BALNEO RESEARCH Balneo and PRM Research Journal
English Edition
e ISSN 2734 - 8458 p ISSN 2734 - 844X ROMANIAN ASSOCIATION OF BALNEOLOGY

Research article

Integrating Clinimetric and Psychometric Approaches in Enhancing Osteoarthritis Care

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Citation: Pavel R.M.S., Radu A.F., Nistor-Cseppento C.D., Vesa C.M., Purza A.L., Tit D.M., Radu A., Bungau S.G. - Integrating Clinimetric and Psychometric Approaches in Enhancing Osteoarthritis Care *Balneo and PRM Research Journal* ***2024****, 15(4): 748*

Academic Editor(s): Constantin Munteanu

Reviewer Officer: Viorela Bembea

Production Officer: Camil Filimon

Received: 04.11.2024
Published: 23.12.2024

Reviewers:
Mihai Hoteteu
Sebastian Giuvara

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Abstract: Osteoarthritis (OA) is a degenerative joint disease that is typically associated with weight-bearing joints, such as the hips and knees, and is defined by the progressive deterioration of cartilage. The effective treatment of OA is contingent upon the accurate assessment of its clinical and psychological effects. In the present work, we aim to compile the most recent evidence regarding the clinimetric and psychometric evaluations of OA, with a particular emphasis on the hip and knee, a topic still insufficient approached. The WOMAC and KOOS are among the clinimetric instruments that offer valuable insights into physical function, stiffness, and pain. By integrating clinimetric and psychometric tools, a comprehensive approach to managing OA is provided, which identifies both physical and mental health need. The significance of these combined evaluations in enhancing treatment adherence and improving patient outcomes is underscored by the present review. Moreover, treatment and recovery options still have limitations that need to be addressed. Additional research is required to elucidate the psychometric properties of quality-of-life measures and postural control assessments. Future research should concentrate on the development of more comprehensive and robust tools that assess all facets of OA, thereby facilitating personalized interventions that address the multifaceted character of this debilitating disease.

Keywords: osteoarthritis; clinimetrics; psychometrics; healthcare; functional disability

1. Introduction

Osteoarthritis (OA) is a degenerative joint disease characterized by the progressive deterioration of articular cartilage, leading to pain, stiffness, and functional impairment [1,2]. As one of the most debilitating conditions affecting the human body, osteoarthritis (OA) is overwhelmingly the most prevalent form of arthritis [3]. Besides causing impairment, rigidity, and joint discomfort, the disorder is chronic and worsens in time. Evidence suggests that joint injury, obesity, and advanced age are the primary causes of OA in joints that support weight including the hips and knees [4].

Clinical symptoms of OA include swelling, stiffness, pain, and constraints in joint function. Furthermore, the illness is characterized by a cascade of changes in the physiology and anatomy of the joints, including remodeling of the bone, the deterioration of cartilage, and the production of osteophytes [5].

Although most studies have directed their attention to OA in particular locations, a small number have shown OA rates more generally. Symptomatic OA affects an estimated 240 million people globally, with 18% female patients and 10% male patients over the age of 60 being affected [6].

As OA affects a significant portion of the aging population [7], accurate assessment of its impact on individuals is crucial for effective management and treatment [8]. Clinimetric assessments focus on quantifying clinical outcomes through standardized instruments, providing healthcare professionals with valuable insights into the severity of OA symptoms, functional limitations, and overall health-related quality of life (QoL) [9]. Commonly used clinimetric tools include the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and the Knee Injury and Osteoarthritis Outcome Score (KOOS), which allow for the systematic evaluation of pain, stiffness, and physical function in patients with OA [10,11].

Psychometric assessments complement clinimetric evaluations by addressing the psychological aspects associated with OA [12,13]. Chronic pain and disability can lead to increased levels of anxiety, depression, and reduced coping mechanisms among patients [14]. Instruments such as the Hospital Anxiety and Depression Scale [15] or the Pain Catastrophizing Scale [16] help identify patients who may benefit from psychological support or rehabilitation programs aimed at improving mental health outcomes.

Integrating both clinimetric and psychometric assessments enables a comprehensive understanding of OA's multifaceted impact on patients, facilitating personalized treatment strategies that address both physical and psychological needs.

Research indicates that incorporating these assessment methodologies into clinical practice can significantly enhance patient outcomes. For instance, studies have shown that patients who are well-informed about their condition through detailed assessments tend to engage more actively in their treatment plans, leading to improved adherence to prescribed therapies and lifestyle modifications [17,18]. Additionally, addressing psychological factors through targeted interventions can enhance recovery trajectories for individuals suffering from OA. Therefore, the integration of clinimetric and psychometric assessments is essential not only for clinical decision-making but also for fostering a holistic approach to patient care in OA management [19].

The aim of this narrative review is to provide a comprehensive and up-to-date synthesis on the importance of proper implementation of clinimetric and psychometric evaluations in enhancing OA management, while also emphasizing the significance of early intervention and personalized treatment strategies to improve patient outcomes.

2. Methodological approaches

The search methodology included an advanced search algorithm based on Boolean operators that facilitated the search process in the topical subject 'clinimetric and psychometric assessments in osteoarthritis'. PubMed, ScienceDirect, SpringerLink and Web of Science were selected as target, validated, and broad-coverage biomedical databases (Fig. 1). Although the articles targeting OA in general are numerous, the approach in terms of clinimetric and psychometric assessments is significantly lower, suggesting the need for further studies in this regard (Fig. 2). During the screening process for scientific literature, we excluded publications in languages other than English that lacked significant relevance or informativeness to the objectives of this paper. Additionally, non-scientific articles, books, and resources not originating from the databases of international health regulatory and advisory organizations were omitted. To support this narrative review, a total of 109 references were selected, evaluated, and cited.

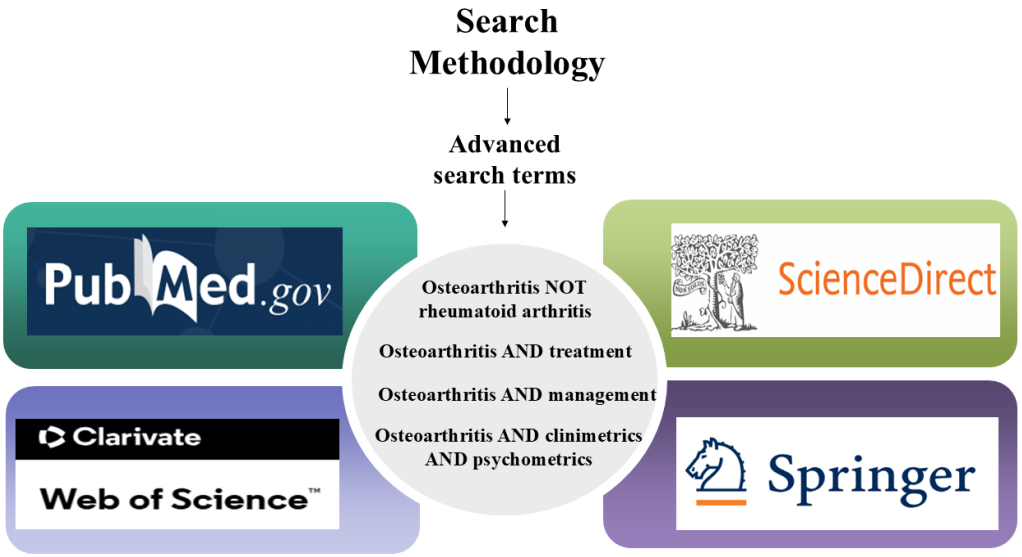


Fig. 1. Methodological algorithm for searching the scientific literature.

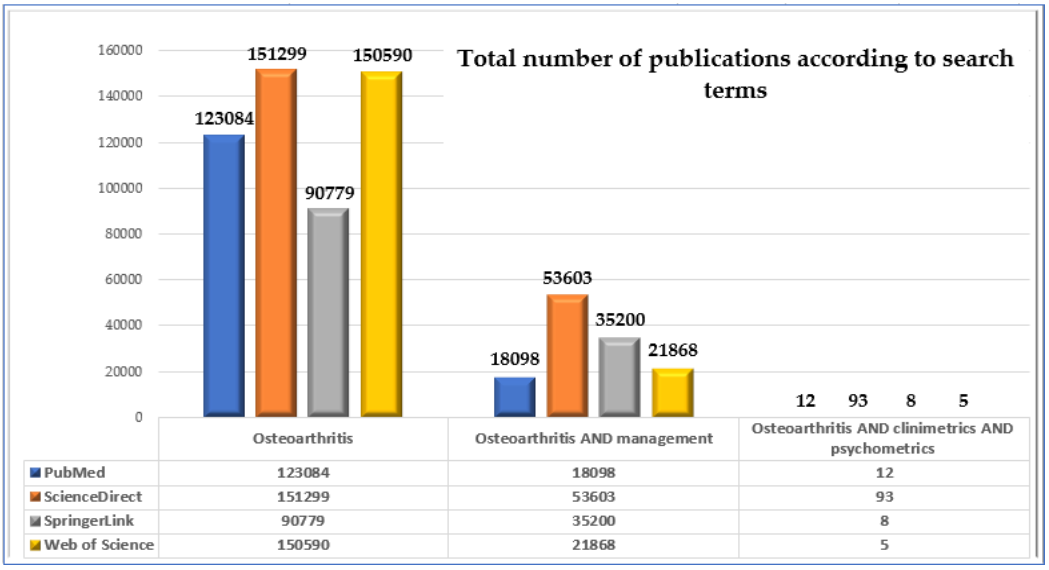


Fig. 2. Variability in publication quantity among search terms, emphasizing the restricted emphasis on clinimetric and psychometric assessments of OA.

3. OA etiology and pathophysiological mechanisms

The rise in chronic diseases, including osteoarthritis (OA), has been linked not only to aging but also to the increasing consumption of processed, refined carbohydrates and junk food, driven by the fast food industry and public dietary habit [20]. However, OA is not an inevitable consequence of aging. Instead, it is a degenerative joint disease influenced by a combination of genetic, biomechanical, and environmental factors. OA radiographic abnormalities, especially osteophytes, are prevalent in the elderly. Nevertheless, pain in the joints may be present regardless of how severe the OA appears on imaging. An increased susceptibility to OA is associated with aging-related alterations to the musculoskeletal system [21].

However, additional risk factors for OA, such as heredity, obesity, joint injuries, and anatomical variables that impact joint mechanics, are more strongly correlated with the joints impacted and the severity of the disease. Cell senescence, which leads

to the senescent secretory phenotype, and matrix aging, which includes the production of developed glycation end-products, both impact the mechanical qualities of joint tissues and increase the risk of OA [22].

Even if there is a strong correlation between OA and aging, the two are actually distinct processes. Researchers demonstrated that aging can cause OA through multiple pathways: age-related changes in cells, inflammation associated with aging, shift in cell signaling as a result of extracellular matrix changes associated with aging, oxidative stress and mitochondrial malfunction, which encompass the senescence-associated secretory phenotype, and impaired energy metabolism caused by decreased autophagy and 5'-AMP-activated protein kinase activity. Joint tissue deterioration and faulty restoration of degraded matrix are both accelerated by these different mechanisms, which also promote an inflammatory and catabolic state and an increased vulnerability to cell death, all of which led to the onset of OA. While most research has concentrated on articular cartilage, it is critical to find out if other joint tissues are affected by the same mechanisms [23].

Progressive joint deterioration, characterized by the clinical condition of post-traumatic OA (PTOA), is a common consequence of joint traumas, particularly intraarticular fractures. Despite orthopaedists' best efforts, many patients continue to have debilitating joint soreness and impairment after undergoing treatment for this medical condition. Researchers still cannot determine what causes PTOA. If a harmed articular area is going to heal and restore or degenerate over time, it depends on more than just the severity and kind of trauma. An upgraded understanding of the pathophysiology of PTOA will allow the scientist to better aid in repairing and remodeling damaged articular surfaces and reduce the likelihood of degeneration of these surfaces, which is crucial for making clinically relevant advancement in avoiding this condition [24].

OA risk factors include obesity as well as injuries. OA caused by obesity can manifest in both joints that bear weight and the hands, which may indicate a function for adipokines, that are circulating mediators secreted by adipose tissue. This suggests that systemic metabolism may be associated with OA. The idea of metabolic OA, a general clinical phenotype that encompasses OA caused by fat, has been backed up by data from biological and epidemiological research. Therefore, metabolic syndrome or a cluster of metabolic issues can be associated with OA. Besides obesity and other determined risk factors for OA, research has shown links between OA and additional aspects of the metabolic syndrome, incorporating high blood pressure and type 2 diabetes. Study shows that anomalies in glucose and lipid levels have a negative impact on the homeostasis of cartilage, both in vitro and in vivo. Both metabolic diseases and OA share the characteristic of chronic low-grade inflammation, which can contribute to the progression of both conditions [25].

Classic research involving identical twins (i.e., monozygotic) who were between the ages of 48 and 70 found that heredity variables influenced the development of OA by 65% [26]. In the general population, hereditary factors account for 39% to 65% of cases of OA. Following menopause, women experience an increase in osteocalcin levels and bone resorption, making them more prone to knee arthritis [27].

Additionally, chondrocytes produce a lot of ROS, which can harm the collagen in cartilage and the hyaluronate in synovial fluid. Therefore, ensuring an adequate intake of micronutrient antioxidants through the diet may contribute to the prevention of OA [28]. As cartilage deterioration progresses, subchondral bone alterations are associated with it, and trabecular thickness and bone volume both rise sharply [29]. Moreover, OA frequent characteristics and cellular processes are depicted in fig. 3 [30–33].

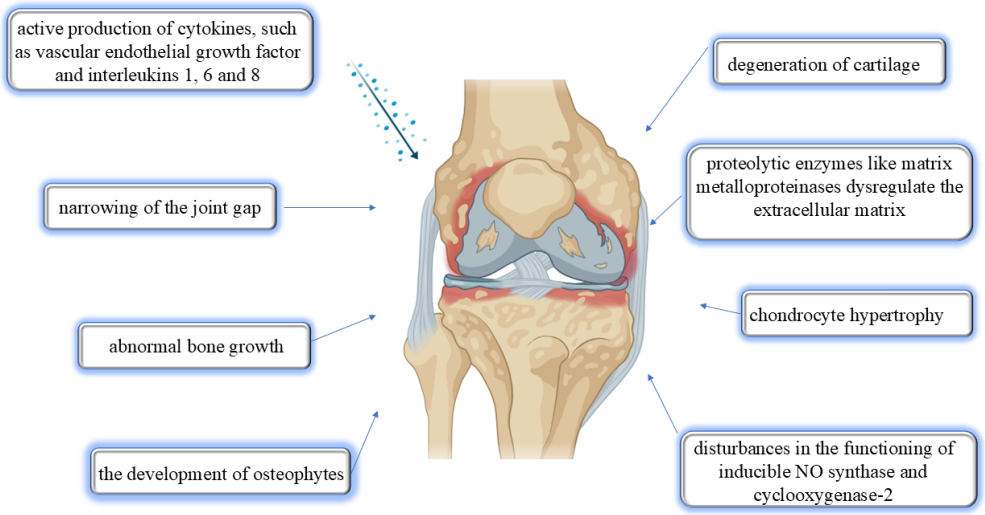


Fig. 3. Key Characteristics and Cellular Mechanisms of OA Pathogenesis.

Apoptosis, inhibited collagen and proteoglycan production, and the release of proinflammatory cytokines were thought to be the mechanisms by which the nitric oxide (NO) propagated the OA disease process until recently. Some new research, however, indicates that NO and associated redox byproducts may also play a role in maintaining cartilage health. There appears to be indication that NO and/or its derivatives may have protective benefits on different cell types. Whether it is a normal cartilage or a cartilage affected by OA, the function of NO and its derivatives remains unclear and requires further investigation [34].

Comparatively, the protease-activated receptor 2-activating peptide (PAR2-AP) had a significantly stronger effect on increasing cyclooxygenase-2 (COX-2) expression than metalloproteinase 1 (MMP-1). At a modest dose, the trypsin-induced COX-2 expression was entirely suppressed when cells were treated with the developed protease-activated receptor 2-inhibitory peptide (PAR2-IP). Additional investigation into the activation of the nuclear factor kappa-light-chain-enhancer of activated B cells (NF-κB) by trypsin revealed that the PAR2-IP had adequate inhibitory effects on both primary synovial cells and synoviosarcoma cells derived from OA patients. According to the results obtained in experiments, synovial cells showed less inflammatory COX-2 production when the PAR2-IP prevents trypsin-induced NF-κB activation. Therefore, one possible treatment option for OA may be the use of PAR2-IP [35].

Publications highlighting the critical function of hypoxia and hypoxia-inducible factor 1-alpha (HIF-1alpha) as transcription factors in cartilaginous tissues have increased in the past few years. Massive cell death generates prominent abnormalities in the middle sections of growth plates with functionally deactivated HIF-1alpha. Based on this significant finding, HIF-1alpha is critical for chondrocytes survival in environments with critically low oxygen pressures. Articular chondrocyte – transport of glucose, matrix synthesis and anaerobic energy production, are all regulated by HIF-1alpha, which is considered an essential protein. In addition to hypoxia, articular chondrocytes have been reported to have increased HIF-1alpha expression in response to mechanical stress and proinflammatory mediators. It is widely recognized that all these biochemical pathways contribute to the development of OA. Therefore, it is plausible to assume that OA chondrocytes rely on HIF-1alpha for survival and correct function [36].

Wu et al. recently evaluated the connection between chondrocytes and exosomes, which are vesicles formed from membranes and involved in intercellular communication. It has been found that OA subchondral bone produces these vesicles. Coculture experiments indicated that chondrocytes internalized exosomes produced from osteoblasts in OA sclerotic subchondral bone, leading to the same expression of genes associated with catabolism as reported in OA cartilage. Hence, these exosomes may be a target for OA therapies since they appear to have a pivotal part in the progression of OA [37].

4. Modern concepts on the evaluation of OA patients

4.1. Clinimetric properties of evaluation tests in hip or knee OA

Patients with hip or knee OA (KOA) are evaluated for their physical function using a series of performance-based tests, including self-paced walking time, the 6-minute walk test, several stair-climb assessments, and the evaluating the time needed to "get up and go". A common aspect of most exams is monitoring how long it takes for the patient to complete the task at hand. There are also a number of documented observational strategies that rely on observer assessments to determine how well a bodily function is performing [38,39].

That time a patient needs to finish a particular task is typically documented in testing protocols. There are also a number of described observational approaches that rely on observer assessments to determine how well a bodily function is performing [40,41].

Meta-analyses benefit significantly from using well accepted metrics for outcome measurement. An OA-specific disability assessment, the WOMAC was established in the context of OA research. Moreover, a pain subscale is a part of it. In the year 1994, a group of specialists came to the conclusion that WOMAC ought to be the primary OA efficacy assessment. The investigation into WOMAC was part of a larger effort to evaluate the efficiency of the physical therapies used in the management of KOA discomfort. When it comes to hip and KOA, the WOMAC is a 24-question battery that may be self-administered to evaluate disability, pain, and joint stiffness. Healthcare providers can use it to assess the efficacy of medical treatments, particularly in the short term [42].

Three health concepts (i.e., physical functional capacity, stiffness, and pain) are reportedly assessed by the WOMAC, a self-evaluation measure of the functional status [43]. Despite its widespread use over the last two decades, the WOMAC has never been found to have factorial validity, according to new research [44].

From 2009 to 2010, a systematic review was conducted to find publications that employed the WOMAC outcome. Both the WOMAC pain subscale and the WOMAC index were examined to ensure accurate reporting and proper usage. The aforementioned WOMAC pain subscale was employed in 45 percent of the 134 trials evaluated. In several instances, the precise way the WOMAC pain subscale was applied was not adequately reported. There was a lack of clarity on the WOMAC scale type in 53% of trials, an uncertain score range in 38% of investigations, and utter ambiguity in 10% of trials. Results for the WOMAC index were similarly unsatisfactory. Inadequate reporting of the WOMAC pain subscale and the WOMAC index severely hindered the ability of individual trials to contribute to a data aggregation and cast doubt on the interpretation of trial outcomes. The WOMAC grading system should be more consistently used and clearly reported in studies involving KOA to improve adherence [42].

In order to evaluate the clinimetric investigations and measurement qualities, standardized criteria were used in a study. The following twenty-six performance-based techniques were provided: 10 multiple-choice assessments, two stair-climb examinations, a chair test, and thirteen walking examinations. Of the seven multi-activity assessments three were evaluated for internal consistency and two were

found to be positive. For the confidence front, fourteen tests were evaluated, with five receiving favorable ratings. Ten experiments were conducted to evaluate the absolute measurement inaccuracy, also known as agreement. A single test was found to be positive. The construct validity was examined using fourteen different tests. Positive ratings were only given to two tests. None of the twelve tests that measured responsiveness yielded a positive result. Most of the uncertain scores were for studies that were either too small or had not performed optimum analyses. In order to evaluate the measuring qualities of performance-based approaches, a large number of additional well-designed investigations are required. Prior to selecting a performance-based approach, it is essential to get a consensus on the tasks and components of function that should be assessed in such a test for individuals suffering from knee or hip OA [45].

In order to better understand OA, a study set out to meta-analyze and thoroughly evaluate the clinimetrics of routinely detected pathologies in the hip, knee, and hand via ultrasound. Data extraction was carried out with particular focus on technical aspects and performance indicators related to ultrasound in accordance with the Outcome Measures in Rheumatology Instrument Selection Algorithm. The quality of the methodology was evaluated using the QAREL score, which consists of 11 items, and the modified Downs and Black score, which consists of 19 items. Only KOA was included in the stratified meta-analysis. The results showed average to good reliability, weak to significant correlation with plain radiography, weak construct validity against function, pain, and blood biomarkers, strong differentiation against patients exhibiting symptoms and strong correlation with magnetic resonance imaging (MRI). The study determined that construct consistency with patient results and other imaging techniques ranged from weak to very strong, based on the conditions and comparing variables. Reliability was moderate to substantial, and criterion reliability with cartilage histology was strong. Treatment responsiveness was minor to moderate. The qualitative analysis of the systematic review showed that there is considerable variation in the use of ultrasound in OA studies, both in terms of technique and clinical practice, thus indicating the need to proceed with caution when applying these meta-analyses [9].

The five items that make up the WOMAC pain scale are the following: flat ground walking, climbing or descending stairs, sitting or lying down, at night when in bed and standing upright. Applying VA3 scaling allows an overall WOMAC pain scale rating range of 0 to 500, while LK3 scaling enables a score range of 0 to 20. When conducting investigations, researchers often use a 100-point scale after converting raw ratings [43].

The WOMAC was applied to 474 patients experiencing hip or KOA and were scheduled for arthroplasty. A variety of data were collected: predictions of internal consistency (coefficient α), SEM based on internal consistency (SEMIC) and the estimates of factorial validity (confirmatory factor analysis). 36 patients have been used as a subsample to evaluate test-retest reliability and the associated SEMTRT. The pain scale did not have a single factor structure that could be supported by confirmatory factor analysis due to the presence of uncorrelated error concepts. Two similar models gave very good matches: one included associated error terms involving the stairs and walking parameters and the sit and night elements; the other was a two-factor model incorporating the standing item loading for both variables, the night alongside sit parameters on one factor, and the stairs and walking elements on another factor [46].

The purpose of another research investigation was to document the outcomes of a battery of functional assessments administered to older individuals diagnosed with knee and hip OA as well as the link between these assessments and the WOMAC Index, a disease-specific questionnaire. The research included 106 sedentary individuals having an average age of 69.4 years, with a history of hip or/and KOA (mean duration of 12.2 years). A person's flexibility, strength, and mobility were assessed

by timing how long it took them to climb and descend four sets of stairs, walk eight feet, and get in and out of a chair five times. Isometric quadriceps strength and hip/knee flexion were also assessed. Each test's data was divided into quartiles (1=greatest score, 4=smallest score, and 5=unable to finish the assignment). Then, a total summary score (TSS) was generated by adding all the scores from each category. Having a Cronbach's alpha of 0.80 or higher, the battery of physical function tests demonstrated satisfactory test-retest reliability and internal consistency. A solid relationship was established between the WOMAC Index and participants' performance ratings on walking, stair climbing, chair-rise, and range of motion for OA joints. There was a significant correlation between lower TSS levels and poorer scores on all WOMAC Index components. Results from the aforementioned study suggest that the WOMAC Index, when used in conjunction with a short array of physical function tests, may be a conclusive and helpful instrument for evaluating the efficacy of treatment programs and geriatric rehabilitation programs [47].

In a group of Turkish patients suffering from hip or KOA, researchers aimed to compare the Lequesne algofunctional index and the WOMAC OA index to determine the accuracy and validity of these tools. Outpatients with OA in Turkey were administered 2 tools specific to the disease: the WOMAC LK 3.1 and the Lequesne parameters. In order to evaluate all the necessary factors, all subjects were required to fill out a standard health-associated quality-of-life questionnaire (SF-36) and participate in an interview with specific topics. Tests of Cronbach's alpha and intra-class correlation (ICC) were used to evaluate the reliability and inner reliability of the dataset. Results from intra- and inter-WOMAC or Lequesne correlations, as well as those between the SF-36 and visual analog scale (VAS), were applied to determine concept reliability. The WOMAC and Lequesne subscales' Cronbach's alphas varied between 0.78 and 0.94, and 0.6 and 0.71, respectively, for KOA, and from 0.78 to 0.95 and 0.5 to 0.85 for hip OA, respectively. ICCs for KOA they were 0.80-0.98 and 0.61-0.71 while for hip OA fluctuated from 0.77 to 0.94, respectively, according to the repeatability of results consistency of the WOMAC and Lequesne subscales. Similar SF-36 subscales (i.e., physical performance and body pain) demonstrated moderate-good correlations for WOMAC and Lequesne, while VAS demonstrated frail-moderate correlations. When compared to the Lequesne, all WOMAC subscales and the total score demonstrated superior internal consistency and acceptable concurrent validity. Based on the study findings, WOMAC is of a greater reliability index than Lequesne for usage with Turkish subjects suffering from knee or hip OA [48].

4.2. Assessment of the pain in OA patients

Several qualitative studies have assessed the pain experienced by OA patients. Hawker et al. conducted the first qualitative research to specifically examine pain, distress, and pain changes during the course of time. Participants with hip and KOA reported two types of pain: one that was intense and intermittent, and a second that was a constant dull ache [49].

There are numerous stages of pain that are associated with OA. During the early stages, there is pain that is associated with activity. As time passes, the pain becomes more consistent, although it still has the potential to be quite intense on occasion. As a consequence of this, individuals begin to proceed with caution in an effort to forestall the occurrence of contexts like these. When compared to "background" (i.e., persistent) pain, the more severe but less often intermittent pain—especially when unpredictable—had a bigger influence on the QoL. Disruptions to sleep, social engagement, and recreational pursuits were all brought on by the pain. One further study found the same thing when looking at people who had KOA recently diagnosed or who experienced symptoms but had not yet received a diagnosis (i.e., "prediagnostic KOA") [50].

KOA causes discomfort and has a negative impact on patients' physical function, QoL, and ability to go about their everyday lives [51]. Furthermore, patients have a substantial impairment due to the effects of OA on their mobility [52].

Chronic pain from OA can lead to anxiety, despair and worry, and the constant need for painkillers increases the likelihood of substance dependence [53]. Due to impaired knee function and slow pain recovery, patients with KOA see a decline in physiological functions as the disease progresses. Consequently, these patients' day-to-day lives are becoming more and more disrupted, which lowers their abilities to manage their social lives, work, and sleep, all of which impact their QoL [54]. Pain and discomfort are reported by 70% to 90% of older persons with KOA, based on statistics from the USA [55].

Given the correlation between depression and cognitive impairment, as well as the fact that chronic pain patients are more likely to suffer from depression, researchers assume that the two conditions may accentuate one another in their effects on cognition [56].

Researchers observe that there is a correlation between selective cognitive impairment and persistent pain caused by advanced hip OA. To understand how total hip arthroplasty affects mental acuity, more research needs to be conducted [57]. Hip OA symptoms most often experienced by patients include hip pain and hip stiffness [58].

As a result, the QoL of the patients, related to health, declines as a result of activity limitations. Despite the prevalence and severity of hip OA, very little is understood regarding the progression of the disease's early symptoms. Prior research mostly focused on the progression of hip and knee problems together [59].

4.3. Psychometric properties of postural control tests for hip and knee OA

Patients affected by KOA often have trouble maintaining their balance. Researchers primarily set out to identify the areas of postural control examined by these tests, and second, to conduct a comprehensive evaluation of the psychometric features of the tests that measure postural control in individuals suffering from KOA [60].

Three clinical measures (i.e., the Star Excursion Balance Test, the Tinetti Performance Oriented assessment of Mobility and the Community Balance and Mobility Scale) were examined in four investigations for their responsiveness, validity, and consistency. Two determined whether a force platform was legitimate and reliable. According to the findings, there is not much confirmation that any of these posture assessments are valid, reliable, or responsive. 'Static stability' was the area of postural control that was evaluated most often. So far, no research has employed instruments to assess each of the nine facets of postural control. The obtained results emphasize the insufficient exploration of psychometric features that are specifically related to controlling posture in individuals with KOA. In terms of psychometric completeness and robustness across several areas of postural control, the few that are now in use have several shortcomings. Subsequent investigations ought to concentrate on validating the standard of current instruments for assessing postural control in KOA for both scientific and medical objectives [61].

A medical study included a total of 125 women, ranging from 20 to 85 years (with an average age of 49 ± 24.4 years), that were divided into three main groups according to factors such as age, health status, and activity level. The evaluation included three groups: one for young, healthy women, one for older women with hip OA (i.e., the cases), and a third for women without the condition (i.e., the controls). The participants' postural stability was evaluated with the use of an electronic podometer, the WIN-POD Pel 38. The statistical analysis was conducted using Statistica 10, which led to a t-test with a significance level of $p < 0.05$. The pedobarographic balancing measurements of the research groups with and without eyes closed differed significantly. Patients suffering from hip OA exhibited the lowest levels of postural stability [62].

The purpose of another study was to compare the Four-Square Step Test (FSST) scores of hip OA patients prior to, then following total hip replacement (THR) in order to draw conclusions about the test's validity and reliability among raters. The study included 58 people that were expected to undergo primary hip replacement within four months of being recruited, and whose hip OA was moderate to severe. The Berg Balance Scale (BBS) score, the Figure of 8 Walk Test (F8W) time and steps—were taken into consideration. According to Bland and Altman, the acceptable ranges for the degree of consistency between repeated applications of a diagnostic test performed by a single rater for FSST varied from -3.2 s to 3.5 seconds prior to THR and -1.5 to 2.0 seconds following THR. When testing for concurrent validity, researchers found a modest correlation between the FSST and the BBS and a strong correlation between the F8W and FSST. Among the participants, only one was found to be at a medium risk of falling in the BBS; others scored minimal; and the F8W was only partially completed by one individual. Before surgery, 21 patients were unable to finish the FSST. Patients in a clinical setting may undergo the FSST prior and following THR surgery because it is a valid and accurate assessment of balance and time required to step in several directions that provides an additional meaningful picture of step function compared to F8W and the BBS [63].

Very few studies have targeted the postural control in patients who experience medical issues with their hip joints; some have identified problems with balance, while others have found no alterations at all. The purpose of another investigation was to identify any disparities between rheumatoid arthritis and unilateral OA in terms of postural stability as measured by several balance exercises. The study included 10 participants suffering from hip OA, 10 participants experiencing rheumatoid arthritis, and 10 volunteers for healthy control. Using a force plate, investigators measured the displacement of the core of pressure in both the medial and sideways orientations while the subjects stood on both rigid and flexible surfaces, with and without their eyes open. When compared to the eyes-open condition, the sway course when positioned on a firm spot was considerably greater in the anteroposterior orientation for both categories as well as the mediolateral direction for both groups. Every group's sway route, when standing on a pliable surface, were significantly greater when eyes were closed compared to when eyes were open. In addition, when compared to the control and OA groups, individuals suffering from rheumatoid arthritis exhibited considerably longer sway patterns when they closed their eyes. The findings of this study suggest that it is possible to identify moderate deficiencies in balance control by manipulating information that is received from the visual and somatosensory systems. Therefore, this model can reveal the consequences of reduced proprioception caused by joint capsule damage in rheumatoid arthritis patients [64].

The Community Balance and Mobility Scale (CB&M), a dynamic test, was used in another study to evaluate the known-groups validity, convergent trustworthiness and accuracy of repeated testing results in a population with KOA. A total of 25 participants, aged 50 years and above, with medial KOA and an equal number of healthy individuals, underwent various tests to assess their mobility and equilibrium. These tests included the CB&M, the Timed "Up & Go" Test, the Berg Balance Scale, a test measuring the maximum time a person can stand on one leg, and the 10-Meter Walk Test (both chosen by oneself and fast walking speeds). Independent t tests were used to evaluate known-groups validity and Pearson product moment correlation indices have been applied to evaluate the convergent validity of balancing tests with the CB&M. ICCs and standard error of measurement (SEM) were used to evaluate the test-retest repeatability of the CB&M. There was a strong correlation between results on the CB&M and all measures of mobility and equilibrium in individuals suffering from KOA. There were notable disparities in CB&M scores among the groups. In patients with KOA, CB&M scores were quite dependable [65].

Researchers recruited a number of 25 patients with bilateral OA of the knee for a research project. Findings from the Timed Up and Go Test (TUGT) with the gait subscale (POMA-G) and the Berg Balance Scale (BBS) with the balance subscale (POMA-B) were correlated to establish convergent validity. The following were established: limits of agreement (LOA) on Bland-Altman plots, intrarater reliability (ICC 3,1), SEM, minimal detectable change (MDC), and ceiling/floor effects. There was moderate convergent validity demonstrated by the positive connection between BBS scores and POMA-B scores and the negative correlation between TUGT and POMA-G. There was strong repeatability of results seen in the POMA-B, POMA-T, and POMA-G according to the ICC data. POMA-T had a standard error of 0.35, POMA-B 0.27, and POMA-G 0.35; POMA-T had an MDC of 0.97, POMA-B 0.75, and POMA-G 0.63. Researchers have shown that the POMA can accurately measure gait and balance problems of individuals suffering from KOA [66].

Individuals experiencing KOA do not yet have a generally recognized clinical outcome measure that focuses on neuromuscular control, despite the known usefulness of these activities. Researchers, in the following presented investigation, set out to examine how well the star excursion balance test (SEBT) held up in a series of tests administered to patients suffering from OA of the knee. The 24 subjects who joined the study had SEBT twice in a span of seven days, and again after 12 weeks of neuromuscular control training at home. As a subset, 37 participants estimated concurrent validity by taking the SEBT from the perspective of a motion capture system. The SEBT was measured in centimeters and then adjusted for leg length LL. Patients also filled out pre- and post-exercise versions of the 40-meter fast-walk assessment and described their health status. There were strong associations between the viewer and the motion capture metrics. The exercise regimen led to a substantial improvement in SEBT, with a standardized response mean of 0.74. Modifications of pain levels and 40-meter walk durations were not significantly correlated with SEBT alterations [67].

4.4. Tests targeting patients' quality of life

The disease specific and generic questionnaires are included in the Patient Reported Outcome Measures (PROMs). PROMs are practical instruments for assessing how well patients feel about their current state of health, their therapies, or their overall QoL (HRQoL). When assessing the cost of a disease, a diagnosis, or available treatments, HRQoL questionnaires show significant potential as valuable instruments. Assessing the QoL allows medical professionals to determine how well patients believe they are generally performing [68].

The multi-dimensional Osteoarthritis Knee and Hip Quality of Life questionnaire (OAKHQoL) was created by researchers in France. It addresses every attribute that is important for persons experiencing pain caused by lower limb OA. Of the 43 items that make up the OAKHQOL set of questions, there are three independent items and five dimensions. Prior to any other QoL instrument, the OAKHQOL was designed specifically for use with the knees and hips in people with OA. To guarantee content reliability, its creation adhered to an a priori planned strategy. It respects the validity and reliability standards set by psychometric testing [69].

The OAKHQOL captures particular features that are particularly important for patients with hip and KOA, and it covers the most OA core set criteria compared to other health status assessments typically used in OA [70].

Physical fitness, social functioning, psychological well-being, and social support were the four components that emerged from the principal component analysis. Initial results demonstrated acceptable discrimination, adequate construct validity as measured by correlation with the SF36, and satisfactory reliability across all five dimensions [69].

With its 43 parameters, the OAKHQOL covers 51 ideas that are associated with 27 distinct ICF domains at the second level. The OAKHQOL may be associated with

20 of the 55 OA core set areas. Several elements in the areas of bodily functions illustrate emotional function, pain, and sleep. In all, the OAKHQOL covers all but three of the nineteen categories of ICF activities and involvement. Medications, personal care items, social support, and interpersonal connections are some of the significant ICF environmental elements investigated by OAKHQOL. When it comes to health status instruments, the OAKHQOL and the AIMS2-SF address the OA essential package more fully than any other. With the exception of the OAKHQOL and the AIMS2-SF, very few methods assess environmental factors, sleep and emotional functions, or involvement in work and social life; instead, they all focus on limitations in activity and engagement as well as pain [70].

In another medical study, participants were questioned whether they had any joint discomfort from OA in their lower back, hips, or knees. QoL was assessed in subjects suffering from OA of the knee, hip, and lumbar region using the EQ-5D questionnaire. After making the necessary adjustments, multiple logistic regression examination was carried out. Five thousand four hundred and forty-one individuals complained of knee, hip, or lower back pain. The results demonstrated strong correlations between affected areas, psychological well-being, and overall happiness. A higher proportion of female OA patients reported depressive and anxious symptoms than male patients. Secondly, when asked about pain and depression, men with OA ranked lower back, hip, and knee as the most common sources of distress, while for anxiety and stress they ranked lower back, knee, hip. When asked about their level of stress associated with OA women most frequently indicated their knees, then their lower backs, and finally their hips. When asked about their level of despair, the same pattern emerged: knees, then lower backs, later hips. Thirdly, when looking at QoL, in men it was hip joint pain that was the most detrimental, but in women it was knee joint pain. Furthermore, the impact on psychological QoL and mental health among OA patients varied by gender and location of pain. Thus, the aforementioned study provides more evidence that the locations of pain, gender, psychological well-being, and QoL are distinct risk factors for pain associated with OA [53].

Varied impairments that affect the knee joint may severely diminishes a person's HRQoL. Reducing the clinical, financial, and social impact of KOA may be possible through the discovery of treatments that enhance HRQoL in individuals suffering from this condition. The overall incapacity of nonsurgical therapy to ameliorate physical manifestations of KOA means that they do not significantly improve HRQoL in patients with this condition. Patients often get acceptable to exceptional outcomes after surgical procedures for KOA. Unfortunately, the clinical utility is limited due to various significant obstacles that prevent surgery from being considered. Higher levels of patient acceptance are anticipated to be associated with better improvements in HRQoL for therapies that efficiently reduce pain associated with OA while maintaining a low risk-to-benefit ratio. Results from early clinical trials on KOA patients show potential for less invasive joint unloading implants as a treatment option that can bridge the gap between nonsurgical and surgical options [71].

A case-control study set out to determine which physiological processes are linked to health-related QoL in elderly individuals suffering from KOA. Physical function indicators linked to HRQoL were compared to the findings of the Medical Outcomes Study 36-Item Short-Form Health assessment. Specifically, researchers evaluated how the OA knee group rated their QoL considering how much pain they were experiencing. In comparison to the control group, those with KOA needed more time to finish the Timed Up and Go and Sit-to-Stand-5 assessments, had considerably slower maximal walking speeds, and had much shorter one-leg standing times. In comparison to the control group, those suffering from KOA scored much lower on seven subdivisions of the 36-Item Short-Form Health study, comprising the physical component summary and the role or social aspect overview. Among those suffering from KOA, there was a correlation between the Timed Up and Go, Sit-to-Stand-5, and maximal walking velocity, along with an association between the role or social aspect

overview and the physical factor synopsis. The effects of knee discomfort on joint loading were shown to be correlated with the physical component summary. A better HRQoL may be achieved in the rehabilitation of older persons with KOA by strategies that alleviate knee discomfort caused by joint loading while performing the sit-to-stand action and facilitate a seamless transition from sitting to standing [72].

The goal of another case-control investigation was to find out how OA really impacts the affected population by comparing their QoL to that of people without symptoms. Using a cross-sectional design, the study examined 140 individuals with OA diagnoses. Using the Ahlbäck classification (1968), radiographic stratification of KOA was performed. The SF-36 questionnaire, which stands for the Medical Outcomes Study 36-Item Short-Form Health study, was used to evaluate the QoL. Each participant was randomly allocated to either the "asymptomatic" (AG) or "osteoarthritis" (OG) group. Compared to the AG, the OG had a larger stature and higher body mass index. Over all SF-36 domains, the OG reported a lower QoL compared to AG. The QoL was assessed as lower by the group suffering from severe OA degeneration (Ahlbäck grades 4 and 5), when compared to the moderate group (grades 1, 2, and 3). Researchers observed a considerable interrelation between a low QoL perception and advanced age, body mass index (BMI), and OA severity. KOA patines reported a lower QoL than those without symptoms. The physical performance and operational limitation domains had the lowest results. Age, sex, body mass index, and OA severity all had an effect on QoL [73].

A cross-sectional study assessed the QoL of KOA patients using the OAKHQOL instrument. Age > 65 years, severity of pain, length of illness, number of co-morbidities, and functional impairment were all factors linked to a worse quality of life [74].

All SF-36 subgroups evaluated showed poorer values in KOA subjects in contrast to controls. Lequesne and WOMAC subgroup scores, as well as effusion and VAS pain, were substantially linked with subjects SF-36 physical function and discomfort regions. There was no association between comorbidity with KOA and the pain area of QoL. Researchers observed that female patients reported significantly higher pain levels on the SF-36 and WOMAC scales. When compared to healthy controls, patients suffering from KOA had a noticeably lower QoL. Individuals with OA may benefit from using the SF-36 as a sharp health condition scale in medical evaluations due to its correlation with their clinical condition and functional abilities. Patients suffering from KOA can also benefit from using WOMAC as a sensitive disability assessment [75].

5. Evaluation of the functional deficit in OA patients

Hip osteoarthritis significantly reduces the QoL for many individuals. Using an arsenal of measurements of muscular strength, function, and physical activity, the declines in functional capacity in both healthy persons and patients with hip OA can be measured. The results can be used to establish rehabilitation goals [76,77].

Investigators measured the isometric strength of the muscles in the hip and knee. Various functional assessments were carried out, including stair climbing, five-times-sit-to-stand, timed-up-and-go, and six-minute walk tests. Physical fitness was measured using the UCLA activity rating scale. To evaluate differences across groups, analysis of covariance (ANCOVA) was employed. Compared to healthy individuals, patients' knee extensor, knee flexor, hip flexor, extensor, and abductor strength was 30%, 38%, 10%, and 23% lower, respectively. There was no difference in the groups' hip adductor strengths. On the stair ascending test, patients were 50% delayed; on the five-times-sit-to-stand examination, 34% slower; on the timed-up-and-go assessment, 34% slower; and on the six-minute walk test, 28% a smaller distance. The physical activity of the patients decreased. Compared to people in good health, patients showed reduced levels of physical activity, strength, and function in their muscles. In order to measure progress during rehabilitation, it is necessary to determine the magnitude of these deficiencies [76].

As a major contributor to the increased likelihood of falling, hip OA affects a disproportionately large number of people. The physical limitations brought on by OA, including pain in the joints, stiff joints, weak muscles, and impaired sensation, can all have an adverse effect on one's ability to maintain balance and heighten the likelihood of falling. Researchers set out to find out if OA affects the ability of older persons to maintain their balance. In order to find out if older adults with hip OA have modified ability with static, reactive, functional, or dynamic balance [8].

The evaluation of dynamic, static, reactive, and functional balance in both clinical and laboratory settings as well as comparisons to a control group with healthy subjects or the symptomless extremity are all part of the quantitative evaluation of postural control. Research indicated that individuals suffering from OA are more likely to experience medium to increased effects in the following areas: standup with eyes closed increases forward-backward and entire sway route dimension; standing with eyes open increases medio-lateral displacement; standing on an insecure area increases overall instability; and taking a lateral step increases misplacement toward the stance leg in contrast to controls. Findings on the prevalence of balance deficits in hip OA are constrained by the fact that they were detected in only a subset of the assessments. Conflicting evidence suggests that worse balance is not the main cause of the increased risk of falls in older persons suffering from hip OA. One possible explanation for the increased risk of falls in this group is the presence of musculoskeletal impairments [78].

A cross-sectional study aimed to recruit patients with advanced KOA that were at that moment on the attending list for total knee replacement surgery. Individuals undergoing treatment were requested to complete the KOOS survey. The degree of knee ache on the two sides was measured using a progressive scale ranging from 0 to 10. Measurements of height, weight, and age were carried out. Individual patient data as well as KOOS subscale scores were subject to descriptive statistics analysis. To find out how much of an impact knee discomfort has on two KOOS subscales— the ability to perform tasks in daily living (KOOS-ADL) and the knee-related quality of life (KOOS-QoL)— researchers built hierarchical models based on linear regression. The QoL subscale had the minimal values among the KOOS subscales, which had low scores across all categories (27.7% to 54.2%). After taking age and body mass index into consideration, hierarchical linear regressions showed that self-perceived KOOS-ADLs were influenced by both sides of the knee, while lower KOOS-QOL scores were significantly caused by the most-affected area of the knee [79].

Another investigation examined KOA patients to see what variables affected their standing balance. The study encompassed 37 female patients who were experiencing painful OA of the knee. Knee alignment, pain, and the Kellgren and Lawrence grade were all assessed in the same manner. Using a force-platform system, subjects were asked to stand for 30 seconds with either their eyes open or closed to evaluate their static standing balance. In order to determine static equilibrium, the average velocity moment (mm2/s) and the mean speed (mm/s) of the middle of pressure's movement in the mediolateral and anteroposterior (AP) directions were examined. There were statistically significant correlations between knee alignment, age, and mean AP speed and eyes opened in the univariate regression analysis. Illness severity was inversely correlated with average velocity in the AP directions whereas age and knee alignment were favorably correlated in the multiple linear regression model with eyes opened. Age, knee alignment, discomfort, and radiographic severity were not substantially linked with the factors for eyes closed static measures. According to these results, poor balance was linked to getting older, having fewer varus knee malalignment, and having minor radiographic alterations. Standing balance did not cause any pain [80].

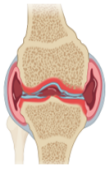
6. Clinical-functional diagnosis in degenerative and inflammatory pathology of the hip and knee

In a multicenter investigation, the clinical parameters for classifying patients reporting with hip pain due to OA were established. Patients in the control group suffered from hip discomfort due to conditions other than spondylarthropathy or rheumatoid arthritis. Hip OA was diagnosed when a patient experienced discomfort in addition to either age 50 and over, internal rotation of the hip with 15 degrees or further, discomfort felt during the internal rotation of the hip, hip lack of mobility for at least one hour first thing in the morning, there was a sensitivity of 86% and a specificity of 75% when the hip flexion was below or equivalent to 115 degrees and the erythrocyte sedimentation rate was lower or equivalent to 45 mm/hour, or when the hip internal rotation was below fifteen degrees. Regarding medical and imaging standards, in its original version, the classic format required either acetabular or femoral osteophytes, constriction of the joint area (axial, superior, or medial), or an ESR below 20 mm/hour in addition to discomfort (89% sensitivity, 91% specificity). With a sensitivity of 89% and a specificity of 91%, the classification tree method was the most effective in differentiating between controls and OA patients based on the radiographic finding of osteophytes. Criteria and sensitivity/specificity levels in the – number of variables available format were comparable to that in the categorization trees for the set of mixed radiographic and clinical parameters. The classification tree significantly improved the specificity of the clinical criteria set [81].

Patients with hip pain who visited their primary care physician for at least two times in a row and were sent for imaging studies all followed the same protocol, which included taking a detailed medical history and doing standardized radiographs, laboratory tests, and physical examinations. Investigators confirmed radiological OA when the joint space was less than or equal to 2.5 mm. Also, a stricter definition was utilized, with a minimum of 1.5 mm. Examining the correlation between radiological OA and potential clinical symptoms or indicators of OA was the aim of the presented investigation. This research aimed to assess the predictive power of combined clinical symptoms and indications that had previously demonstrated an independent connection with radiological OA in multivariate analysis. Radiological OA, defined as a joint space less than or equal to 2.5 mm, was found in 35.5% of the participants with hip symptoms, whereas 11.4% had more severe OA, defined as a joint space less than or equal to 1.5 mm. The positive predictive value (PPV) for radiographic OA was 73% (specificity 91%, sensitivity 45%) when four specific symptoms or indicators were present in the individual`s medical history and physical evaluation. In cases with severe radiological OA, the PPV was 82% when 5 symptoms or signs were detected (sensitivity 72%, specificity 98%), and 100% when 6 or 7 symptoms or signs were observed (sensitivity 40% and 8%, respectively, specificity 100%,).

Fig. 4. ACR classification of hip and KOA. ESR, erythrocyte sedimentation rate.

Hip osteoarthritis classification criteria



Knee osteoarthritis classification criteria

Clinical	Criteria fulfilled if the following combinations are present:
1. Hip pain (most days prior month) 2. Internal rotation <15^0 3. ESR ≤ 45 mm/h 4. Hip flexion ≤ 115^0 5. Internal rotation >15^0 6. Morning stiffness ≤ 60 minutes 7. Age > 50 years 8. Pain on internal rotation	a) 1, 2 + 3 b) 1, 2 + 4 c) 1, 5, 6, 7 + 8

Clinical, laboratory and radiographic	Criteria fulfilled if the following combinations are present:
1. Hip pain (on most days of prior month) 2. ESR ≤ 20 mm/h 3. Radiographic osteophytes 4. Radiographic joint space narrowing	a) 1, 2 + 3 b) 1, 2 + 4 c) 1, 3 + 4

Clinical	Criteria fulfilled if the following combinations are present:
1. Knee pain (most days of prior month) 2. Crepitus 3. Morning stiffness ≤ 30 mins 4. Age ≥ 38 years 5. Bony enlargement	a) 1, 2, 3 + 4 b) 1, 2 + 5 c) 1, 4 + 5

Clinical, laboratory and radiographic	Criteria fulfilled if the following combinations are present:
1. Knee pain (most days of prior month) 2. Osteophyte 3. Synovial Fluid typical of OA 4. Age ≥ 40 years 5. Morning stiffness ≤ 30 mins 6. Crepitus	a) 1 + 2 b) 1, 3, 5 + 6 c) 1, 4, 5 + 6

The majority of combinations have high negative predictive values [82].Diagnosing KOA is a challenging endeavor, despite the fact that it is common and a real burden on patients and healthcare systems. To diagnose KOA, Altman and colleagues introduced the so-called ACR guidelines in 1986 [83]. Fig. 4 presents the American College of Rheumatology (ACR) classification criteria for hip and KOA [84].

7. Imaging diagnosis approaches

Since radiography is easily accessible, inexpensive, and easy to interpret, it is currently the diagnostic tool of choice for detecting and tracking OA. Radiographic OA assessment methods commonly used in research include the Kellgren-Lawrence and Tönnis systems. These systems indicate the extent to which the joint space is narrowed, the presence of cysts, deformities of the acetabulum and femoral head, and osteophytes. Imaging techniques like unenhanced computed tomography (CT) allow for a clear view of the posterolateral and inferoposterior hip joints, which can be challenging to see on radiographs. Various forms of intra-articular hip impairment may be identified using imaging techniques like arthrography, CT, MRI, and MRI with two-dimensional reconstructions. When it comes to investigating hip OA, investigative MRI procedures like delayed gadolinium-enhanced MRI of cartilage, T2 and T2* mapping, T1rho, zero echo time and ultra-short echo duration, have shown significant promise [85].

In 1963, Kellgren distinguished four types of hip OA: category 1 (potential medial constriction of the joint area and osteophytes adjacent to the femoral head), probable OA; grade 2 (minor OA), well defined osteophytes, a minor degree of sclerosis, and a marked diminution of the joint space inferiorly; degree 3 (moderate OA), acetabulum and femoral head deformities, mild osteophytes, noticeable joint space constriction, sclerosis, and cyst formation; and grade 4 (severe OA), which is characterized by a considerable deformity of the acetabulum and femoral head as well as massive osteophytes, cysts, sclerosis, and a severe loss of joint space [86].

An evaluation set out to find specific risk factors for OA of the hip joint was conducted using weight-bearing, regulated pelvic radiographs. The radiological definition of hip joint OA was a joint space width of less than or equal to 2.0 mm. The

assessment of hip dysplasia was conducted based on widely used radiographic indicators. The radiographic results were compared to the overall lifestyle and medical data collected at the initial examinations and through questionnaires. Age, smoking, self-reported hip discomfort, hip dysplasia, body mass index, professional exposure to daily repetitive lifting, and other risk factors were the primary focus of the study. Based on the radiographic criterion that was used, the incidence of hip dysplasia varied between 5.4% and 12.8%. In individuals younger than 60 years old, the incidence of hip OA was 1.0-2.5%, while in subjects older than or equal to 60 years old, it ranged from 4.4-5.3%. There was a statistically significant association between the incidence of hip OA in women and just two of the variables included in the logistic regression analyses: age and hip dysplasia. The only condition linked to an increased risk of hip OA in males was hip dysplasia. Hip dysplasia and advanced age were the only individual risk variables linked to hip OA in the present investigation [87].

In a medical study, two experienced operators, who were not given access to any patient records or any imaging results, conducted 92 simultaneous bilateral ultrasounds. One operator reviewed the pictures again after four to six weeks. A third imaging expert evaluated the X-rays. Cohen's ordinal kappa statistics were used for binary categorical parameters and weighted kappa for ordered categorical parameters to evaluate inter- and intrarater dependability and consistency between X-ray and ultrasound imaging. The inter-rater reliability for hip effusion/synovitis grading was 0.9 and for OA scaling, it was 0.8, according to the Kappa values (κ). Modifications in the cartilage of the femur and labrum κ varied between 0.4 and 0.7 for acetabular and osteophytes at the femoral level. When comparing intra- and inter-rater reliability, the beta value was either equal to or greater than the latter. The consistency of the results between the ultrasound and X-ray imaging varied between κ=0.2 and κ=0.5. The most prevalent ultrasound results associated with OA classification and hip OA were found to exhibit substantial to near-perfect reliability in this investigation. When comparing the ultrasound and X-ray results for OA grade, there was a moderate degree of consistency. When taken as together, these findings lend credence to the use of ultrasonic imaging to diagnose hip OA [88].

Radiography often shows symmetric joint space narrowing, subchondral sclerosis, bone remodeling, osteophyte formation, and subluxation. Joint complications can be either unicompartmental (i.e., only the medial tibio-femoral joint), bicompartmental (i.e., both the medial and patellofemoral joints or both the lateral and patellofemoral joints), or tricompartmental. These abnormalities are most commonly seen in radiography [89].

Other symptoms commonly seen in OA include joint effusion and free bony structures within the joints. To assess KOA and track the disease's progression through time, radiologists apply one of many radiographic classification systems. There are a number of well-known systems for assessing OA, the most prominent of which being the K/L and OARSI atlas criteria. From 0 (i.e., no X-ray alterations detected) to 4 (i.e., considerable joint area reduction, large osteophytes, critical sclerosis, and clear abnormality of bone ends), the K/L approach offers four levels of OA severity. It was initially described in 1957 [90].

Researchers conducted another investigation to evaluate KOA by comparing results from ultrasonography with those from clinical and radiographic evaluations. The rheumatologists assessed the patient's knees clinically and documented the patient's discomfort using a VAS for pain, examined each patient's knees using ultrasound, and evaluated the weight-bearing lateral and anteroposterior knee radiographs. Moreover, the Kellgren and Lawrence (K-L) degree, the size of the area between the femur and tibia, and the existence of degenerative symptoms in the patellofemoral region have been assessed. In patients experiencing knee pain, ultrasound revealed effusion in 47% of cases, Baker's cyst in 22% of cases and medial meniscus protrusion (MMP) with medial collateral ligament displacement (MCLD) in 61% of cases. The VAS pain score was considerably higher in patients with US effusion,

MMP, and MCLD. The medial FT space size was found to be linked with MMP. Compared to individuals with a variance of less than 30 on the VAS for discomfort in every knee, those with a discrepancy of more than 30 (28 patients) had worse K-L grade in the troublesome knee, as well as MMP more unilateral effusion, and MCLD. Discomfort in the knee is often linked to KOA, as is the presence of MMP with MCLD and knee effusion. Furthermore, MMP could exacerbate the narrowing of the radiographic medial FT space. To further understand the etiology of KOA, researchers suggest using ultrasound to evaluate periarticular and intraarticular abnormalities [91].

Since its development, MRI has had reduced use in the treatment of OA. By providing a three-dimensional view of the knee joint at once, MRI provides superior discriminating between articular soft tissues over traditional radiography, enabling a more holistic assessment of the knee. The results of the studies showed that MRI findings in KOA can include irregularities in the cartilage, bone, subarticular cysts, osteophytes, intra-articular loose bodies, ligament abnormalities, meniscal tears, joint effusion, synovial thickening, and periarticular cysts [92].

8. Treatment strategies

A meta-analysis and systematic examination employing 18 randomized controlled trials set out to assess the impact on function and pain following treatment, as well as at 6-9 months post-treatment. The research was believed to be clinically meaningful when the SMD was less than or equal to -0.37. Researchers discovered that exercise therapy had a positive impact on both function and pain after treatment. Six to nine months following exercise therapy, patients reported less discomfort and improved function. Small effect sizes were common, and whether or not they have any bearing on treatment methods is debatable [93].

Due to the fact that not all the patients will respond positively to the same treatment, it is essential that therapy be personalized. For optimal results, it is essential to combine non-pharmacological and pharmacological treatments. A healthy diet and regular exercise are the two most effective ways for losing extra pounds. If a patient is unable to engage in high-impact exercise, they should begin with isometric exercises, which do not involve moving any joints. Isotonic exercise, such as biking, walking, and swimming, might be recommended when joint function is not substantially impaired, and pain levels are manageable. For moderate to severe, intermittent OA symptoms, acetaminophen is the pharmacological treatment of choice. A non-steroidal anti-inflammatory medicine (NSAID) can be administered when the pain is not getting better with acetaminophen or when the symptoms are worsening. Prior to administering NSAIDs, it is imperative to assess the individual's risk profile for heart disease and stomach ulcer complications [94].

When recommending medication, clinicians encounter an overwhelming variety of alternatives, which challenges clinical decision-making. Both opioids and NSAIDs have the potential to alleviate discomfort and improve physical performance, but opioids are associated with a far higher risk of adverse outcomes [95].

Recent findings regarding the inflammatory nature of OA and the potential risks to cardiovascular health from COX-2-specific inhibitors have generated suggestions to reevaluate the current guidelines regarding the use of NSAIDs for the treatment of OA. Clinical trials have shown that COX-2-specific inhibitors are effective in lowering gastrointestinal toxicity. To decrease the probability of gastrointestinal adverse reactions, it is recommended to use NSAIDs at lower doses for shorter periods of time or to take a proton pump inhibitor alongside them. When it comes to cardiovascular risks, all prescription NSAIDs have a black box warning [96].

Total hip replacement should only be done when there is clear evidence of advanced OA in the hip joint (Kellgren and Lawrence grade 3 or 4), after trying conservative treatment for at least three months, and when the patient is experiencing significant subjective suffering from the symptoms caused by the affected hip joint.

Contraindications for this treatment include persistent infection that does not respond to treatment, both acute and long-term illnesses that occur at the same time, and a body mass index equal to or more than 40 kg/m2. Patients are advised to cease smoking a minimum of one month prior to undergoing surgery. For individuals diagnosed with diabetes mellitus, it is recommended to achieve preoperative glycemic control with a HbA1c level below 8%. Patients are advised to reduce their weight to a BMI below 30 kg/m2. When the potential benefits of treatment exceed the potential hazards, the physician and patient should jointly decide whether or not to undergo total hip replacement. According to the available evidence, surgical outcomes are worse for patients whose conditions were worse before the procedure [97].

Patients with OA now have a decision-making tool with standardized criteria for hip replacement surgery, following the completion of the aforementioned investigation. When combined with data regarding individual preferences and social circumstances, the technology will facilitate doctors' clinical decision about whether or not to do hip surgery [98].

When it comes to surgical procedures, total hip arthroplasty is now among the most popular and trusted choices for patients. Although there are a number of possible surgical methods to the process, the three most common worldwide are the posterior, direct lateral, and direct anterior approaches. While there are benefits and drawbacks to each method, total hip arthroplasty can safely and effectively apply any of them. There is a current scarcity of robust, compelling, high-quality research that compares the various methods. Consequently, surgeons should select the method with which they are most familiar and at ease. The two-incision method and the anterolateral approach, which are alternate names for the same procedure, are not covered in the presented article. Furthermore, there have been reports of surgeons using the so-called direct superior technique for total hip arthroplasty recently. Although these methods are not as popular as the more conventional ones, they are acknowledged as good substitutes [99].

Increasing surgical effectiveness, improving osseointegration to provide biological fixation, and reducing systemic issues linked to cement impaction and attrition from cement debris are some of the conceptual benefits that have led to a recent upsurge in the popularity of cementless knee arthroplasty. Cementless fixation has the potential to increase implant survival and functional outcomes, which is encouraging because the procedure is being requested by youthful and more physically active individuals [100].

It is likely to find a reduced rate of revision in unicompartmental knee arthroplasty and a greater rate in cementless total knee arthroplasty, according to the National Joint Registry. Cementless implants, especially unicompartmental knee arthroplasty, have been the subject of current promising research due to their noticeable performance advantages over cemented kinds. Despite promising results in short- and medium-term cohort trials, cementless total knee arthroplasty has not yet demonstrated any long-term advantages. Still, new ideas like radiostereometric evaluation, robotic-assisted surgery, 3D-printed coatings, and the concepts of kinematic or functional knee alignment hold promise for the future of cementless total knee arthroplasty and its potential to improve results [101].

In both younger and older patients, the latest cementless total knee arthroplasty models have demonstrated remarkable functional outcomes, satisfaction, and survival rates. Potential advantages may exist with the most recent cementless implants in comparison to cement fixation [102].

In severe cases of KOA, a total knee replacement may be necessary. One of the most popular options is cemented arthroplasty. The theoretical benefits of cementless knee fixation, such as maintaining bone stock and acquiring a biological fixation that avoids cement fragmentation, are attracting increasing interest, similar to the progressive shift from cemented to uncemented fixation procedures for prosthetic hips.

In light of current research, an uncemented knee prosthesis offers a promising alternative to cemented implants for patients under the age of 65 with good bone density and a desire for a biological bone-prosthesis fixation, all without the problems associated with cement fragmentation or the need for subsequent implant revisions. However, the tibial fixation is still not strong enough, thus it is essential to follow technical guidelines to prevent micromovements that could lead to osteointegration failure [103].

There are a lot of current options for treating symptoms in OA, including opioid and non-opioid analgesics, slow-acting symptomatic drugs, nonsteroid anti-inflammatory drugs, and topical preparations. However, these options have different effects on patients and different recommendations from different professional organizations. An individual's reaction to treatment for KOA symptoms can be greatly enhanced by pharmacogenomic-guided therapy, which is based on the tenets of giving each patient the correct medicine at the right time. Despite its widespread usage in clinical practice, injecting hyaluronic acid or corticosteroids into an injured joint causes heated debate within various guidelines. Injectable mesenchymal stem cells and platelet-rich plasma are two biological approaches that have demonstrated promise in alleviating OA symptoms and, when used in conjunction with other treatments, substantially improving patients' QoL. It is necessary to conduct bigger and more rigorous studies to determine the actual effects of various therapies and revise the current recommendations because the guidelines do not include the latter and have an inconsistent position on several therapy alternatives [104].

For adults suffering from KOA, researchers set out to compare three different intervention types: exercise with extra passive manual mobilization, exercise therapy (a mix of strength training, aerobic activity, and active range of motion exercises), and a non-exercise control group. Additionally, they aimed to compare the three therapies. The main indicators for effectiveness were functional capacity and pain levels. Physical function was also markedly enhanced by each intervention. There was a lack of evidence from randomized trials comparing the three therapies. Yet compared to exercise alone, exercise in conjunction with manual mobilizations considerably decreased discomfort. When comparing the effects of exercise therapy with manual mobilisation on pain, the combined effect was moderate, while the results of strength exercising, and exercise therapy by itself were small. Physiotherapists and manual therapists may find that patients suffering from KOA benefit more from their supervised physical exercise programs if they incorporate manual mobilization into them [105].

A personalized, 12-week non-surgical therapy program is more effective than conventional care at 12 months in individuals with moderate to severe KOA who are not eligible for total knee replacement. Additionally, there are fewer treatment-related adverse events [106].

One of the peck economical and reliably efficient orthopedic intervention is total knee arthroplasty. Functional restoration, pain alleviation, and enhanced QoL are three areas where patients report significant improvements in their outcomes. Results from total knee arthroplasty are consistently favorable for individuals with advanced tri-compartmental degenerative OA. Deterioration and loss of articular cartilage characterize OA, a degenerative joint condition that affects millions of Americans. The knee is the joint most frequently affected by this progressive illness. According to estimates, 240 out of 100,000 persons experience symptomatic KOA each year, and approximately 400,000 primary total knee arthroplasty interventions are carried out in the US every year. Although primary OA is the most prevalent medical condition linked with TKA, dysplasia, fracture (post-traumatic OA and/or deformity), inflammatory arthritis, and cancer are all possible underlying causes [107].

The best alternative for individuals with advanced KOA is total knee arthroplasty. Although patient-specific instruments can enhance implant placement and limb alignment, there is no obvious change in functional outcomes. The natural knee

anatomy and biomechanics are a starting point for the personalized implants. During total knee arthroplasty, the sensors should strive to provide objective data on the balance of ligaments. At the moment, there is barely any research detailing the outcomes of these two devices over the medium term. In order to better align the total knee arthroplasty, engineers created the sophisticated gadgets known as accelerometers. Their advantages are still up for debate. Because of the robotic interface and 3D surgical planning made possible by robotic-assisted systems, bone preparation can be both accurate and reproducible, regardless of whether or not preoperative 3D imaging is used. Despite its potential, this technology is not without its limitations. Technological advancements in total knee arthroplasty are both fascinating and ever-changing [108].

When it comes to musculoskeletal surgeries, knee replacement is among the most popular and economical options. Despite significant regional and national variance in use rates, the total number of cases done is rising steadily over the globe. KOA, which causes discomfort and hinders mobility and QoL, is still the most frequent reason for surgical intervention. Several parameters like the subject's preferences as a patient or surgeon, impact the threshold for intervention, which is not clearly defined. Contrary to popular belief, a significant minority of individuals do not experience a positive clinical outcome following knee replacement surgery. While the operation has a great long-term survivability rate, there is still room for improvement, and researchers are appropriately concentrating on ways to make post-operative pain medication more effective for more patients. While it is true that new implant designs have the potential to improve results, it is also true that better implantation techniques, problem avoidance, and perioperative care for patients—including expanded recovery programs—can lead to even better results. Improved knee replacement care in the future is possible with the help of new technology, but more regulation and monitoring of their introduction is necessary to protect patients [109].

9. Conclusion

OA is a persistent, degenerative illness characterized by the progressive degradation of articular cartilage, representing the most debilitating form of arthrosis due to its substantial effect on patients' QoL. The critical importance of integrating clinimetric and psychometric assessments in the management of OA is highlighted. Clinimetric tools, including the WOMAC and KOOS, provide valuable insights into the physical manifestations of OA, including pain, stiffness, and functional limitations. Equally essential, psychometric evaluations help address the psychological impacts, such as anxiety and depression, which often accompany chronic OA pain. The combination of these approaches offers a more comprehensive understanding of the disease, allowing for personalized treatment strategies that target both physical and mental health needs. Treatment and recovery strategies, although multiple and with improved results in recent years, still have shortcomings that need to be addressed through future research directions.

Early intervention, informed by comprehensive assessments, can improve adherence to treatment and optimize patient outcomes. Future research should focus on refining both clinimetric and psychometric measures to ensure holistic, patient-centered care in OA management, which is vital for improving the QoL for those affected by this multifaceted disease.

Author Contributions: All authors have read and agreed to the published version of the manuscript and have significant contribution to this work.

Funding: The APC was funded by the University of Oradea, Romania.

Data Availability Statement: All the patient's data are available at the first author per request.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Lawrence, R.C.; Felson, D.T.; Helmick, C.G.; Arnold, L.M.; Choi, H.; Deyo, R.A.; Gabriel, S.; Hirsch, R.; Hochberg, M.C.; Hunder, G.G.; et al. Estimates of the Prevalence of Arthritis and Other Rheumatic Conditions in the United States. Part II. Arthritis Rheum. 2008, 58, 26–35.
2. Minea, M.; Vladareanu, L.; Minea, A.-E.; Andronache, I.-T.; Madalina Gabriela, I. Correlations Between Imaging and Clinical, Functional and Biological Features in Knee Osteoarthritis. Balneo PRM Res. J. 2024, 15, 699, doi:10.12680/balneo.2024.699.
3. Radu, A.F.; Bungau, S.G.; Tit, D.M.; Behl, T.; Uivaraseanu, B.; Marcu, M.F. Highlighting the Benefits of Rehabilitation Treatments in Hip Osteoarthritis. Medicina (B. Aires). 2022, 58, 494–571.
4. Blagojevic, M.; Jinks, C.; Jeffery, A.; Jordan, K.P. Risk Factors for Onset of Osteoarthritis of the Knee in Older Adults: A Systematic Review and Meta-Analysis. Osteoarthr. Cartil. 2010, 18, 24–33.
5. Osteoarthritis Research Society International. OA as a Serious Disease Available online: https://oarsi.org/research-oarsi-success/oa-serious-disease (accessed on 9 September 2024).
6. Allen, K.D.; Thoma, L.M.; Golightly, Y.M. Epidemiology of Osteoarthritis. Osteoarthr. Cartil. 2022, 30, 184–195.
7. Munteanu, C.; Onose, G.; Marius, T.; Rotariu, M. Cellular and Molecular Homeostatic Microenvironmental Imbalances in Osteoarthritis and Rheumatoid Arthritis. Balneo PRM Res. J. 2023, 14, 564.
8. Loeser, R.F. The Role of Aging in the Development of Osteoarthritis. Trans. Am. Clin. Climatol. Assoc. 2017, 128, 44–54.
9. Oo, W.M.; Linklater, J.M.; Daniel, M.; Saarakkala, S.; Samuels, J.; Conaghan, P.G.; Keen, H.I.; Deveza, L.A.; Hunter, D.J. Clinimetrics of Ultrasound Pathologies in Osteoarthritis: Systematic Literature Review and Meta-Analysis. Osteoarthr. Cartil. 2018, 26, 601–611.
10. McConnell, S.; Kolopack, P.; Davis, A.M. The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC): A Review of Its Utility and Measurement Properties. Arthritis Rheum. 2001, 45, 453–461.
11. Collins, N.J.; Prinsen, C.A.C.; Christensen, R.; Bartels, E.M.; Terwee, C.B.; Roos, E.M. Knee Injury and Osteoarthritis Outcome Score (KOOS): Systematic Review and Meta-Analysis of Measurement Properties. Osteoarthr. Cartil. 2016, 24, 1317–1329.
12. Tomba, E.; Tomei, G. Bridging Perspectives: Exploring the Convergence of Clinimetrics and Network Theory in Mental Health Assessment and Conceptualization. J. Clin. Med. 2024, 13, 1814.
13. Lundgren-Nilsson, Å.; Dencker, A.; Palstam, A.; Person, G.; Horton, M.C.; Escorpizo, R.; Küçükdeveci, A.A.; Kutlay, S.; Elhan, A.H.; Stucki, G.; et al. Patient-Reported Outcome Measures in Osteoarthritis: A Systematic Search and Review of Their Use and Psychometric Properties. RMD open 2018, 4, e000715.
14. Meda, R.T.; Nuguru, S.P.; Rachakonda, S.; Sripathi, S.; Khan, M.I.; Patel, N. Chronic Pain-Induced Depression: A Review of Prevalence and Management. Cureus 2022, 14, e28416.
15. Wu, Y.; Levis, B.; Sun, Y.; He, C.; Krishnan, A.; Neupane, D.; Bhandari, P.M.; Negeri, Z.; Benedetti, A.; Thombs, B.D. Accuracy of the Hospital Anxiety and Depression Scale Depression Subscale (HADS-D) to Screen for Major Depression: Systematic Review and Individual Participant Data Meta-Analysis. BMJ 2021, 373, n972.
16. Cheng, S.-T.; Chen, P.P.; Chow, Y.F.; Chung, J.W.Y.; Law, A.C.B.; Lee, J.S.W.; Leung, E.M.F.; Tam, C.W.C. The Pain Catastrophizing Scale-Short Form: Psychometric Properties and Threshold for Identifying High-Risk Individuals. Int. psychogeriatrics 2019, 31, 1665–1674.
17. Krist, A.H.; Tong, S.T.; Aycock, R.A.; Longo, D.R. Engaging Patients in Decision-Making and Behavior Change to Promote Prevention. Stud. Health Technol. Inform. 2017, 240, 284–302.
18. Bhattad, P.B.; Pacifico, L. Empowering Patients: Promoting Patient Education and Health Literacy. Cureus 2022, 14, e27336.
19. Wise, B.L.; Niu, J.; Zhang, Y.; Wang, N.; Jordan, J.M.; Choy, E.; Hunter, D.J. Psychological Factors and Their Relation to Osteoarthritis Pain. Osteoarthr. Cartil. 2010, 18, 883–887.
20. Nishida, C.; Uauy, R.; Kumanyika, S.; Shetty, P. The Joint WHO/FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases: Process, Product and Policy Implications. Public Health Nutr. 2004, 7, 245–250.
21. O'Brien, M.S.; McDougall, J.J. Age and Frailty as Risk Factors for the Development of Osteoarthritis. Mech. Ageing Dev. 2019, 180, 21–28.

22. Shane Anderson, A.; Loeser, R.F. Why Is Osteoarthritis an Age-Related Disease? Best Pract. Res. Clin. Rheumatol. 2010, 24, 15–26.
23. Loeser, R.F.; Collins, J.A.; Diekman, B.O. Ageing and the Pathogenesis of Osteoarthritis. Nat. Rev. Rheumatol. 2016, 12, 412–420.
24. Buckwalter, J.A.; Brown, T.D. Joint Injury, Repair, and Remodeling: Roles in Post-Traumatic Osteoarthritis. Clin. Orthop. Relat. Res. 2004, 7–16.
25. Sellam, J.; Berenbaum, F. Is Osteoarthritis a Metabolic Disease? Jt. bone spine 2013, 80, 568–573.
26. Spector, T.D.; MacGregor, A.J. Risk Factors for Osteoarthritis: Genetics. Osteoarthr. Cartil. 2004, 12 Suppl A, S39-44.
27. Hunter, D.; De Lange, M.; Snieder, H.; MacGregor, A.J.; Swaminathan, R.; Thakker, R. V; Spector, T.D. Genetic Contribution to Bone Metabolism, Calcium Excretion, and Vitamin D and Parathyroid Hormone Regulation. J. bone Miner. Res. 2001, 16, 371–378.
28. Felson, D.T.; Lawrence, R.C.; Dieppe, P.A.; Hirsch, R.; Helmick, C.G.; Jordan, J.M.; Kington, R.S.; Lane, N.E.; Nevitt, M.C.; Zhang, Y.; et al. Osteoarthritis: New Insights. Part 1: The Disease and Its Risk Factors. Ann. Intern. Med. 2000, 133, 635–646.
29. Bobinac, D.; Spanjol, J.; Zoricic, S.; Maric, I. Changes in Articular Cartilage and Subchondral Bone Histomorphometry in Osteoarthritic Knee Joints in Humans. Bone 2003, 32, 284–290.
30. Nagaosa, Y.; Lanyon, P.; Doherty, M. Characterisation of Size and Direction of Osteophyte in Knee Osteoarthritis: A Radiographic Study. Ann. Rheum. Dis. 2002, 61, 319–324.
31. Hoff, P.; Buttgereit, F.; Burmester, G.-R.; Jakstadt, M.; Gaber, T.; Andreas, K.; Matziolis, G.; Perka, C.; Röhner, E. Oste-oarthritis Synovial Fluid Activates Pro-Inflammatory Cytokines in Primary Human Chondrocytes. Int. Orthop. 2013, 37, 145–151.
32. Akkiraju, H.; Nohe, A. Role of Chondrocytes in Cartilage Formation, Progression of Osteoarthritis and Cartilage Regeneration. J. Dev. Biol. 2015, 3, 177–192.
33. Wojdasiewicz, P.; Poniatowski, Ł.A.; Szukiewicz, D. The Role of Inflammatory and Anti-Inflammatory Cytokines in the Pathogenesis of Osteoarthritis. Mediators Inflamm. 2014, 2014, 561459.
34. Abramson, S.B. Osteoarthritis and Nitric Oxide. Osteoarthr. Cartil. 2008, 16 Suppl 2, S15-20.
35. Chen, T.-L.; Lin, Y.-F.; Cheng, C.-W.; Chen, S.-Y.; Sheu, M.-T.; Leung, T.-K.; Qin, C.-H.; Chen, C.-H. Anti-Inflammatory Mechanisms of the Proteinase-Activated Receptor 2-Inhibiting Peptide in Human Synovial Cells. J. Bio-med. Sci. 2011, 18, 43.
36. Pfander, D.; Gelse, K. Hypoxia and Osteoarthritis: How Chondrocytes Survive Hypoxic Environments. Curr. Opin. Rheumatol. 2007, 19, 457–462.
37. Liu, Y.; Zhang, Z.; Li, T.; Xu, H.; Zhang, H. Senescence in Osteoarthritis: From Mechanism to Potential Treatment. Ar-thritis Res. Ther. 2022, 24, 174.
38. Kreibich, D.N.; Vaz, M.; Bourne, R.B.; Rorabeck, C.H.; Kim, P.; Hardie, R.; Kramer, J.; Kirkley, A. What Is the Best Way of Assessing Outcome after Total Knee Replacement? Clin. Orthop. Relat. Res. 1996, 221–225.
39. Marks, R. Walking Time Measures for Evaluating OA of the Knee. South African J. Physiother. 1994, 50, 5–8.
40. Steultjens, M.P.; Dekker, J.; van Baar, M.E.; Oostendorp, R.A.; Bijlsma, J.W. Internal Consistency and Validity of an Observational Method for Assessing Disability in Mobility in Patients with Osteoarthritis. Arthritis care Res. 1999, 12, 19–25.
41. Odding, E.; Valkenburg, H.A.; Stam, H.J.; Hofman, A. Assessing Joint Pain Complaints and Locomotor Disability in the Rotterdam Study: Effect of Population Selection and Assessment Mode. Arch. Phys. Med. Rehabil. 2000, 81, 189–193.
42. Woolacott, N.F.; Corbett, M.S.; Rice, S.J.C. The Use and Reporting of WOMAC in the Assessment of the Benefit of Physical Therapies for the Pain of Osteoarthritis of the Knee: Findings from a Systematic Review of Clinical Trials. Rheumatology 2012, 51, 1440–1446.
43. Tubach, F.; Ravaud, P.; Baron, G.; Falissard, B.; Logeart, I.; Bellamy, N.; Bombardier, C.; Felson, D.; Hochberg, M.; van der Heijde, D.; et al. Evaluation of Clinically Relevant Changes in Patient Reported Outcomes in Knee and Hip Osteoarthritis: The Minimal Clinically Important Improvement. Ann. Rheum. Dis. 2005, 64, 29–33.
44. Thumboo, J.; Chew, L.H.; Soh, C.H. Validation of the Western Ontario and Mcmaster University Osteoarthritis Index in Asians with Osteoarthritis in Singapore. Osteoarthr. Cartil. 2001, 9, 440–446.
45. Terwee, C.B.; Mokkink, L.B.; Steultjens, M.P.M.; Dekker, J. Performance-Based Methods for Measuring the Physical Function of Patients with Osteoarthritis of the Hip or Knee: A Systematic Review of Measurement Properties. Rheuma-tology 2006, 45, 890–902.

46. Stratford, P.W.; Kennedy, D.M.; Woodhouse, L.J.; Spadoni, G.F. Measurement Properties of the WOMAC LK 3.1 Pain Scale. Osteoarthr. Cartil. 2007, 15, 266–272.
47. Lin, Y.C.; Davey, R.C.; Cochrane, T. Tests for Physical Function of the Elderly with Knee and Hip Osteoarthritis. Scand. J. Med. Sci. Sports 2001, 11, 280–286.
48. Basaran, S.; Guzel, R.; Seydaoglu, G.; Guler-Uysal, F. Validity, Reliability, and Comparison of the WOMAC Osteoarthritis Index and Lequesne Algofunctional Index in Turkish Patients with Hip or Knee Osteoarthritis. Clin. Rheumatol. 2010, 29, 749–756.
49. Hawker, G.A.; Stewart, L.; French, M.R.; Cibere, J.; Jordan, J.M.; March, L.; Suarez-Almazor, M.; Gooberman-Hill, R. Understanding the Pain Experience in Hip and Knee Osteoarthritisan OARSI/OMERACT Initiative. Osteoarthr. Cartil. 2008, 16, 415–422.
50. Maly, M.R.; Cott, C.A. Being Careful: A Grounded Theory of Emergent Chronic Knee Problems. Arthritis Rheum. 2009, 61, 937–943.
51. Ackerman, I.N.; Kemp, J.L.; Crossley, K.M.; Culvenor, A.G.; Hinman, R.S. Hip and Knee Osteoarthritis Affects Younger People, Too. J. Orthop. Sports Phys. Ther. 2017, 47, 67–79.
52. Jordan, J.M. An Ongoing Assessment of Osteoarthritis in African Americans and Caucasians in North Carolina: The Johnston County Osteoarthritis Project. Trans. Am. Clin. Climatol. Assoc. 2015, 126, 77–86.
53. Lee, Y.; Lee, S.-H.; Lim, S.M.; Baek, S.H.; Ha, I.-H. Mental Health and Quality of Life of Patients with Osteoarthritis Pain: The Sixth Korea National Health and Nutrition Examination Survey (2013-2015). PLoS One 2020, 15, e0242077.
54. Sutbeyaz, S.T.; Sezer, N.; Koseoglu, B.F.; Ibrahimoglu, F.; Tekin, D. Influence of Knee Osteoarthritis on Exercise Capacity and Quality of Life in Obese Adults. Obesity 2007, 15, 2071–2076.
55. Oliveria, S.A.; Felson, D.T.; Reed, J.I.; Cirillo, P.A.; Walker, A.M. Incidence of Symptomatic Hand, Hip, and Knee Osteoarthritis among Patients in a Health Maintenance Organization. Arthritis Rheum. 1995, 38, 1134–1141.
56. Moritz, S.; Stöckert, K.; Hauschildt, M.; Lill, H.; Jelinek, L.; Beblo, T.; Diedrich, S.; Arlt, S. Are We Exaggerating Neuropsychological Impairment in Depression? Reopening a Closed Chapter. Expert Rev. Neurother. 2017, 17, 839–846.
57. Kazim, M.A.; Strahl, A.; Moritz, S.; Arlt, S.; Niemeier, A. Chronic Pain in Osteoarthritis of the Hip Is Associated with Selective Cognitive Impairment. Arch. Orthop. Trauma Surg. 2023, 143, 2189–2197.
58. Lespasio, M.J.; Sultan, A.A.; Piuzzi, N.S.; Khlopas, A.; Husni, M.E.; Muschler, G.F.; Mont, M.A. Hip Osteoarthritis: A Primer. Perm. J. 2018, 22, 17–84.
59. Schiphof, D.; Runhaar, J.; Waarsing, E.J.; van Spil, E.W.; van Middelkoop, M.; Bierma-Zeinstra, S.M. The 10-Year Course of the Clinical American College of Rheumatology (Acr) Criteria for Hip and Knee Osteoarthritis in an Early Symptomatic Cohort, Data from Check. Osteoarthr. Cartil. 2018, 26, S347–S348.
60. Liu, C.; Wan, Q.; Zhou, W.; Feng, X.; Shang, S. Factors Associated with Balance Function in Patients with Knee Osteoarthritis: An Integrative Review. Int. J. Nurs. Sci. 2017, 4, 402–409.
61. French, H.P.; Hager, C.K.; Venience, A.; Fagan, R.; Meldrum, D. Psychometric Properties and Domains of Postural Control Tests for Individuals with Knee Osteoarthritis: A Systematic Review. Int. J. Rehabil. Res. 2020, 43, 102–115.
62. Slomka, B.; Rongies, W.; Sierdzinski, J.; Dolecki, W.; Worwag, M.; Trzepla, E. Assessment of Postural Stability in Women with Hip Osteoarthritis: A Case-Control Study. Acta Orthop. Traumatol. Turc. 2019, 53, 56–60.
63. Batting, M.; Barker, K.L. Reliability and Validity of the Four Square Step Test in Patients with Hip Osteoarthritis before and after Total Hip Replacement. Physiotherapy 2019, 105, 244–253.
64. Sziver, E.; Nagy, E.; Preszner-Domján, A.; Pósa, G.; Horvath, G.; Balog, A.; Tóth, K. Postural Control in Degenerative Diseases of the Hip Joint. Clin. Biomech. 2016, 35, 1–6.
65. Takacs, J.; Garland, S.J.; Carpenter, M.G.; Hunt, M.A. Validity and Reliability of the Community Balance and Mobility Scale in Individuals with Knee Osteoarthritis. Phys. Ther. 2014, 94, 866–874.
66. Parveen, H.; Noohu, M.M. Evaluation of Psychometric Properties of Tinetti Performance-Oriented Mobility Assessment Scale in Subjects with Knee Osteoarthritis. Hong Kong Physiother. J. 2017, 36, 25–32.
67. Kanko, L.E.; Birmingham, T.B.; Bryant, D.M.; Gillanders, K.; Lemmon, K.; Chan, R.; Postic, M.; Giffin, J.R. The Star Excursion Balance Test Is a Reliable and Valid Outcome Measure for Patients with Knee Osteoarthritis. Osteoarthr. Cartil. 2019, 27, 580–585.

68. Guyatt, G.H.; Feeny, D.H.; Patrick, D.L. Measuring Health-Related Quality of Life. Ann. Intern. Med. 1993, 118, 622–629.
69. Rat, A.-C.; Coste, J.; Pouchot, J.; Baumann, M.; Spitz, E.; Retel-Rude, N.; Le Quintrec, J.-S.; Dumont-Fischer, D.; Guil-lemin, F. OAKHQOL: A New Instrument to Measure Quality of Life in Knee and Hip Osteoarthritis. J. Clin. Epidemiol. 2005, 58, 47–55.
70. Rat, A.-C.; Guillemin, F.; Pouchot, J. Mapping the Osteoarthritis Knee and Hip Quality of Life (OAKHQOL) Instrument to the International Classification of Functioning, Disability and Health and Comparison to Five Health Status Instruments Used in Osteoarthritis. Rheumatology 2008, 47, 1719–1725.
71. Farr Ii, J.; Miller, L.E.; Block, J.E. Quality of Life in Patients with Knee Osteoarthritis: A Commentary on Nonsurgical and Surgical Treatments. Open Orthop. J. 2013, 7, 619–623.
72. Yokota, A.; Maeshima, E.; Sasaki, K.; Ooi, T.; Sainoh, T.; Hosokawa, H. Physical Functions Associated with Health-Related Quality of Life in Older Adults Diagnosed with Knee Osteoarthritis. J. Phys. Ther. Sci. 2023, 35, 60–65.
73. Obara, K.; Cardoso, J.R.; Reis, B.M.; Matos, M.A.; Kawano, M.M. Quality of Life in Individuals with Knee Osteoarthritis versus Asymptomatic Individuals. Musculoskeletal Care 2023, 21, 1364–1370.
74. Tekaya, A.; Bouzid, S.; Kharrat, L.; Rouached, L.; Galelou, J.; Bouden, S.; Tekaya, R.; Saidane, O.; Mahmoud, I.; Abdel-moula, L. Health-Related Quality of Life and Associated Factors Among Patients With Knee Osteoarthritis. Curr. Rheu-matol. Rev. 2023, 19, 355–361.
75. Alkan, B.M.; Fidan, F.; Tosun, A.; Ardıçoğlu, O. Quality of Life and Self-Reported Disability in Patients with Knee Os-teoarthritis. Mod. Rheumatol. 2014, 24, 166–171.
76. Judd, D.L.; Thomas, A.C.; Dayton, M.R.; Stevens-Lapsley, J.E. Strength and Functional Deficits in Individuals with Hip Osteoarthritis Compared to Healthy, Older Adults. Disabil. Rehabil. 2014, 36, 307–312.
77. Kraus, V.B.; Sprow, K.; Powell, K.E.; Buchner, D.; Bloodgood, B.; Piercy, K.; George, S.M.; Kraus, W.E. Effects of Physical Activity in Knee and Hip Osteoarthritis: A Systematic Umbrella Review. Med. Sci. Sports Exerc. 2019, 51, 1324–1339.
78. Picorelli, A.M.A.; Hatton, A.L.; Gane, E.M.; Smith, M.D. Balance Performance in Older Adults with Hip Osteoarthritis: A Systematic Review. Gait Posture 2018, 65, 89–99.
79. Abujaber, S.; Altubasi, I.; Hamdan, M.; Al-Zaben, R. Impact of End-Stage Knee Osteoarthritis on Perceived Physical Function and Quality of Life: A Descriptive Study from Jordan. PLoS One 2023, 18, e0286962.
80. Park, H.J.; Ko, S.; Hong, H.M.; Ok, E.; Lee, J.I. Factors Related to Standing Balance in Patients with Knee Osteoarthritis. Ann. Rehabil. Med. 2013, 37, 373–378.
81. Altman, R.; Alarcón, G.; Appelrouth, D.; Bloch, D.; Borenstein, D.; Brandt, K.; Brown, C.; Cooke, T.D.; Daniel, W.; Feldman, D. The American College of Rheumatology Criteria for the Classification and Reporting of Osteoarthritis of the Hip. Arthritis Rheum. 1991, 34, 505–514.
82. Bierma-Zeinstra, S.M.A.; Oster, J.D.; Bernsen, R.M.D.; Verhaar, J.A.N.; Ginai, A.Z.; Bohnen, A.M. Joint Space Narrowing and Relationship with Symptoms and Signs in Adults Consulting for Hip Pain in Primary Care. J. Rheumatol. 2002, 29, 1713–1718.
83. Altman, R.; Asch, E.; Bloch, D.; Bole, G.; Borenstein, D.; Brandt, K.; Christy, W.; Cooke, T.D.; Greenwald, R.; Hochberg, M. Development of Criteria for the Classification and Reporting of Osteoarthritis. Classification of Osteoarthritis of the Knee. Diagnostic and Therapeutic Criteria Committee of the American Rheumatism Association. Arthritis Rheum. 1986, 29, 1039–1049.
84. Hart, D.J.; Spector, T.D. The Classification and Assessment of Osteoarthritis. Baillieres. Clin. Rheumatol. 1995, 9, 407–432.
85. Huang, B.K.; Tan, W.; Scherer, K.F.; Rennie, W.; Chung, C.B.; Bancroft, L.W. Standard and Advanced Imaging of Hip Osteoarthritis. What the Radiologist Should Know. Semin. Musculoskelet. Radiol. 2019, 23, 289–303.
86. Kohn, M.D.; Sassoon, A.A.; Fernando, N.D. Classifications in Brief: Kellgren-Lawrence Classification of Osteoarthritis. Clin. Orthop. Relat. Res. 2016, 474, 1886–1893.
87. Jacobsen, S.; Sonne-Holm, S. Hip Dysplasia: A Significant Risk Factor for the Development of Hip Osteoarthritis. A Cross-Sectional Survey. Rheumatology 2005, 44, 211–218.
88. Clausen, S.; Kjær, S.; Fredberg, U.; Terslev, L.; Hartvigsen, J.; Arnbak, B. Ultrasound Imaging in Patients with Hip Pain and Suspected Hip Osteoarthritis: An Inter-Rater and Intra-Rater Reliability Study. BMJ Open 2020, 10, e038643.
89. Sharma, L. Osteoarthritis of the Knee. N. Engl. J. Med. 2021, 384, 51–59.

90. Culvenor, A.G.; Engen, C.N.; Øiestad, B.E.; Engebretsen, L.; Risberg, M.A. Defining the Presence of Radiographic Knee Osteoarthritis: A Comparison between the Kellgren and Lawrence System and OARSI Atlas Criteria. Knee surgery, Sport. Traumatol. Arthrosc. 2015, 23, 3532–3539.
91. Naredo, E.; Cabero, F.; Palop, M.J.; Collado, P.; Cruz, A.; Crespo, M. Ultrasonographic Findings in Knee Osteoarthritis: A Comparative Study with Clinical and Radiographic Assessment. Osteoarthr. Cartil. 2005, 13, 568–574.
92. Guermazi, A.; Zaim, S.; Taouli, B.; Miaux, Y.; Peterfy, C.G.; Genant, H.G.K. MR Findings in Knee Osteoarthritis. Eur. Radiol. 2003, 13, 1370–1386.
93. Teirlinck, C.H.; Verhagen, A.P.; van Ravesteyn, L.M.; Reijneveld-van de Vendel, E.A.E.; Runhaar, J.; van Middelkoop, M.; Ferreira, M.L.; Bierma-Zeinstra, S.M. Effect of Exercise Therapy in Patients with Hip Osteoarthritis: A Systematic Review and Cumulative Meta-Analysis. Osteoarthr. Cartil. open 2023, 5, 100338.
94. Yusuf, E. Pharmacologic and Non-Pharmacologic Treatment of Osteoarthritis. Curr. Treat. Options Rheumatol. 2016, 2, 111–125.
95. Busse, J.W.; Wang, L.; Kamaleldin, M.; Craigie, S.; Riva, J.J.; Montoya, L.; Mulla, S.M.; Lopes, L.C.; Vogel, N.; Chen, E.; et al. Opioids for Chronic Noncancer Pain: A Systematic Review and Meta-Analysis. JAMA 2018, 320, 2448–2460.
96. Fendrick, A.M.; Greenberg, B.P. A Review of the Benefits and Risks of Nonsteroidal Anti-Inflammatory Drugs in the Management of Mild-to-Moderate Osteoarthritis. Osteopath. Med. Prim. Care 2009, 3, 1.
97. Günther, K.-P.; Deckert, S.; Lützner, C.; Lange, T.; Schmitt, J.; Postler, A. Total Hip Replacement for Osteoarthritis-Evidence-Based and Patient-Oriented Indications. Dtsch. Arztebl. Int. 2021, 118, 730–736.
98. Atsma, F.; Molenkamp, O.; Bouma, H.; Bolder, S.B.; Groenewoud, A.S.; Westert, G.P. Uniform Criteria for Total Hip Replacement Surgery in Patients with Hip Osteoarthritis: A Decision Tool to Guide Treatment Decisions. Int. J. Qual. Heal. care J. Int. Soc. Qual. Heal. Care 2021, 33, 1–7.
99. Moretti, V.M.; Post, Z.D. Surgical Approaches for Total Hip Arthroplasty. Indian J. Orthop. 2017, 51, 368–376.
100. Schwabe, M.T.; Hannon, C.P. The Evolution, Current Indications and Outcomes of Cementless Total Knee Arthro-plasty. J. Clin. Med. 2022, 11, 6608.
101. Asokan, A.; Plastow, R.; Kayani, B.; Radhakrishnan, G.T.; Magan, A.A.; Haddad, F.S. Cementless Knee Arthroplasty: A Review of Recent Performance. Bone Jt. open 2021, 2, 48–57.
102. Newman, J.M.; Sodhi, N.; Khlopas, A.; Sultan, A.A.; Chughtai, M.; Abraham, R.; Oh, J.; Molloy, R.M.; Harwin, S.F.; Mont, M.A. Cementless Total Knee Arthroplasty: A Comprehensive Review of the Literature. Orthopedics 2018, 41, 263–273.
103. Ponziani, L.; Di Caprio, F.; Meringolo, R. Cementless Knee Arthroplasty. Acta Biomed. 2017, 88, 11–18.
104. Primorac, D.; Molnar, V.; Matišić, V.; Hudetz, D.; Jeleč, Ž.; Rod, E.; Čukelj, F.; Vidović, D.; Vrdoljak, T.; Dobričić, B.; et al. Comprehensive Review of Knee Osteoarthritis Pharmacological Treatment and the Latest Professional Societies' Guidelines. Pharmaceuticals (Basel). 2021, 14, 205.
105. Jansen, M.J.; Viechtbauer, W.; Lenssen, A.F.; Hendriks, E.J.M.; de Bie, R.A. Strength Training Alone, Exercise Therapy Alone, and Exercise Therapy with Passive Manual Mobilisation Each Reduce Pain and Disability in People with Knee Osteoarthritis: A Systematic Review. J. Physiother. 2011, 57, 11–20.
106. Skou, S.T.; Rasmussen, S.; Laursen, M.B.; Rathleff, M.S.; Arendt-Nielsen, L.; Simonsen, O.; Roos, E.M. The Efficacy of 12 Weeks Non-Surgical Treatment for Patients Not Eligible for Total Knee Replacement: A Randomized Controlled Trial with 1-Year Follow-Up. Osteoarthr. Cartil. 2015, 23, 1465–1475.
107. Varacallo, M.; Luo, T.D.; Mabrouk, A.; Johanson, N.A. Total Knee Arthroplasty Techniques. In StatPearls; StatPearls Publishing, Treasure Island (FL): Treasure Island (FL), 2024.
108. Batailler, C.; Swan, J.; Sappey Marinier, E.; Servien, E.; Lustig, S. New Technologies in Knee Arthroplasty: Current Concepts. J. Clin. Med. 2020, 10, 47.
109. Price, A.J.; Alvand, A.; Troelsen, A.; Katz, J.N.; Hooper, G.; Gray, A.; Carr, A.; Beard, D. Knee Replacement. Lancet (London, England) 2018, 392, 1672–1682.