

Systematic Review

Association between fluoroquinolones and Achilles tendon injuries: A systematic review

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Abstract

Objective: To analyze the available scientific evidence on the association between fluoroquinolone use and the risk of Achilles tendon injuries, including tendinopathy, tendinitis, and tendon rupture, compared with unexposed individuals or those exposed to other antibiotics.

Methods: A systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) recommendations. Searches were performed in MEDLINE via PubMed, Embase, the Cochrane Library, SciELO, and Google Scholar as a supplementary search source. Study selection, data extraction, and methodological quality assessment were performed by two independent reviewers using Joanna Briggs Institute tools according to each study design.

Results: Seventeen studies were included, predominantly cohort studies, case-control studies, and case reports, with higher methodological quality among studies with a comparator group. The evidence indicated an association between fluoroquinolones and an increased risk of tendinitis, tendinopathy, and Achilles tendon rupture, particularly during the first weeks after exposure. Risk was higher among older adults, patients with renal impairment, diabetes mellitus, obesity, and corticosteroid users. Ciprofloxacin and levofloxacin were the drugs most frequently associated with tendon outcomes.

Conclusion: Fluoroquinolones are associated with an increased risk of Achilles tendon injuries, particularly among individuals with predisposing factors. Early identification of at-risk groups and judicious prescribing of these antimicrobials may reduce severe tendon complications.

Level of evidence V; Systematic Review.

Keywords: Achilles tendon; Fluoroquinolones; Tendon rupture; Tendinopathy; Antibiotic therapy.

Introduction

Fluoroquinolones are a class of broad-spectrum antibiotics used to treat urinary, respiratory, gastrointestinal, and osteo-articular infections due to their high oral bioavailability, good tissue penetration, and prolonged half-life^(1,2). However, their widespread clinical use has been associated with relevant musculoskeletal adverse events^(3,4).

Among these events, tendon injuries, including tendinitis, tendinopathy, and tendon rupture, are particularly noteworthy⁽⁵⁾. The Achilles tendon is the main site affected,

possibly because of high biomechanical loading and reduced local vascularity, factors that favor degenerative changes following drug exposure^(6,7). Risk is higher among older adults, patients with renal impairment or diabetes mellitus, corticosteroid users, and individuals exposed to greater mechanical demand on the tendons⁽⁸⁾.

Although the pathophysiology has not yet been fully elucidated, evidence suggests that fluoroquinolones may induce collagen degradation, oxidative stress, and extracellular matrix alterations, thereby compromising tendon strength⁽⁹⁾.

Study performed at the Universidade José do Rosário Vellano, Faculdade de Medicina, Alfenas, MG, Brazil.

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Clinically, these changes may cause pain, edema, stiffness, and functional limitation and may progress to partial or complete tendon rupture, a condition associated with functional impairment and a possible need for surgical treatment⁽¹⁰⁾.

The clinical relevance of this association has prompted warnings from international regulatory agencies, such as the Food and Drug Administration (FDA) and the European Medicines Agency (EMA), regarding the risk of tendinitis and tendon rupture associated with fluoroquinolones^(11,12). Nevertheless, these antibiotics remain widely prescribed, including settings in which therapeutic alternatives are available⁽¹³⁾.

Despite the growing scientific literature on this topic, the available evidence remains characterized by a predominance of observational studies, case reports, and reviews, with heterogeneity in the populations, fluoroquinolones investigated, and diagnostic criteria for tendon outcomes^(14,15). These limitations hinder precise estimation of the magnitude of risk and the definition of preventive strategies^(16,17).

A previous systematic review and meta-analysis addressed this association⁽¹³⁾; however, more recent primary studies have evaluated large population-based samples, active antibiotic comparators, and pharmacovigilance data. An updated synthesis is therefore warranted. Accordingly, this study aimed to analyze the available scientific evidence on the association between fluoroquinolone use and the risk of Achilles tendon injuries, including tendinopathy, tendinitis, and tendon rupture.

Methods

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) recommendations⁽¹⁸⁾, and its protocol was registered in PROSPERO under number CRD420261414571⁽¹⁹⁾.

Research question

The guiding question was structured according to the PECO framework (Population, Exposure, Comparator, and Outcome)⁽²⁰⁾, as follows: population, individuals exposed to fluoroquinolones; exposure, use of ciprofloxacin, levofloxacin, moxifloxacin, norfloxacin, or ofloxacin; comparator, unexposed individuals or users of other antibiotics; and outcome, Achilles tendon injuries, including tendinopathy, tendinitis, and tendon rupture.

Eligibility criteria

Primary observational studies, including cohort, case-control, cross-sectional, and pharmacovigilance studies, as well as randomized clinical trials, case series, and case reports, published in English, Portuguese, or Spanish between 2017 and 2026, were eligible. Studies were included when they assessed Achilles tendon injuries, including tendinopathy, tendinitis, or tendon rupture, following exposure to fluoro-

quinolones. Comparative studies were required to include individuals unexposed to fluoroquinolones or exposed to other antibiotics as comparators. *In vitro* and animal studies, opinion articles, editorials, letters without original empirical data, narrative reviews, systematic reviews, meta-analyses, scoping reviews, and studies that did not directly assess the association of interest were excluded.

Search strategies

The search was performed on July 12, 2026, in the following electronic databases and information sources: Scientific Electronic Library Online (SciELO), Medical Literature Analysis and Retrieval System Online (MEDLINE) via PubMed, Excerpta Medica database (Embase), the Cochrane Library, and Google Scholar as a supplementary search source. Controlled vocabulary and free-text terms were selected according to each database. Medical Subject Headings (MeSH) were used in PubMed and the Cochrane Library, Emtree terms in Embase, and Health Sciences Descriptors (DeCS) in SciELO. In Google Scholar, combinations of free-text terms were used. The Boolean operators “OR” and “AND” were used to combine controlled terms and alternative keywords, as shown in Table 1.

Study selection

Study selection was performed by two independent reviewers. Initially, records identified in the databases were exported to Rayyan® software⁽²¹⁾, where duplicates were removed, titles and abstracts were screened, and potentially eligible studies were assessed in full text. Disagreements were resolved by consensus.

Data extraction

Data extraction was performed using a previously developed instrument applied independently by the reviewers. Information on study methodological characteristics was collected, including authors, year of publication, country, study design, population assessed, type of fluoroquinolone used, comparator group, outcomes, and main findings. Data were organized in Microsoft Excel® spreadsheets and presented descriptively in figures and tables. For comparative studies, the reported effect measures were also extracted, including odds ratios, incidence rate ratios, hazard ratios, risk ratios, absolute rate differences, and their respective 95% confidence intervals, when available.

Methodological quality assessment

Methodological quality was assessed using the Joanna Briggs Institute (JBI) critical appraisal tools⁽²²⁾, according to each study design. Aspects related to participant selection, exposure definition, outcome measurement, control of confounders, and appropriateness of the analyses were considered.

Table 1. Search strategies used in the databases consulted for the systematic review

Database	Search strategy
PubMed*/MEDLINE	((("Fluoroquinolones"[Mesh] OR fluoroquinolone*[tiab] OR quinolone*[tiab] OR ciprofloxacin[tiab] OR levofloxacin[tiab] OR moxifloxacin[tiab] OR norfloxacin[tiab] OR ofloxacin[tiab])) AND ((("Achilles Tendon"[Mesh] OR "Tendon Injuries"[Mesh] OR "Tendinopathy"[Mesh] OR achilles tendon[tiab] OR achilles tendinopathy[tiab] OR achilles tendinitis[tiab] OR tendon rupture[tiab] OR tendinopathy[tiab] OR tendinitis[tiab] OR tendon injur*[tiab])))) AND ((("Drug-Related Side Effects and Adverse Reactions"[Mesh] OR adverse effect*[tiab] OR side effect*[tiab] OR drug-induced[tiab] OR risk[tiab] OR association[tiab]))).
Embase* (EMTREE)	('fluoroquinolone'/exp OR fluoroquinolone*:ti,ab OR quinolone*:ti,ab OR ciprofloxacin:ti,ab OR levofloxacin:ti,ab OR moxifloxacin:ti,ab OR norfloxacin:ti,ab OR ofloxacin:ti,ab) AND ('achilles tendon'/exp OR 'tendon injury'/exp OR tendinopathy/exp OR 'achilles tendon':ti,ab OR 'tendon rupture':ti,ab OR tendinopathy:ti,ab OR tendinitis:ti,ab) AND ('adverse drug reaction'/exp OR risk:ti,ab OR association:ti,ab OR 'drug induced':ti,ab).
Cochrane Library	(fluoroquinolone* OR quinolone* OR ciprofloxacin OR levofloxacin OR moxifloxacin) AND ("Achilles tendon" OR tendinopathy OR tendinitis OR "tendon rupture")
SciELO	(fluoroquinolones OR quinolones) AND ("Achilles tendon" OR tendinopathy OR tendinitis OR tendon rupture).
Google Scholar	"fluoroquinolones" AND ("Achilles tendon" OR tendinopathy OR tendinitis OR "tendon rupture")

Data synthesis

The search strategy and article inclusion process were documented using the PRISMA flow diagram⁽¹⁸⁾. The data obtained were consolidated into tabular matrices and analyzed descriptively. Owing to the clinical and methodological heterogeneity among the included studies, statistical pooling was not considered appropriate. Therefore, the findings were synthesized narratively, and the effect estimates of the comparative studies were presented in tabular form according to the tendon outcome and type of fluoroquinolone exposure.

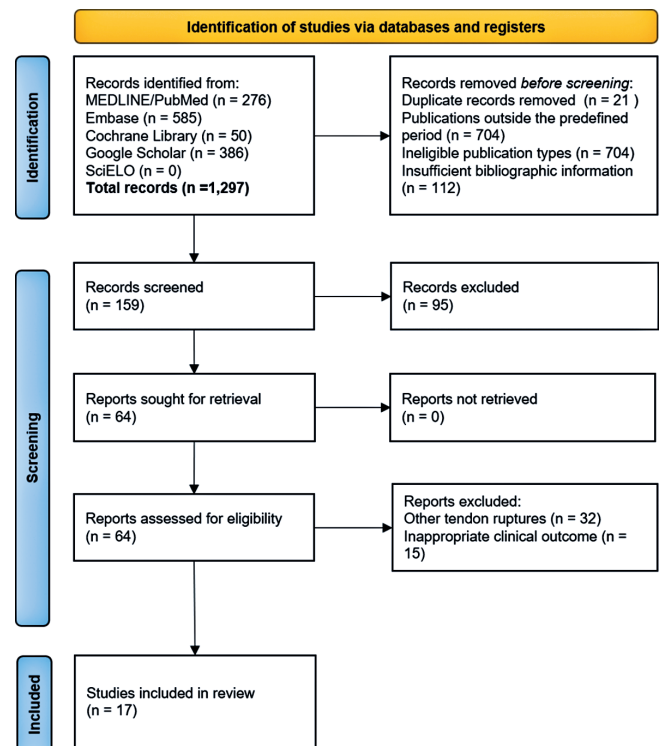
Results

A total of 1,297 records were identified in MEDLINE/PubMed, Embase, the Cochrane Library, Google Scholar, and SciELO. Twenty-one duplicate records and 1,117 records were removed before screening. A total of 159 records remained for screening in Rayyan®. Subsequently, 95 records were excluded after title and abstract screening. Of the 64 reports assessed for eligibility, 47 were excluded because they did not meet the established criteria, resulting in 17 studies included in the final synthesis, as shown in the PRISMA flow diagram in Figure 1⁽¹⁸⁾.

General characteristics of the studies included in the systematic review

Seventeen studies were included; publications from North America accounted for 47.0% (n = 8) of the sample, followed by Europe with 29.4% (n = 5) and Asia with 23.5% (n = 4). The United States had the highest number of publications, representing 41.1% (n = 7), followed by the United Kingdom with 17.6% (n = 3). Canada, Ireland, Denmark, India, China, Taiwan, and Japan each accounted for 5.9% (n = 1) of the included studies.

Regarding methodological design, cohort studies predominated, accounting for 47.1% (n = 8) of the sample, followed

**Figure 1.** PRISMA 2020 flow diagram of the study selection process for the systematic review.

by case reports with 23.5% (n = 4), case-control studies with 11.8% (n = 2), and one case series, one descriptive observational study, and one pharmacovigilance analysis, each accounting for 5.9% (n = 1). Levofloxacin was the most frequently assessed fluoroquinolone, appearing in 76.5% (n = 13) of the studies, followed by ciprofloxacin in 58.8% (n = 10) and moxifloxacin in 47.1% (n = 8). Eleven studies (64.7%) included a comparator group, generally individuals

unexposed to fluoroquinolones, users of non-fluoroquinolone antibiotics, or other reports in pharmacovigilance databases. Six studies (35.3%) had no formal comparator group, including case reports, a case series, and a descriptive analysis of incident and compensation records (Table 2).

Methodological quality and risk-of-bias assessment

The methodological quality and risk of bias of the 17 included studies were assessed using the JBI critical appraisal tools⁽²²⁾, with the checklist corresponding to each study

Table 2. General characteristics of the studies included in the systematic review

Author/Year	Country	Population	Sample	Study design	Type of fluoroquinolone	Comparator group	JBI Appraisal results
Morales et al. (2019)	United Kingdom	Adults aged ≥18 years from the THIN primary care database exposed to systemic fluoroquinolones or co-amoxiclav	4,836 cases and 18,356 matched controls (source cohort: 1,351,780 adults)	Case-control study	Systemic fluoroquinolones: ciprofloxacin, moxifloxacin, levofloxacin, norfloxacin, and ofloxacin	Matched controls selected from the source cohort prescribed systemic fluoroquinolone or co-amoxiclav; co-amoxiclav was also used as an active negative comparator	JBI Case control checklist/ Low risk of bias
Persson and Jick (2019)	United Kingdom	Patients from the CPRD Gold database	3,802 cases / 14,002 controls	Case-control study	Fluoroquinolones	Matched controls	JBI Cohort study checklist/ Low risk of bias
Baik et al. (2020)	United States	Medicare fee-for-service beneficiaries aged ≥65 years enrolled under the federal Old-Age and Survivors Insurance program	1,009,925 participant	Case-control study	Oral fluoroquinolones: ciprofloxacin, levofloxacin, and moxifloxacin	No exposure to the respective fluoroquinolone; non-fluoroquinolone antibiotics: amoxicillin, amoxicillin-clavulanate, azithromycin, and cephalexin	JBI Case-control checklist/ Low risk of bias
Rasmus et al. (2024)	Denmark	General population registered in national health databases	Nationwide	Case-control study	Oral fluoroquinolones	Amoxicillin	JBI Case-control checklist/ Low risk of bias
McCullagh et al. (2025)	Ireland	Patients exposed to fluoroquinolones with tendon injury records reported to the national incident and compensation system	20 incidents and 4 compensation claims related to tendon injury	Retrospective cohort study	Ciprofloxacin and levofloxacin	Not applicable	JBI Retrospective cohort study checklist/ Low risk of bias
Zellers et al. (2024)	United States	Patient with bilateral Achilles tendon rupture associated with fluoroquinolone use	One patient	Case report	Levofloxacin	Not applicable	JBI Case report checklist/ Moderate risk of bias
Tran et al. (2023)	United States	Patients treated with quinolone-containing otic drops	Retrospective cohort based on an administrative database	Cohort study	Otic quinolones (ofloxacin and ciprofloxacin)	Otic neomycin, oral amoxicillin, or azithromycin	JBI Cohort study checklist/ Low risk of bias
Shu et al. (2022)	China	Reports of fluoroquinolone-related adverse events recorded in US FAERS between 2016 and 2021	35,667 adverse events associated with fluoroquinolones, including 1,771 cases of tendinitis and 1,018 tendon ruptures	Descriptive and analytical observational study of the pharmacovigilance type	Ciprofloxacin, levofloxacin, and moxifloxacin	Comparison among different fluoroquinolones and other reports in the FAERS database	JBI Descriptive and analytical observational checklist/ Low risk of bias

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Table 2. General characteristics of the studies included in the systematic review

Author/Year	Country	Population	Sample	Study design	Type of fluoroquinolone	Comparator group	JB1 Appraisal results
Fleming et al. (2024)	United States	Adult patients treated for community-acquired pneumonia (CAP)	436,257 patients from the combined MarketScan CCAE and COB databases	Retrospective cohort study	Ciprofloxacin, levofloxacin, and moxifloxacin	Amoxicillin-clavulanate, azithromycin, doxycycline, among others	JB1 Retrospective cohort study checklist/ Low risk of bias
Fleming et al. (2025)	United States	Adult patients with urinary tract infection (UTI) and no previous history of tendon injury	2,234,036 patients identified in the MarketScan® databases between 2014 and 2020	Retrospective cohort study	Ciprofloxacin, levofloxacin, and moxifloxacin	Nitrofurantoin, sulfamethoxazole/trimethoprim, cephalaxin, amoxicillin-clavulanate, amoxicillin, azithromycin, doxycycline, cefdinir, and cefuroxime	JB1 Retrospective cohort study checklist/ Low risk of bias
Gupta and Katiyar (2020)	India	Incidence of tendinopathies in adult patients treated with fluoroquinolones at an orthopedic clinic	108 participants (54 fluoroquinolone-associated tendinopathy cases and 54 matched controls without tendinopathy)	Case-control study	Ciprofloxacin, levofloxacin, ofloxacin, and moxifloxacin	Controls without fluoroquinolone-associated tendinopathy (ofloxacin and moxifloxacin)	JB1 Case-control checklist/ Low risk of bias
Alison (2024)	United Kingdom	Patients with Achilles tendon rupture associated with fluoroquinolone use	Case series of 13 patients with Achilles tendon rupture	Case report	Not reported in the study	Not applicable	JB1 Case report checklist/ Moderate risk of bias
Chang et al. (2022)	Taiwan	Individuals registered in the National Health Insurance Research Database (NHIRD) between 2000 and 2015	714,140 individuals: 357,070 fluoroquinolone-exposed participants and 357,070 matched unexposed controls	Cohort study	Ciprofloxacin, levofloxacin, norfloxacin, ofloxacin, gemifloxacin, and moxifloxacin	Individuals not exposed to fluoroquinolones	JB1 Cohort study checklist/ Low risk of bias
Anziano (2024)	Canada	Older woman with Achilles tendinitis after exposure to a fluoroquinolone	One patient	Case report	Levofloxacin	Not applicable	JB1 Case report checklist/ Moderate risk of bias
Kaneko et al. (2024)	Japan	Patient with autosomal dominant polycystic kidney disease undergoing treatment for hepatic cyst infection	One patient	Case report	Levofloxacin	Not applicable	JB1 Case report checklist/ Moderate risk of bias
Anderson et al. (2025)	United States	Patient with bilateral Achilles tendon rupture after levofloxacin use	One patient	Case report	Levofloxacin	Not applicable	JB1 Case report checklist/ Moderate risk of bias
Patel et al. (2024)	United States	Patients hospitalized with community-acquired pneumonia	1,071 patients	Retrospective cohort study	Moxifloxacin, levofloxacin, and ciprofloxacin	Aminoglycosides, carbapenems, cephalosporins, clindamycin, linezolid, macrolides, metronidazole, penicillins, tetracyclines, TMP/SMX, and vancomycin	JB1 Retrospective cohort study checklist/ Low risk of bias

Abbreviations: FDA: Food and Drug Administration; FAERS: FDA Adverse Event Reporting System; CAP: Community-acquired pneumonia; UTI: Urinary tract infection; CCAE: Commercial Claims and Encounters; COB: Coordination of Benefits; NHIRD: National Health Insurance Research Database; TMP: Trimethoprim; SMX: Sulfamethoxazole; JB1: Joanna Briggs Institute.

design. Criteria related to participant selection, definition of fluoroquinolone exposure, measurement of tendon outcomes, control of confounding factors, and appropriateness of statistical analyses were considered.

Overall, cohort and case-control studies had higher methodological quality and a lower risk of bias because they included comparator groups and adjustment for confounding factors. Case reports and case series had a higher risk of bias because of the absence of a comparator group and their limited capacity for causal inference, although they contributed to the clinical and temporal description of fluoroquinolone-associated tendon injuries (Table 2).

Clinical outcomes and association between fluoroquinolones and Achilles tendon injuries

The main outcomes assessed were tendinitis, tendinopathy, and Achilles tendon rupture. Most studies identified an association between fluoroquinolone exposure and the occurrence of tendon events, particularly during the first weeks after use. Risk was most frequently associated with advanced age, concomitant corticosteroid use, renal impairment, diabetes mellitus, obesity, and greater mechanical demand on the tendons.

Comparative studies reported heterogeneous effect measures, including odds ratios, incidence rate ratios, hazard ratios, reporting odds ratios, and absolute rate differences. Despite differences in study design, exposure windows, and comparator groups, most estimates indicated an increased risk of Achilles tendon injury following fluoroquinolone exposure. The effect estimates reported by the comparative studies are summarized in Table 3.

Discussion

The results of this review are consistent with an association between fluoroquinolone exposure and tendon injuries, particularly those involving the Achilles tendon. This association was observed across different study designs, including case-control studies, population-based cohorts, pharmacovigilance analyses, and studies conducted in specific clinical populations. Studies with a comparator group identified a higher risk of tendinitis, tendinopathy, and tendon rupture among individuals exposed to fluoroquinolones than among unexposed individuals or users of non-fluoroquinolone antibiotics, strengthening the epidemiological plausibility of this relationship^(23,29-31,34). Even in settings with a low absolute frequency, studies in hospitalized populations identified tendinitis as a clinically relevant adverse event, with functional and care-related implications that justify clinical monitoring⁽³⁸⁾.

A recurring finding was the concentration of events in the period immediately following drug exposure. The included studies indicated a higher risk during the first weeks after treatment initiation, particularly within the first 30 days, with attenuation of the association over longer follow-up periods^(23,29-31). This temporal pattern suggests a window of

greater clinical vulnerability during which monitoring for pain, edema, stiffness, or functional limitation of the Achilles tendon should be intensified.

The occurrence of injuries does not appear to be uniform among all fluoroquinolone users. Advanced age, diabetes mellitus, obesity, renal impairment, and concomitant corticosteroid use were frequently associated with a higher risk of tendon events^(23,32,34,36). These findings are clinically relevant because they indicate that the decision to prescribe fluoroquinolones should consider not only the antimicrobial indication but also the individual profile of tendon vulnerability.

Although most evidence concerns systemic administration, one included study⁽²⁸⁾ suggests that exposures considered to involve lower systemic absorption, such as quinolone-containing optic drops, may also be associated with the risk of Achilles tendon rupture. This finding broadens the discussion of medication safety and indicates that tendon toxicity should be considered in different contexts of quinolone exposure.

Case reports and case series complemented observational studies by describing the clinical course of injuries, including tendinitis, tendinopathy, unilateral or bilateral rupture, functional limitation, need for rehabilitation, and, in some cases, surgical treatment^(27,33,35,37). Although these studies do not permit causal inference, they reinforce the temporal relationship between exposure and clinical manifestation and highlight the potentially severe functional impact of these complications.

Despite warnings issued by international regulatory agencies, the occurrence of tendon events in patients with previously recognized risk factors suggests persistent gaps between safety recommendations and clinical practice⁽²⁶⁾. Therefore, the findings of this review reinforce the need for judicious fluoroquinolone prescribing, particularly among older adults, patients with metabolic or renal diseases, and corticosteroid users, as well as counseling regarding the early recognition of tendon symptoms during and after treatment.

This study has some limitations that warrant acknowledgment. First, the inherent nature of the included hypothesis-generating studies limits causal inferences. Second, a precise characterization of exposure was partially constrained by data missing from the primary literature; specifically, one included study⁽³³⁾ did not specify the exact type of fluoroquinolone administered to the patients. This lack of granularity limits determination of compound-specific risks and prevents a definitive assessment of whether the observed tendon injuries are a class effect or driven by specific generations of the drug.

Conclusion

The available evidence indicates that fluoroquinolone use is associated with an increased risk of Achilles tendon injuries, including tendinopathy, tendinitis, and tendon rupture, particularly during the first weeks after exposure. Risk was higher among older adults, patients with renal impairment,

Table 3. Effect estimates reported by comparative studies assessing the association between fluoroquinolone exposure and Achilles tendon injuries

Author/Year	Outcome	Exposure and comparator	Effect measure	Estimate (95% CI)
Morales et al. (2019)	Achilles tendon rupture	Current systemic fluoroquinolone exposure compared with matched controls and co-amoxiclav exposure	Adjusted incidence rate ratio	3.14 (2.11-4.65)
Persson and Jick (2019)	Achilles tendon rupture	Current fluoroquinolone exposure compared with matched	Adjusted odds ratio	2.71 (1.76-4.17)
Baik et al. (2020)	Achilles tendon rupture	Levofloxacin exposure compared with no exposure to the respective fluoroquinolone	Adjusted hazard ratio	2.20 (1.50-3.24)
Rasmussen et al. (2024)	Achilles tendon lesion or rupture within 90 days	Oral fluoroquinolone exposure compared with amoxicillin exposure	Adjusted hazard ratio	2.74 (1.87-4.02)
Zellers et al. (2024)	Functional recovery after bilateral Achilles tendon rupture	Exposure to fluoroquinolones; no comparator group.	Not applicable	Not applicable
McCullagh et al. (2025)	Achilles tendon lesion or rupture within 1 year	Oral fluoroquinolone exposure compared with amoxicillin exposure	Adjusted hazard ratio	1.49 (1.29-1.73)
Tran et al. (2023)	Achilles tendon rupture	Optic quinolones compared with optic neomycin, oral amoxicillin, or azithromycin	Adjusted hazard ratio	4.49 (1.83-11.02)
Shu et al. (2022)	Tendonitis	Ciprofloxacin reports compared with all other drug-event reports in FAERS	Reporting odds ratio	98.50 (91.52-106.02)
Fleming et al. (2024)	Any tendon injury within 1 month	Fluoroquinolone antibiotics compared with non-fluoroquinolone antibiotics for community-acquired pneumonia	Propensity score-weighted odds ratio	1.42 (1.19-1.70)
Fleming et al. (2025)	Any tendon injury within 1 month	Fluoroquinolone antibiotics compared with non-fluoroquinolone antibiotics for urinary tract infection	Propensity score-weighted odds ratio	1.03 (0.93-1.32)
Anziano (2024)	Bilateral Achilles tendonitis (without rupture)	Levofloxacin.	Not applicable.	Not applicable, as this is a case report.
Gupta and Katiyar (2020)	Fluoroquinolone-associated tendinopathy	Ciprofloxacin exposure among patients with tendinopathy compared with controls without tendinopathy	Odds ratio	2.42 (1.08-5.42)
Alison (2024)	Functional recovery after Achilles tendon rupture	Exposure to fluoroquinolones; no comparator group.	Not applicable	Not applicable, as this is a case report
Chang et al. (2022)	Tendon disorders	Fluoroquinolone exposure compared with no fluoroquinolone exposure	Adjusted hazard ratio	1.42 (1.02-1.87)
Kaneko et al. (2024)	Achilles tendon tendinopathy (without rupture)	Intravenous levofloxacin; no comparator group.	Not applicable	Not applicable, as this is a case report
Anderson et al. (2025)	Complete bilateral rupture of the Achilles tendon treated surgically	Levofloxacin; no comparator group.	Not applicable	Not applicable, as this is a case report
Patel et al. (2024)	Adverse tendon event	Levofloxacin compared with moxifloxacin and ciprofloxacin among fluoroquinolone-treated patients	Incidence comparison	3.1% vs 1.2% vs 0%; p = 0.04

diabetes mellitus, obesity, and concomitant corticosteroid users, reinforcing the need for judicious prescribing and clinical monitoring in individuals with predisposing factors.

Although the findings are consistent, they should be interpreted considering the predominance of retrospective observational studies and case reports, as well as hete-

roogeneity across populations, drugs assessed, diagnostic criteria, and follow-up periods. Prospective studies with well-defined comparator groups and standardized follow-up are recommended to estimate the magnitude of risk more accurately and guide preventive strategies aimed at reducing fluoroquinolone-associated tendon injuries.

Authors' contributions: Each author contributed individually and significantly to the development of this article: LBLP *(<https://orcid.org/0000-0002-2591-9158>) and TCSA *(<https://orcid.org/0009-0005-7019-9160>) Conceived and planned the activities that led to the study, interpreted the results of the study, participated in the review process, data collection, statistical analysis, bibliographic review, formatting of the article, and wrote the article; PPF *(<https://orcid.org/0009-0007-9870-9470>), GPF *(<https://orcid.org/0000-0002-3008-2380>), and ILSM *(<https://orcid.org/0000-0002-0543-9317>) Participated in the review process, data collection, bibliographic review, and wrote the article. All authors read and approved the final manuscript. *ORCID (Open Researcher and Contributor ID) .

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