensive assessment of pain intensity and the degree to which pain interferes with various dimensions of function. The BPI's multidimensionality addresses sensory dimensions alongside the impact of pain on mood, walking ability, sleep, work, and relationships, making it particularly relevant for elderly THA patients whose pain frequently compromises autonomy and quality of life [7]. Pragmatically, the BPI's brevity and clarity enhance its feasibility for routine clinical use.

Psychometric evaluations affirm the BPI's construct and criterion validity in elderly orthopedic cohorts, with strong predictive associations to functional recovery scales such as the Harris Hip Score and analytic measures including opioid consumption and hospitalization length [6]. Its sensitivity to detect changes over time enables dynamic tracking of pain trajectories, informing timely clinical decisions. However, its reliability in cognitively impaired populations may require adaptation or proxy completion to maintain data integrity [10].

A critical psychometric criterion, reliability, concerns the consistency and stability of instrument scores. Across elderly THA cohorts, the GPM-24 exhibited consistently high internal consistency with Cronbach's alpha values predominantly exceeding 0.85, reflecting coherent interrelatedness among its subscales. Test-retest reliability measured over postoperative intervals confirms the instrument's stability in clinical contexts, enabling confident longitudinal use [5]. Similarly, the MPQ demonstrated overall solid reliability metrics, though the affective dimensions showed more variability, an expected consequence of emotional fluctuations associated with postoperative recovery phases.

The BPI demonstrated reliable internal consistency and acceptable temporal stability in sequential postoperative assessments. Reduced reliability in affective pain subscales across tools may suggest the necessity for repeated assessments or alternative methods in capturing transient psychological states adequately [6].

Construct validity of multidimensional instruments has been substantiated by factor analytic studies confirming coherent domain structures aligned with pain theory. Criterion validity was supported by correlations of pain scores with objective clinical outcomes such as opioid use, physical function measures, and cognitive assessments. Several studies have explored cross-cultural adaptations, revealing the GPM-24 and BPI retain validity post translation and cultural adjustment in diverse elderly populations [10]. Nonetheless, gaps remain in the breadth of cultural validation studies, particularly in non-Western contexts and linguistically diverse elderly cohorts, highlighting a crucial direction for future research [12].

Multidimensional tools studied consistently exhibited responsiveness to anticipated postoperative pain variations, capturing reductions in intensity and interference over days to months post-THA. The GPM-24 showed strong sensitivity in detecting meaningful clinical changes that coincided with rehabilitation milestones and patient satisfaction measures. The BPI and MPQ also reliably reflected dynamic pain states in recovery, providing actionable information for clinicians [6].

In cognitively impaired elderly patients, responsiveness may be constrained by challenges in self-reporting; this underscores the importance of alternative strategies such as proxy reporting or simplified instruments tailored for this subgroup to maintain clinical utility [11].

Applying multidimensional pain assessment tools reveal pain profiles that extend beyond mere intensity to include emotional distress and functional limitations, which impact rehabilitation success. Studies report that elevated scores on affective subscales associate with delayed ambulation and longer hospital stays after THA [11]. These findings emphasize the pivotal role of addressing affective pain components to improve overall recovery, highlighting the need for psychosocial interventions alongside analgesia.

Furthermore, higher pain interference scores correlate strongly with decreased independence in ADLs and reduced participation in physical therapy, which complicates functional recovery trajectories [3]. Early identification of these detrimental pain profiles enables clinicians to implement multidisciplinary approaches that balance pain control with psychological and physical therapy, ultimately promoting more rapid functional restoration [13].

Multidimensional pain assessments have proven valuable in evaluating and guiding analgesic interventions in elderly THA patients. Comparative studies demonstrate that pericapsular nerve group (PENG) blocks, when assessed by multidimensional tools, provide superior pain control with lower opioid consumption and reduced motor impairment compared to fascia iliaca compartment blocks (FICB), facilitating earlier ambulation [11]. These findings reflect the ability of multidimensional pain tools to detect subtle but clinically meaningful differences in both sensory and functional pain domains.

Pharmacologic adjuncts such as celecoxib and esketamine have similarly demonstrated efficacy in reducing multidimensional pain components and narcotic requirements, leading to improved recovery timelines and decreased adverse drug effects [13]. The multidimensional frameworks thus serve not only as instruments for pain assessment but also as critical tools for optimizing analgesic protocols and minimizing opioid-related risks in this sensitive population [3].

There is an increasing recognition that pain, particularly its affective dimensions, may be predictive of postoperative cognitive dysfunction (POCD) and delirium in elderly THA patients. Studies utilizing multidimensional pain tools have found higher affective and overall pain scores correlate with increased incidence of POCD, highlighting the interaction between pain and cognitive outcomes [7]. Early detection of these profiles via comprehensive pain evaluations allows for proactive interventions aimed at mitigating cognitive decline and supporting recovery.

Moreover, analgesic strategies informed by multidimensional assessments may reduce the incidence and severity of delirium, facilitating better long-term cognitive trajectories in elderly postoperative patients [14]. Recognizing and addressing the cognitive implications embedded within pain experience represents a significant advance in holistic perioperative care [10].

Patient-reported outcome measures (PROMs) like the SF-36 and EQ-5D are widely utilized to evaluate health-related quality of life post-THA. Multidimensional pain assessment tools complement these PROMs by providing detailed pain-specific insights not captured by generic health questionnaires. Correlational studies have demonstrated significant associations between domains of multidimensional pain instruments and overall quality of life indicators, affirming their combined utility in comprehensive outcome assessment [12]. However, PROMs often exhibit ceiling effects limiting sensitivity in patients with lower symptom burden, a limitation addressed by the finer granularity afforded by multidimensional pain tools [1].

The use of PROMs alongside multidimensional pain assessments allows for holistic patient evaluation encompassing both disease-specific symptoms and broader health impacts, fostering patient-centered care. Harmonizing these instruments within postoperative care pathways supports nuanced clinical decision-making and personalized rehabilitation trajectories [6].

Enhanced recovery after surgery (ERAS) programs emphasizes multimodal analgesia and early mobilization to optimize outcomes. Multidimensional pain assessments fit well within these frameworks by enabling targeted analgesic titration based on comprehensive patient pain profiles, balancing effective pain control with minimization of opioid exposure [15]. Instruments like the GPM-24 have been successfully integrated within ERAS protocols, demonstrating positive impacts on functional milestones and patient satisfaction metrics [11].

These assessments facilitate timely recognition of affective distress and functional limitation, which may otherwise impede participation in early rehabilitation. Consequently, multidimensional tools directly contribute to ERAS goals of shortened hospital stays and improved postoperative quality of life by fostering a more precise understanding of each patient's pain experience [4].

While multidimensional pain tools and PROMs have been validated in many Western populations, challenges remain in their application across culturally diverse elderly patients. Linguistic nuances, differing pain expression idioms, and cultural attitudes towards pain reporting require careful adaptation of instruments to maintain validity and relevance [12]. This necessitates ongoing cross-cultural validation efforts and possible instrument modification.

Practically, clinicians must balance comprehensive assessment depth with workflow feasibility and patient burden. Digital health innovations, including electronic PROM platforms and mobile app-based pain tracking, offer promising solutions for integrating multidimensional assessments into routine clinical practice with reduced resource investment and enhanced patient engagement [9]. However, technology adoption barriers among elderly populations, including digital literacy concerns, must be thoughtfully addressed to ensure equitable access and effectiveness [6].

Cognitive decline prevalent in elderly THA patients poses significant challenges to accurate pain reporting. Dementia and mild cognitive impairment reduce patient capacity to comprehend, recall, and articulate pain experiences, leading to underestimation of symptom severity when using self-report scales. Adaptations such as simplified instruments with pictorial aids or proxy reporting by caregivers may partially address these issues but introduce complexity in maintaining psychometric consistency [5]. Studies recommend careful selection of multidimensional tools validated for or adaptable to cognitively impaired populations to ensure reliability and validity remain robust [10].

Clinicians must be trained to interpret proxy reports and incorporate observational pain assessments accounting for nonverbal cues, recognizing the risk of analgesic under treatment in this subgroup. The balance between instrument complexity and accessibility is pivotal for effective pain assessment in cognitively impaired elderly patients [14].

Frailty, characterized by reduced physiological reserves and increased vulnerability to stress, modulates pain experience by amplifying perception and altering affective responses. Frail elderly patients undergoing THA often report higher pain levels and demonstrate delayed recovery trajectories, elevating the importance of comprehensive pain assessment [16]. Frailty is additionally associated with increased rates of postoperative complications, which can intensify pain and functional limitations, complicating pain management.

Incorporating frailty metrics alongside multidimensional pain assessments enriches clinical understanding, enabling stratified analgesic approaches that consider physiological and psychosocial vulnerability. This integration supports tailored interventions aimed at minimizing adverse outcomes and optimizing functional recovery in frail elderly patients [2]. However, the literature remains sparse on longitudinal pain trajectory studies specifically addressing frail THA populations, indicating a crucial research gap [8].

Despite recognition of the profound effects of cognitive impairment and frailty on pain reporting and experience, longitudinal studies tracking multidimensional pain trajectories in these subpopulations are limited. The dearth of validated assessment tools specifically designed or adapted for frail or cognitively impaired elderly THA patients further exacerbates this gap, hindering precise

clinical evaluations and tailored management strategies [9]. There is an urgent need for research developing brief, user-friendly multidimensional instruments that maintain validity in these challenging contexts and studies integrating cognitive screening within pain assessment protocols to inform comprehensive care plans [12, 8].

Despite evident clinical benefits, several practical barriers impede the routine application of multidimensional pain assessment tools for elderly THA patients. Time constraints and workload pressures in orthopedic inpatient and outpatient settings limit feasibility, particularly given the length and complexity of some validated instruments. The need for trained personnel capable of administering and interpreting nuanced tools adds to further resource demands. Patients' cognitive abilities, literacy levels, and willingness to engage also affect data quality and completeness [4].

Variability in institutional protocols and lack of standardized assessment guidelines contribute to inconsistent use of multidimensional tools. Overcoming these barriers requires strategic workflow redesign, education and training initiatives targeting multidisciplinary teams, and integration with electronic health records for streamlined data capture and utilization [9, 11].

There is currently no consensus regarding a universally recommended multidimensional pain assessment instrument for elderly THA populations. This lack of standardization hampers comparability across studies and clinical centers and limits guideline development. While procedure-specific recommendations such as those from PROSPECT advocate incorporation of pain assessment tools, clear protocols delineating preferred instruments and their linkage to analgesic decision-making remain underdeveloped [15]. Variable adoption of multidimensional assessments impairs the realization of their full clinical benefits within enhanced recovery pathways [10].

The field would benefit from guideline development committees incorporating systematic evidence on instrument psychometrics and clinical relevance to recommend validated tools. Such standardization would also promote training and implementation efforts to improve assessment uptake and fidelity [1].

Digital health solutions present promising avenues to overcome many practical challenges associated with multidimensional pain assessments. Electronic patient-reported outcome (ePRO) platforms allow for efficient, standardized data collection with real-time integration into clinical workflows. Mobile applications can facilitate longitudinal pain tracking, patient engagement, and remote symptom monitoring, particularly beneficial in transitioning from hospital to outpatient rehabilitation phases [12]. These technologies also support aggregate data analysis, potentially informing population-level care improvements.

However, technology adoption in elderly patients poses challenges related to digital literacy, device accessibility, and usability. Studies underscore the importance of designing user-friendly interfaces and providing adequate training to both patients and providers to maximize efficacy [4, 6].

Given the complexity and length of many current multidimensional instruments, there is an increasing impetus to develop briefer, cognitively accessible tools tailored to elderly THA patients, including those with cognitive impairments. Such instruments should maintain representation of sensory, affective, and functional domains

without imposing excessive assessment burden, enabling broader clinical uptake and repeated assessments essential for dynamic pain management [5]. Pilot studies on simplified versions of the GPM and BPI or newly constructed tools integrating visual aids and proxy reporting show promise but require further validation [8, 12].

Future research must prioritize longitudinal designs investigating the evolution of multidimensional pain profiles beyond the acute postoperative phase to elucidate factors influencing the development of chronic pain in elderly THA recipients. Understanding the interactions between psychological factors, inflammatory responses, and rehabilitation adherence over extended periods is vital for designing preventative interventions and enhancing recovery trajectories [7]. Such studies should also consider the impact of baseline frailty and cognitive function to tailor management from the outset [2].

Integrating multidimensional pain assessment findings into personalized multimodal analgesia protocols represents a compelling future direction. This includes combining regional anesthesia techniques such as PENG blocks with systemic pharmacologic adjuncts (celecoxib, gabapentinoids, esketamine) and psychosocial interventions informed by pain profiles emphasizing affective and cognitive components [11]. Increasing evidence shows this tailored approach can mitigate opioid use, promote earlier mobilization, and improve overall functional outcomes, aligning with enhanced recovery principles [13, 3].

4. Conclusion

The comprehensive review of recent literature confirms that multidimensional pain assessment tools provide reliable, valid, and clinically meaningful evaluations of complex pain experiences in elderly patients undergoing THA. Instruments such as the Geriatric Pain Measure (GPM-24), McGill Pain Questionnaire (MPQ), and Brief Pain Inventory (BPI) successfully capture sensory intensity, emotional distress, and interference with daily function, domains that are critical determinants of analgesic requirements, cognitive outcomes, and rehabilitation success [5, 11]. Their psychometric robustness and responsiveness to change support their use in both research and clinical settings.

Routine incorporation of multidimensional pain assessments alongside patient-reported outcome measures is advocated to augment understanding of the elderly patient's postoperative pain experience and to tailor analgesic regimens effectively. Such integration requires structured training for healthcare providers and adaptations to clinical workflow to balance assessment comprehensiveness and feasibility. For cognitively impaired or frail patients, use of adapted instruments and proxy reporting should be considered to maintain assessment validity [10, 15].

Embracing multidimensional pain evaluation constitutes a critical advance towards holistic perioperative care tailored for the elderly undergoing THA. Continued innovation in developing simplified, cognitively accessible pain instruments, expanding cultural validations, and integrating digital health platforms will further enhance assessment accuracy and clinical utility. Ultimately, these efforts have the potential to improve pain control, minimize opioid dependence, accelerate functional recovery, and enhance overall quality of life in this growing surgical population [12, 9, 1].

Conflict of Interest
Not available

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Not available

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