

Knee Osteoarthritis in Farmers: Occupational Risk, Functional Burden and Comparative Review of Patient Reported and Performance Based Assessment Scales

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Abstract

Background: Knee osteoarthritis (KOA) is a major cause of pain, functional limitation and disability. Farmers represent an important occupational population because agricultural work commonly involves kneeling, squatting, prolonged standing and walking, lifting, carrying and repetitive knee loading. Epidemiological evidence supports an association between physically demanding agricultural work and KOA, with particularly consistent evidence for cumulative kneeling or squatting exposure.

Objective: To review the occupational relationship between farming and KOA and compare commonly used clinical, patient-reported and performance-based assessment instruments, with emphasis on the Lower Extremity Functional Scale (LEFS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Knee Injury and Osteoarthritis Outcome Score (KOOS), Oxford Knee Score (OKS), Lequesne index, pain scales, Kellgren–Lawrence radiographic grading and OARSI performance-based measures.

Methods: A structured narrative review was prepared using peer-reviewed literature identified through PubMed/MEDLINE and major biomedical literature sources, supplemented by established measurement and clinical guidance documents. Literature concerning occupational knee loading, farming, kneeling and squatting, KOA, and measurement properties of KOA outcome instruments was critically synthesized. Particular attention was given to validity, reliability, responsiveness, interpretability, feasibility and applicability to agricultural workers.

Conclusion: Farming is an important occupational context associated with increased KOA risk, although it should not be regarded as a sole cause. No single outcome instrument captures structural disease, pain, function, performance and occupational participation simultaneously. A multidimensional assessment combining a validated patient-reported measure such as LEFS, WOMAC, KOOS or OKS with pain assessment, appropriate structural assessment and objective performance testing can provide a more complete picture of KOA in farmers.'

Keywords: Knee Osteoarthritis, Farmers, Agricultural Workers, Occupational Exposure, Kneeling, Squatting, LEFS, KOOS, WOMAC, Oxford Knee Score, Physical Function Knee osteoarthritis; farmers

agricultural workers; occupational exposure; kneeling; squatting; LEFS; KOOS; WOMAC; Oxford Knee Score; OARSI; physical function; disability.

1. Introduction

Osteoarthritis is a chronic disorder of the whole joint involving articular cartilage, subchondral bone, synovium, menisci, ligaments and periarticular structures. Knee osteoarthritis is particularly important because the knee is a major weight-bearing joint and impairment can interfere with walking, stair climbing, squatting, kneeling, rising from a chair and occupational activity.

The clinical burden of KOA extends beyond pain. Patients may develop stiffness, reduced range of motion, muscle weakness, impaired mobility, activity limitation, participation restriction and reduced quality of life. Consequently, clinical and research assessment should not rely exclusively on radiographic severity. Farmers represent a particularly relevant occupational group because agricultural work commonly requires prolonged standing and walking, work on uneven terrain, kneeling, squatting, lifting, carrying and repetitive transitions between floor-level and standing positions. A systematic review and meta-analysis of observational studies reported increased odds of knee OA in physically demanding occupations and specifically identified farming among job titles associated with KOA. Occupational lifting, kneeling, climbing, squatting and standing were also associated with greater odds compared with sedentary work [1].

2. Review Methodology

This article was developed as a structured narrative review rather than a formal systematic review. Literature was identified using PubMed/MEDLINE and peer-reviewed biomedical literature addressing occupational risk factors for KOA, farming and agricultural workers, occupational kneeling/squatting, and validation or measurement properties of commonly used KOA outcome instruments. Key guideline and measurement sources were also examined. The synthesis emphasized systematic reviews, meta-analyses, validation studies and established clinical guidance.

Because the present manuscript is a narrative review, it does not claim a PRISMA-compliant systematic-review process or quantitative meta-analysis performed by the authors. A formal systematic review would require a prospectively defined protocol, reproducible database searches, independent screening, risk-of-bias assessment and PRISMA reporting.

3. Farming and Occupational Risk of Knee Osteoarthritis

3.1 Occupational mechanical loading

Agricultural work combines several potential knee-loading exposures. Important activities include kneeling, squatting, prolonged standing, walking, climbing, lifting and carrying. The biological plausibility of occupational loading is supported by repetitive mechanical stress on the knee and cumulative exposure over many years.

3.2 Kneeling and squatting

The strongest dose-response evidence concerns cumulative kneeling or squatting. A systematic review and dose-response meta-analysis including 15 studies found an incremental odds ratio of 1.26 (95% CI 1.17–1.35) for each additional 5,000 hours of occupational kneeling exposure, with moderate-quality evidence. The authors concluded that longer cumulative kneeling or squatting exposure was associated with greater risk of knee OA [2].

3.3 Farming as an occupational exposure

The 2020 systematic review and meta-analysis by Wang and colleagues found increased odds of KOA in strenuous occupations and specifically identified farmers among job titles associated with KOA [1]. A broader systematic review of physically demanding occupations also identified farming as an occupational task context contributing to lower-limb OA and reported associations between knee OA and squatting/kneeling, heavy lifting, prolonged standing and walking [3].

3.4 Multifactorial nature of risk

The relationship between farming and KOA is multifactorial. Age, body mass index, previous knee injury, sex, genetic susceptibility, metabolic factors, recreational activity and occupational exposure may all contribute. Therefore, an association between farming and KOA should not be interpreted as proof that farming alone causes the disease.

4. Clinical Assessment of Knee Osteoarthritis

A comprehensive assessment should distinguish structural disease, symptoms, impairments, activity limitations and participation restrictions. Useful domains include pain, stiffness, physical function, mobility, quality of life, radiographic severity and occupational capacity.

The Kellgren–Lawrence system remains widely used for radiographic classification. However, radiographs describe structural changes and do not directly measure pain or functional disability. Current clinical guidance emphasizes that typical KOA can often be diagnosed clinically and that imaging should not routinely be used to guide diagnosis in uncomplicated presentations [4].

5. Lower Extremity Functional Scale (LEFS)

The LEFS is a 20-item patient-reported instrument assessing lower-extremity functional limitation. Each item is scored from 0 to 4, producing a total score from 0 to 80, with higher scores representing better function. The original development study reported excellent test-retest reliability (ICC approximately 0.94) and estimated clinically meaningful change thresholds in the range of approximately 9 points [5].

Validation work in hip and knee OA has demonstrated strong reliability, validity and responsiveness [6]. A recent study also evaluated a 10-item LEFS version in people with KOA, reporting strong correlations with established knee OA measures and excellent test-retest reliability [7].

For farmers, LEFS is attractive because it assesses general lower-extremity function rather than only knee symptoms. It can therefore complement disease-specific measures when the research question concerns mobility and functional capacity.

Important methodological distinction: the difference between pre-treatment and post-treatment LEFS scores is a change score. It should not automatically be described as an MCID. MCID is an interpretive threshold that requires population- and context-appropriate evidence.

6. Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)

WOMAC is one of the most established disease-specific outcome measures for hip and knee OA. It assesses pain, stiffness and physical function and has been extensively used in clinical trials and observational studies [8].

WOMAC is particularly useful when the primary research question concerns OA-specific symptoms and disability. Its extensive historical use also facilitates comparison with published intervention studies.

Investigators should specify the exact WOMAC version, scoring direction, response format and validated language used.

7. Knee Injury and Osteoarthritis Outcome Score (KOOS)

KOOS was developed as an extension of WOMAC for assessment of both short- and long-term consequences of knee injury and OA. The full instrument contains five domains: pain, symptoms, activities of daily living, sport and recreation, and knee-related quality of life [9,10].

KOOS is useful when quality of life and higher-level activity are important research outcomes. Measurement-property reviews have generally supported its reliability, validity and responsiveness, while also identifying areas in which further validation may be useful [11].

Shorter derivatives such as KOOS-12 can reduce respondent burden while retaining information on pain, function and quality of life. KOOS-PS provides a short physical-function measure, but investigators should consider the measurement-property evidence and study population before using it as the sole outcome.

8. Oxford Knee Score (OKS)

The Oxford Knee Score is a concise 12-item patient-reported knee-specific instrument assessing pain and function. It has been widely used in knee OA and knee replacement research. Its short format makes it practical for clinical and observational studies, particularly where questionnaire burden is important.

The OKS can be useful as a knee-specific outcome, but it does not cover the same breadth of domains as KOOS. For farmer-specific research, occupational exposure and broader lower-extremity function may therefore need to be measured separately.

9. Lequesne Algofunctional Index

The Lequesne index combines pain or discomfort, walking capacity and activities of daily living. It has a long history in OA clinical trials and observational research. As with other instruments, investigators should use the validated version appropriate to the population and clearly specify scoring and interpretation.

10. Pain Assessment: VAS and NRS

Pain intensity can be measured using a visual analogue scale (VAS) or numeric rating scale (NRS). These measures are simple and impose minimal respondent burden. They are useful as complementary outcomes but should not be used as the sole measure of KOA severity because pain intensity does not capture physical function, occupational participation or quality of life.

11. Performance-Based Assessment

Patient-reported measures capture the patient's perception of symptoms and functional difficulty. Performance-based measures assess what the individual can actually perform under standardized conditions. OARSI recommended a set of performance-based tests for people with hip or knee OA, including the 30-second chair-stand test, 40-m fast-paced walk test, stair-climb test, Timed Up and Go and 6-minute walk test. The first three constitute the minimal core set [12].

11.1 30-second chair stand

This test measures the number of complete chair rises in 30 seconds and provides information about lower-limb strength and functional mobility. It is relevant to farmers because repeated rising from low or flexed positions may be occupationally important.

11.2 40-m fast-paced walk

The 40-m fast-paced walk assesses standardized walking performance and can provide an objective complement to patient-reported mobility.

11.3 Stair-climb test

The stair-climb test evaluates lower-limb functional performance and mobility. It may be relevant when stair or step negotiation is a meaningful component of daily or occupational activity.

11.4 Timed Up and Go

The Timed Up and Go evaluates functional mobility through a standardized sequence of standing, walking, turning and sitting.

11.5 Six-minute walk test

The 6-minute walk test provides an endurance-oriented measure of walking capacity and may be useful when broader walking tolerance is a study outcome.

12. Comparative Assessment of Major Instruments

Instrument	Primary domain	Knee-specific	Pain	Function	QOL	Performance	Typical role
LEFS	Lower-extremity function	No	Indirect	High	Limited	No	General functional outcome
WOMAC	OA symptoms/function	Hip/knee	High	High	Indirect	No	Disease-specific OA outcome
KOOS	Knee symptoms/function/QOL	Yes	High	High	High	No	Broad knee-specific outcome
KOOS-12	Pain/function/QOL	Yes	Moderate	Moderate	Moderate	No	Shorter knee-specific outcome
KOOS-PS	Physical function	Yes	Limited	High	No	No	Short physical-function measure
OKS	Knee pain/function	Yes	High	High	Indirect	No	Concise knee-specific outcome
Lequesne	Pain/function	Hip/knee	High	Moderate	Limited	No	Algofunctional outcome

VAS/NRS	Pain intensity	No	High	No	No	No	Pain outcome
KL grade	Radiographic structure	Yes	No	No	No	No	Structural classification
OARSI tests	Physical performance	No	No	High	No	Yes	Objective performance

13. Why Multidimensional Assessment Is Important in Farmers

A farmer may report improvement in pain without equivalent improvement in the ability to squat, walk over uneven ground or climb steps. Conversely, a patient may retain some pain while demonstrating meaningful improvement in functional capacity. This illustrates why symptom, patient-reported function and objective performance measures should be interpreted as complementary rather than interchangeable outcomes.

For farmer-specific research, occupational variables should ideally include age, sex, BMI, years in farming, average work hours, type of crop or agricultural activity, kneeling and squatting exposure, standing and walking exposure, lifting/carrying, previous knee trauma, mechanization and terrain. This allows the investigator to distinguish occupational exposure from other determinants of disability.

14. Suggested Research Assessment Framework

A practical farmer-specific clinical research battery may include: (1) LEFS as a broad lower-extremity functional outcome; (2) WOMAC or KOOS as a disease-specific knee OA outcome; (3) NRS or VAS for pain; (4) Kellgren–Lawrence grade when radiographic assessment is clinically or scientifically justified; and (5) at least one OARSI performance-based test, preferably the 30-second chair stand, 40-m fast-paced walk and stair-climb test when feasible.

For a more comprehensive study, EQ-5D or another validated quality-of-life instrument can be added. Investigators should avoid unnecessary duplication of instruments and should prespecify one primary outcome to reduce selective interpretation.

15. Occupational Exposure Quantification

A major methodological opportunity is to quantify agricultural exposure rather than classifying participants simply as farmers or non-farmers. For example, cumulative kneeling exposure can be approximated as hours per day multiplied by working days per year and years of exposure. Similar calculations can be developed for squatting or other exposures, provided that the exposure assessment instrument is standardized and validated where possible.

Such quantitative variables can then be examined in relation to LEFS, WOMAC, KOOS, OKS, pain, performance measures and radiographic severity. The approach is supported by dose-response literature on cumulative kneeling/squatting exposure [2].

16. Management and Occupational Relevance

Evidence-based KOA management emphasizes therapeutic exercise, appropriate physical activity, self-management and weight management when applicable, with pharmacological and other interventions individualized to the patient. The 2019 ACR/Arthritis Foundation guideline strongly recommends exercise for knee OA and recommends weight loss for people with knee or hip OA who are overweight or obese

[13]. NICE guidance similarly emphasizes therapeutic exercise and appropriate weight management and advises against routine imaging for diagnosis in typical presentations [4].

For farmers, occupational adaptation may include reducing prolonged kneeling where feasible, alternating postures, using appropriate tools, introducing rest intervals, modifying repetitive deep squatting, and strengthening the lower extremity. Such measures should be individualized and should not be presented as universally effective interventions without appropriate evidence.

17. Research Gaps

Future research should prioritize prospective designs, quantitative occupational exposure measurement, standardized outcome batteries and farmer-specific functional outcomes. Research is particularly needed on crop-specific exposure patterns, mechanization, ergonomic interventions, long-term functional trajectories and occupational participation.

Another important gap is the limited availability of assessment instruments designed specifically around agricultural tasks. Standard PROMs are valuable, but farmer-specific research could additionally measure the ability to kneel, squat, rise from ground level, walk on uneven terrain, carry agricultural loads and sustain work for a defined period.

18. Ethical Considerations

Research involving farmers should obtain prior approval from the relevant Institutional Ethics Committee when required. Written informed consent should be obtained from participants, participation should be voluntary, confidentiality should be maintained and participants should be free to withdraw without penalty. Data should be de-identified for analysis and publication.

If an interventional study is conducted, the protocol should clearly define eligibility criteria, intervention and comparator, outcomes, adverse-event monitoring, sample-size justification and statistical analysis. Applicable prospective trial registration should be completed before enrollment when required. Reporting should follow the appropriate guideline: CONSORT for randomized trials, STROBE for observational studies and PRISMA for systematic reviews.

19. Discussion

The literature supports an association between physically demanding occupational exposure and knee OA, with farming being an important occupational context. The most consistent exposure-response evidence concerns cumulative kneeling or squatting [2]. However, farming is a heterogeneous occupation, and individual exposure varies according to crop, task, mechanization, terrain and duration of employment.

The selection of an outcome measure should follow the study objective. LEFS is particularly useful for general lower-extremity function; WOMAC provides a classic OA-specific assessment of pain, stiffness and function; KOOS broadens assessment to knee-related quality of life and higher-level activities; and OKS provides a concise knee-specific measure. Performance tests add an objective dimension that cannot be obtained from questionnaires alone.

For farmer-specific research, a combined assessment strategy is therefore more defensible than relying on any single instrument. The primary outcome should be selected a priori, and secondary outcomes should be justified according to the clinical and occupational question.

20. Conclusion

Knee osteoarthritis is an important occupational and functional health problem in farmers. Evidence from systematic reviews and meta-analyses indicates that agricultural work and physically demanding occupational activities are associated with increased odds of KOA, while cumulative kneeling and squatting demonstrate a measurable exposure-response relationship [1–3].

No single assessment scale adequately captures structural disease, pain, symptoms, physical function, performance and occupational participation. LEFS, WOMAC, KOOS, OKS and Lequesne provide complementary patient-reported information, while OARS performance-based tests provide objective functional assessment. Kellgren–Lawrence grading can describe radiographic structure but should not be interpreted as a complete measure of clinical disability.

Future farmer-specific studies should use standardized multidimensional outcomes and quantify occupational exposure wherever feasible. This approach can improve the clinical relevance, methodological quality and interpretability of research concerning knee osteoarthritis in agricultural workers.

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