osteology

MDPI

Systematic Review

Insurance Payor Status and Outcomes in Foot and Ankle Surgery

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Abstract

Background/Objectives: The increasing prevalence of foot and ankle procedures in the United States has coincided with rising costs of care, exposing socioeconomic disparities within this area of orthopedics. Insurance payor status is one such factor that can affect the quality and accessibility of medical care and has been implicated in orthopaedic patient outcomes. While previous studies in other fields of orthopaedics have demonstrated an association between insurance status and access to treatment, length of hospital stay, post-operative outcomes and complication rates, no comprehensive review has yet explored this relationship in foot and ankle surgery. Thus, the goal of this study is to examine the association between insurance payor status and outcomes in foot and ankle procedures. **Methods:** A systematic review of five databases was conducted, focusing on the interplay between insurance coverage and foot/ankle procedures. Included studies reported on insurance payor status and patient outcomes following foot and ankle surgery. Extracted outcomes included time to be seen by a provider, complication and revision rates, post-operative Emergency Department (ED)/Urgent Care utilization, readmission rates, hospital length of stay, pain, functional scores, discharge destinations, return to work/activity, and follow-up. Meta-analyses were performed using the Revman 5.3 software. Studies that did not qualify for meta-analyses were described qualitatively. **Results:** Of 1401 studies identified, 24 texts met inclusion and exclusion criteria. Across the 24 studies, there were a total of 20,950 patients. Noninsured patients had a 59% higher risk of ED/urgent care utilization within 30 days of surgery compared to insured patients [Risk Ratio (RR) = 1.59, 95% Confidence Interval (CI) = 1.18 to 2.12, $p < 0.05$]. Privately insured patients were seen 3.65 days earlier than patients with government insurance [95% CI = 2.02 to 5.27, $p < 0.0001$]. Worker's Compensation patients had statistically significant findings for poorer outcomes, higher pain scores, and lower functional scores. Similarly, Medicaid patients also fared worse on functional scores and had delayed access to appointments and treatments. **Conclusions:** Patients without private insurance have worse pain and functional outcomes, delayed access to care, and increased utilization of emergency resources following foot and ankle procedures. It is crucial for providers to be cognizant of these discrepancies when caring for patients. Further research is needed to better understand the nuances of these insurance-related disparities within foot and ankle subspecialties.

Keywords: insurance; outcomes; foot and ankle surgery

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1. Introduction

The prevalence of foot and ankle procedures in the United States (US) has steadily increased over recent years, reflecting both an escalating demand for interventions and notable advancements in surgical techniques and outcomes [1–3]. Alongside the rise in procedure rates across the US, there has been a simultaneous increase in healthcare costs, consequently exacerbating disparities within foot and ankle procedures [4–6]. This trend is concerning, especially considering the aging population and the ongoing upward trend in foot and ankle procedure rates, underscoring the urgency in understanding and resolving disparities in accessing care within this domain.

A pivotal aspect influencing the quality and accessibility of medical care is insurance payor status. Various studies have consistently highlighted the profound impact of uninsured status on healthcare-related outcomes, correlating lack of insurance coverage with prolonged hospital stays, increased complication rates, and elevated mortality rates [7–11]. Across multiple orthopaedic subspecialties, insurance payor status has demonstrated a profound correlation with barriers to accessing clinical and surgical care, greater waiting times, compromised outcomes, and higher 90-day morbidity for both pediatric and older patients alike [12]. These findings bear significant implications for treatment accessibility, post-operative recovery, and overall complications, emphasizing the critical role insurance status plays in shaping patient outcomes.

Thus, the primary goal of this study is to examine the association between insurance payor status and outcomes in foot and ankle procedures. We hypothesize that public insurance would be associated with longer length of stay and worse post-operative outcomes compared to patients on private insurance. In the field of orthopaedics, various systematic reviews have scrutinized the influence of insurance status on outcomes and surgical utilization. These reviews have focused on spine, shoulder, knee, and hip surgeries, revealing associations between payor status and crucial aspects of care, including access, duration of hospitalization, patient satisfaction, as well as post-operative pain and disability [8,13–15]. Similar trends have been observed in foot and ankle procedures, yet there remains a notable absence of a comprehensive review examining disparities based on insurance status within this specific sub-specialty [5,16]. Given the rising prevalence of foot and ankle procedures interventions and the established impact of insurance status on healthcare outcomes, there is a pressing need to address this gap in research.

2. Materials and Methods

2.1. Literature Search and Screening

This study followed PRISMA guidelines. The PRISMA checklist can be found in the Supplemental Materials. The search protocol was not registered. We searched Medline (PubMed), Embase (Elsevier), Scopus (Elsevier), and SPORTDiscus (EBSCOhost) using a combination of keywords and database-specific subject headings for the concept of insurance coverage and foot/ankle procedures. The complete, reproducible search strategies for all included databases can be found in Appendix A. The search yielded a total of 1401 citations. All citations were imported to Covidence (Veritas Health, Melbourne, Australia), a systematic review screening software. Covidence detected and automatically removed 593 duplicates, leaving 808 citations for screening. Inclusion criteria involved studies that analyzed patients who required foot and/or ankle evaluation and/or surgery, and it included insurance payor status relative to treatment access, patient outcomes, and/or utilization of healthcare resources. Review articles, case reports, non-English texts, opinion pieces, letters to the editor, and studies with pediatric populations were excluded. Studies involving amputation and/or diabetic foot ulcers were excluded due to overlap with vascular surgery and podiatry. Studies outside of the United States also excluded. After abstract and full-text screening, 24 articles remained for inclusion (Figure 1).

All voting disagreements at abstract and full-text levels were resolved with discussion. Manual data extraction was performed with one reviewer extracting each article.

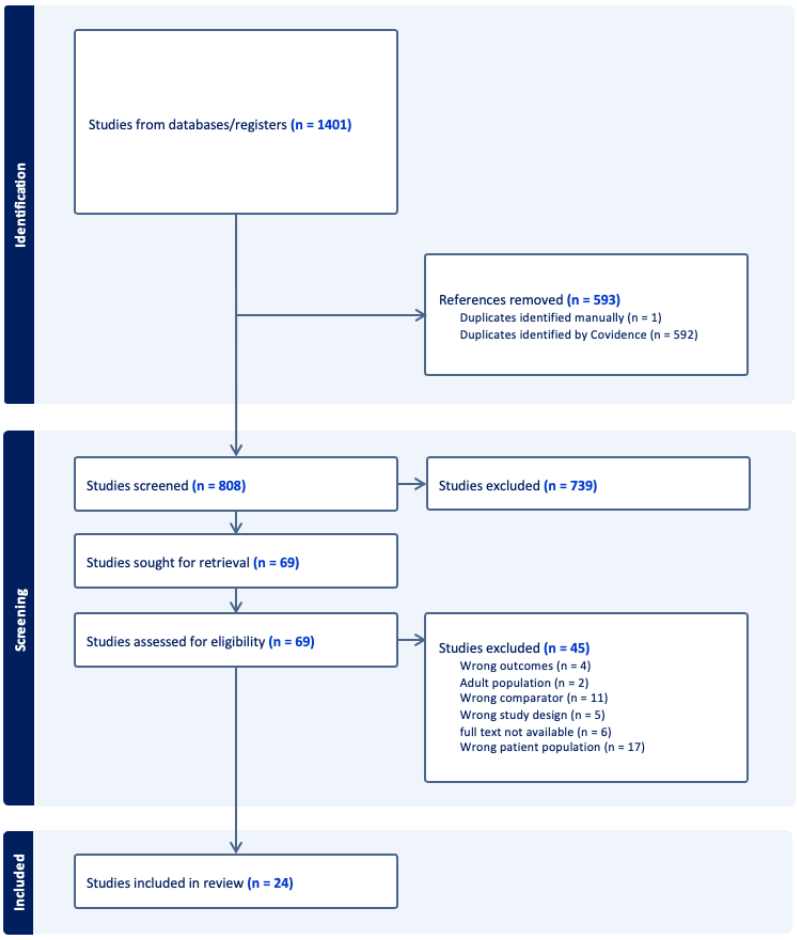

Figure 1. PRISMA flow diagram.

2.2. Meta-Analysis

To prepare for the meta-analysis, we systematically extracted data from diverse studies that compared insurance payor groups, organizing the information based on reported outcomes. The presentation of dichotomous outcome measures, including complications and facility location, utilized Relative Risk (RR). For the meta-analysis, we employed Review Manager (Revman) Version 5.3 (Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014), utilizing the inverse variance and random effects model to calculate a 95% Confidence Interval. The assessment of statistical heterogeneity included a thorough examination of forest plots, as well as the performance of the τ^2 test, χ^2 test, degrees of freedom (df), I^2 value, and the overall effect Z test. To account for heterogeneity of procedures, analysis was divided between trauma and elective surgery. Studies lacking complete data that were unable to be pooled were excluded from full meta-analysis.

2.3. Quality Appraisal and Risk of Bias

All of the studies included were assess for risk of bias and study quality via the Methodological Index for Nonrandomized Studies (MINORS) criteria [17]. The MINORS criteria includes a 12-item checklist, with each item receiving a score of either 0 (not reported), 1 (inadequately reported), or 2 (adequately reported). Noncomparative and comparative studies may have a maximum score of 16 and 24 points respectively. The risk of bias and quality assessment is included in Table 1.

Table 1. Study and cohort characteristics.

Author (Year)	Study Design	Insurance Type	Surgical Operation or Patient Cohort	Number of Subjects and/or Feet/Ankles	Age in Years: Mean (Range or SD)	Quality Assessment
Singh (2020) [18]	Retrospective	Medicaid, Medicare, Private, Self, Other	TAA	6280 patients	62	10
Zelle (2021) [19]	Retrospective	Insured, Uninsured	Ankle ORIF	619 patients	40.7	12
Prather (2020) [20]	Retrospective	Government, Private, Uninsured	Ankle ORIF	596 patients	<45 versus >45	12
Ogawa (2007) [21]	Prospective	Workers Compensation, Non-Workers Compensation	Repair of peroneal tendon subluxation	15 patients	33.7 (14–59)	13
McKissack (2021) [22]	Retrospective	Private Insurance, Medicaid	Ankle ORIF	311 patients	Private Insurance: 41.7 (13.1), Medicaid: 38.1 (12.9)	11
Labrum (2017) [23]	Simulated Patient Survey	Medicaid, Private Insurance	NR	NR	NR	14
Komenda (1999) [24]	Retrospective	Workers Compensation, Non-Workers Compensation	Ankle arthroscopy	54 patients, 55 ankles	31 (14–64)	10
Kim (2016) [25]	Survey	Medicaid, Medicare, BlueCross	TAA	240 foot and ankle surgeons	NR	9
Hutchinson (1994) [26]	Prospective	Workers Compensation, Non-Workers Compensation	Calcaneal ORIF	43 patients, 47 fractures	36.02 (17–66)	11
Gaedke (2018) [27]	Retrospective	Workers Compensation, Non-Workers Compensation	Ankle Fusion	103 patients	53 (23–80)	12
Flemister Jr (2000) [28]	Retrospective	Workers Compensation, Non-Workers Compensation	Subtalar Arthrodesis	86 patients	45 (23–66)	11
Dooley (2004) [29]	Prospective	Workers Compensation, Non-Workers Compensation	Calcaneal fractures-bilateral nonoperative, bilateral ORIF, unilateral total, bilateral total	47 patients	NR	14
Dobbins (2020) [30]	Retrospective	Private, Medicare, Medicaid, Workers Compensation, Self/No pay, other	Acute, unstable ankle fracture	192 patients	43.63 (14.1)	12

Table 1. *Cont.*

Author (Year)	Study Design	Insurance Type	Surgical Operation or Patient Cohort	Number of Subjects and/or Feet/Ankles	Age in Years: Mean (Range or SD)	Quality Assessment
Deister (2017) [31]	Retrospective	Private Insurance, Workers Compensation, Medicare/Medicaid	Ankle arthrodesis, triple arthrodesis, pantalar arthrodesis, subtalar arthrodesis	198 patients	NR	12
Csizy (2003) [32]	Prospective	Workers Compensation, Non-Workers Compensation	Displaced intra-articular calcaneal fracture fusion	461 patients	NR	12
Cherney (2018) [33]	Prospective	Medicaid, Medicare, Private Insurance, No insurance	Trans-syndesmotic stabilization	69 patients	NR	14
Bui (2020) [34]	Retrospective	Workers Compensation, Non-Workers Compensation	Foot and Ankle Procedure	221 patients	Workers Compensation: 43.25 (11.77) Non-Workers Compensation: 42.88 (13.22)	14
Boden (2020) [35]	Retrospective	Medicare, Medicaid, Private, Uninsured	Achilles Tendon Rupture Repair	89 patients	Uninsured/Medicaid: 32.58 (12.43), Private/Medicare: 35.16 (13.31)	12
Shibuya (2018) [36]	Retrospective	Private, Government, Self-pay, None	Foot and Ankle Procedure	513 patients	ED visit within 30 days: 53.9, No ED visit within 30 days: 53.2	12
Bazaz (2007) [37]	Prospective	Workers Compensation, Non-Workers Compensation	Endoscopic plantar fasciitis release	16 patients, 19 feet	44.7 (28–70)	14
Bakhsh (2019) [38]	Retrospective	Under/Uninsured (Medicaid, Options plans) Fully insured	Elective foot and ankle surgeries	267 patients	Insured: 52.1, Uninsured/Underinsured (46.9)	13
Amendola (1996) [39]	Prospective	Workers Compensation, Other	Ankle Arthroscopy	79 patients	30.8 (15–56)	16
Abdurrob (2020) [40]	Retrospective	Commercial, Free Care, Medicaid, Medicare, Workers Compensation	Foot and Ankle patients	10,745 patients	55.7 (17.3)	12
Abousayed (2019) [41]	Retrospective	Private, Medicare, Medicaid, Other	Ankle ORIF	35	55.7 (17.3)	12

Abbreviations: ORIF = open reduction internal fixation, TAA = total ankle arthroplasty, NR = not reported.

3. Results

3.1. Study and Cohort Characteristics

From the literature following screening criteria, a total of 24 studies were analyzed in this systematic review. Among various factors, study design and descriptive information including insurance type, the surgical operation/patient cohort, number of subjects, average age, and study quality are available in Table 1. Insurance payor type was reported as was written for each study. Terms such as "insured" typically represented private insurance, "underinsured" representing Medicaid or options plans, and "uninsured" signifying no insurance plan.

3.2. Descriptive Outcomes Analysis

3.2.1. Treatment Access

Five studies analyzed patient access to treatment (Table 2) [19,22,23,25,35]. Compared to commercial insurance, those who were uninsured or had Medicaid or Medicare insurance were more likely to be denied care and had longer wait times throughout treatment [25]. Labrum et al. reported that the acceptance rates into a clinic for patients with Medicaid and Medicare, 47% and 36% respectively, were less than half of acceptance rates of individuals with commercial insurance [23]. The average time from injury to first clinic visit for uninsured patients was also generally longer than those with insurance [35]. Other studies found that Medicaid patients also have a longer wait time from injury to first seen and from first seen to surgery [22,35]. More specifically, uninsured patients had the second longest wait times from injury to first clinic, time from injury to surgery, and time from presentation to a diagnostic MRI scan [35].

3.2.2. Treatment Course

Five studies evaluated differences in patient treatment course, which included analyzing hospital length of stay, discharge location, as well as follow-up (Table 3) [18,19,22,31,38]. Medicare and Medicaid insurance was generally associated with longer hospital stays and discharge to inpatient or extended care facilities compared to private insurance [18,31]. Medicaid, underinsured, and uninsured patients were more likely to be lost to post-operative outpatient follow-up or have an increased number of missed appointments; however, not all findings were statistically significant [19,22,38].

3.2.3. Post-Operative Complications

Eight studies reported on post-operative complications associated with foot and ankle procedures, including surgical complications, revision surgery, Emergency Department/Urgent Care visit, and readmission (Table 4) [18–21,30,36,38,41].

In regard to surgical complications, only one study found a statistically significant difference in the development of complex regional pain syndrome amongst Workers Compensation patients [21]. All other studies did not find significant differences regarding post-operative infection, surgical complications, or risk of adverse events [18,19,30,38]. In terms of revision surgery, there was also similarly no statistically significant difference in rates of revision procedures [18,20]. Lastly, while Shibuya et al. found that private insurance was protective against post-operative Emergency Department visit, other studies found no significant difference in Emergency Department/Urgent Care visits or in rates of readmission [20,36,41].

3.2.4. Patient-Reported Outcomes

Pain

In regard to pain-related outcomes, studies used either the Visual Analogue Scale (VAS) for pain, subsequent pain or injury (SPI), the PROMIS pain score, or the Numeric Pain Rating Scale (NPRS) score (Table 5). Five studies compared Workers Compensation

to Non-Workers Compensation patients, and four of the five studies found that Workers Compensation was associated with worse pain and/or higher pain values [27,29,34,37]. While Amendola et al. did find improved scores for Workers Compensation patients, there was a lower overall perception of benefit following ankle arthroscopy compared to Non-Workers Compensation patients [39]. Two studies compared Medicaid, Medicare, Private, and no insurance plans and noted worse pain for Medicaid, underinsured, and uninsured patients [33,38].

Table 2. Treatment access outcomes.

Author (Year)	Time to Treatment	Conclusion
Boden (2020) [35]	Time from injury to first clinic appointment (days) - Medicare: 9.75 - Medicaid: 16.86 - Private: 4.84 - Uninsured: 11.83 $p = 0.004$ Time from first visit to surgery: - Medicare: 7.75 - Medicaid: 41.36 - Private: 4.64 - Uninsured: 26.67 $p = 0.018$ Injury to surgery time: - Medicare: 13.75 - Medicaid: 57.86 - Private: 9.56 - Uninsured: 38.42 $p = 0.007$ Presentation to MRI time: - Medicare: 2 - Medicaid: 56.43 - Private: 1.84 - Uninsured: 36.4 $p = 0.021$	When compared to adequately insured patients (Private and Medicare), underinsured patients (uninsured, Medicaid) had significantly greater time from date of injury to first clinic visit, first clinic visit to surgery, injury to surgery date, and initial presentation to MRI
Zelle (2021) [19]	Time (days) from injury to presentation (mean ± SD): Insured: 2.3 ± 5.5, uninsured: 4.5 ± 7.6 *p*-value: <0.001 Time from presentation at our hospital to surgery in days (mean ± SD): - Insured: 5.0 ± 7.3 - Uninsured: 4.8 ± 4.3; $p = 0.816$ Time (days) from injury to surgery (mean ± SD): - Insured: 7.3 ± 9.1 - Uninsured: 9.4 ± 8.5 $p < 0.001$	Uninsured patients with ankle fractures requiring surgery experience significant barriers regarding access to healthcare
Kim (2016) [25]	Rate for successfully obtaining an appt: - Medicaid: 38 (19.8%) - Medicare: 173 (92.0%) - BlueCross: 170 (90.4%) Waiting period (days): - Medicaid: 22.6 (18.9–31.3) - Medicare: 11.7 (9.8–14.0), $p = 0.004$ - BlueCross: 10.7 (9.0–12.5), $p = 0.001$	Patients with Medicaid must wait longer for evaluation even when they obtain an appointment
McKissack (2021) [22]	Average time from injury to first visit (days): - Private Insurance: 1.2 - Medicaid: 6.2 $p < 0.001$ Average time from injury to surgery (days): - Private Insurance: 8.3 - Medicaid: 16.1 $p < 0.001$	Medicaid patients have significantly delayed access to care compared to Private insurance
Labrum (2017) [23]	- Offices less likely to accept Medicaid (30/64 = 47%) than commercial insurance (62/64 = 97%) - Medicaid patients (23/64 = 36%) less likely to be offered appointment within 2 weeks compared to commercial insurance (59/64 = 89%), OR = 0.0154, 95% CI 0.00094–0.251, $p < 0.001$	Medicaid patients are less likely to find an office that accepts insurance or get appointment within 2 weeks compared to commercial insurance

Table 3. Treatment course.

Author (Year)	Hospital Length of Stay (Days)	Discharge Location	Follow-Up	Conclusion
Singh (2020) [18]	Length of hospital stay >2 days, Odds ratio (95% CI) - Private: Reference - Medicaid: 0.97 (0.67, 1.41) - Medicare: 1.32 (1.12, 1.57) - Other: 1.48 (1.14, 1.93) - Self: 1.71 (0.79, 3.72)	Discharge to inpatient facility, Odds ratio (95% CI) - Private: Reference - Medicaid: 2.19 (1.17, 4.07) - Medicare: 2.52 (1.85, 3.44) - Other: 1.17 (0.63, 2.15) - Self: <0.01 (<0.01, <0.01)	NR	Medicare and other insurance patients had significantly increased length of hospital stay. Medicaid and Medicare patients had increased odds of discharge to inpatient facilities
Zelle (2021) [19]	NR	NR	Loss to post-operative outpatient follow-up at 3 months: - Insured: 34 (23.6%), - Uninsured: 137 (39.7%) $p = 0.002$	Uninsured patients with ankle fractures had significant loss of follow-up care
McKissack (2021) [22]	NR	NR	Number of patients with at least 6 months follow-up - Private Insurance: 109 (46.2%) - Medicaid: 34 (47.2%) $p = 0.877$ Number of patients with at least 1 year follow-up - Private Insurance: 50 (21.2%) - Medicaid: 12 (16.7%) $p = 0.403$	No significant differences in follow-up care between private and Medicaid insurance
Deister (2017) [31]	Longer length of hospital stay significantly related to Medicare/Medicaid insurance (standard regression coefficient = 0.153, $p < 0.01$)	Extended Care Facility (ECF) stay - ECF admission (n = 34): Private insurance or Workers Compensation = 0.21, Medicare and Medicaid = 0.79 - Non-ECF admission (n = 164): Private insurance or Workers Compensation = 0.60, Medicare and Medicaid = 0.40 $p < 0.01$	NR	Longer length of hospital stay and extended care facility stay were significantly related to Medicare/Medicaid insurance
Bakhsh (2019) [38]	NR	NR	Number of missed appointments: - Insured: 0.13 - Under-/Uninsured: 0.61 $p < 0.01$	Under-/uninsured patients were more at risk for loss to follow-up after elective foot and ankle surgery

Table 4. Post-operative complications.

Author (Year)	Complications	Revision Surgery	ED/UC Visit	Readmission	Conclusion
Abousayed (2019) [41]	NR	NR	Urgent Care Visit: # of patients (%) - Private: 216 (64.86%) - Medicare: 66 (19.82%) - Medicaid: 28 (8.41%) - Other: 23 (6.91%) $p = 0.91$	NR	Insurance payer status was not statistically correlated with UC visits after ORIF
Shibuya (2018) [36]	NR	NR	ED visit within 30 days. - Government: Yes = 82 (48%), No = 89 (52%) - None: Yes = 16 (100%), No = 0 (0%) - Private: Yes = 60 (32%), No = 129 (68%) - Self: Yes = 0 (0%), No = 10 (100%)	NR	Having Private insurance was protective against ED visits after foot and ankle surgery
Singh (2020) [18]	Infection Odds ratio (95% CI): - Private: Reference - Medicaid: <0.01 (<0.01, <0.01) * - Medicare: 2.25 (0.63, 8.01) - Other: 2.25 (0.25, 20.07) - Self: <0.01 (<0.01, <0.01) *	Revision Odds ratio (95% CI) - Private: Reference - Medicaid: <0.01 (<0.01, <0.01) * - Medicare: 0.68 (0.40, 1.15) - Other: <0.01 (<0.01, <0.01) * - Self: <0.01 (<0.01, <0.01) *	NR	NR	No significant differences in post-operative infection or revision surgery
Zelle (2021) [19]	Surgical site infections: - Insured: 12 (10.8%) - Uninsured: 25 (11.6%) $p = 0.83$	NR	NR	NR	No significant difference in surgical site infections when comparing insured versus uninsured patients
Ogawa (2007) [21]	Low grade complex regional pain syndrome - Workers Compensation: 4/5 patients	NR	NR	NR	Patients with Workers Compensation claims have poorer post-operative outcomes
Dobbins (2020) [30]	Patients with adverse events: N (%) - Private: 5 (15) - Medicare: 6 (25) - Medicaid: 4 (13) - Workers compensation: 2 (10) - Self/No-pay: 2 (15) - Other: 9 (12) Patients without adverse events: N (%) - Private: 29 (85) - Medicare: 18 (75) - Medicaid: 27 (87) - Workers compensation: 19 (90) - Self/No-pay: 6 (75) - other: 65 (88) $p > 0.05$	NR	NR	NR	Insurance was not associated with a difference in rates of adverse events

Table 4. *Cont.*

Author (Year)	Complications	Revision Surgery	ED/UC Visit	Readmission	Conclusion
Bakhsh (2019) [38]	Surgical Complications - Insured: 0.04 - Under-/Uninsured: 0.06 $p = 0.36$	NR	NR	NR	No significant differences in surgical complications when comparing insured versus under-/uninsured patients
Prather (2020) [20]	NR	Reoperation within 30d: - Government Insurance: 3 (1.6) - Private Insurance: 4 (1.4) - No Insurance: 3 (2.4) $p = 0.751$	ED visit within 30 days: N (%) - Government Insurance: 12 (6.4) - Private Insurance: 18 (6.3) - No Insurance: 13 (10.6) $p = 0.272$	Readmission within 30 days: - Government Insurance: 9 (4.8) - Private Insurance: 13 (4.6) - No Insurance: 8 (6.5) $p = 0.698$	Insurance status was not found to be significantly related to 30-day events

Abbreviations: ED = Emergency Department, UC = Urgent Care. * For categories with very small numbers, odds ratios < 0.01—estimates are likely not stable and should be interpreted with caution (from Singh et al.).

Table 5. Patient Reported Outcomes.

Author (Year)	Pain	Functional Score	Return to Work/Activity:	Other Outcomes	Conclusion
Ogawa (2007) [21]	NR	AOFAS - Average (Range) = 87.1 (74–100) - Workers Compensation: 80.6 - Non-Workers Compensation: 90.4 $p = 0.07$	NR	NR	Patients with Workers Compensation claims have poorer functional outcomes
Komenda (1999) [24]	NR	Subjective Rating Scale: - Non-Workers Compensation: Excellent = 25 (76%), Good = 8 (24%), Fair = 0 (0%) Poor = 0 (0%) - Workers Compensation: Excellent = 5 (23%), Good = 15 (68%), Fair = 2 (9%), Poor = 0 (0%)	NR	NR	Workers Compensation patients had fewer excellent results, attributed to increased rate of subjective complaints of pain with activity
Hutchinson (1994) [26]	NR	NR	NR	Clinical Assessment Rating System: Number of feet satisfactory/total - Workers Compensation: 16/26 (61.5%) - Non-Workers Compensation: 19/21 (90.5%) $p = 0.013$	Unsatisfactory clinical outcomes significantly correlated with Workers Compensation status
Gaedke (2018) [27]	VAS Pain Value: - Workers compensation: 4.1 - Non-workers compensation: 2.9 $p = 0.018$	AOFAS Score: - Workers compensation: 53.5 - Non-workers compensation: 64.7 $p = 0.017$	NR	NR	Workers compensation patients had significantly higher VAS pain scores and lower AOFAS scores
Flemister Jr. (2000) [28]	NR	AOFAS Score: - Workers Compensation: 73.5 - Non-Workers Compensation: 77.8 $p > 0.05$	Return to Work: - Workers Compensation: 62% of patients (33/53) - Non-Workers compensation: 85% of patients (23/27)	NR	Workers Compensation patients tended to have poorer clinical outcomes
Dooley (2004) [29]	Non-Workers Compensation patients had significantly better outcomes on VAS compared to workers compensation patients ($p < 0.01$)	Non-Workers Compensation patients had significantly better outcomes on SF-36 compared to workers compensation patients ($p < 0.01$)	NR	NR	
Cherney (2018) [33]	Numeric Pain Rating Scale Score - Private (30 pts): 2.3 - Medicare (3): 1.0 - Medicaid (4): 8.0 - Uninsured (11): 3.9 $p = 0.013$	SMFA-FI: - private (30 pts): 8.4 - Medicare (3): 3.2 - Medicaid (4): 41.9 - Uninsured (11): 27.3 $p = 0.004$ SMFA-BI - Private (30 pts): 8.9 - Medicare (3): 2.8 - Medicaid (4): 57.9 - Uninsured (11): 31.1 $p = 0.005$ OMAS - Private (30 pts): 71.7 - Medicare (3): 86.7 - Medicaid (4): 21.3 - Uninsured (11): 52.7 $p = 0.012$	NR	NR	Medicaid patients reported significantly worse SMFA-DI, SMFA-BI, OMAS, Numeric Pain Rating Score

Table 5. *Cont.*

Author (Year)	Pain	Functional Score	Return to Work/Activity:	Other Outcomes	Conclusion
Bui (2020) [34]	Subsequent Pain or Injury: (SPI): - Workers Compensation: 13/56 (23.2%) - Non-Workers Compensation: 12/165 (7.3%) $p = 0.001$	NR	NR	NR	Workers Compensation patients had higher rates of subsequent pain or injury than Non-Workers Compensation patients following foot and ankle procedures
Bazaz (2007) [37]	Workers Compensation: - No pain: 2/8 feet - Mild pain: 1/8 feet - Moderate pain: 5/8 feet	AOFAS Score: - Workers Compensation: Preoperative (63), Post-Operative (81) - Non-Workers Compensation: Preoperative (69), Post-Operativee (93)	NR	NR	Improvement after endoscopic plantar fascia release was noted in the Workers Compensation and Non-Workers Compensation groups. However, patients with Workers Compensation claims had inferior outcomes compared to Non-Workers Compensation patients using both assessment scales
	Non-Workers Compensation - No pain: 7/11 feet - Mild pain: 3/11 feet - Severe pain: 1/11 feet	Maryland Score: - Workers Compensation: Preoperative (56), Post-Operative (72) - Non-Workers Compensation: Preoperative (68),Post-Operativee (92)			Patients with Workers Compensation claims also did not achieve pain relief to the same extent as the Non-Workers Compensation patients
Bakhsh (2019) [38]	Number of narcotic refills: - Insured: 0.72 - Under-/Uninsured: 1.74 $p < 0.01$ VAS Pain Score: - Insured: 0.7 - Under-/Uninsured: 1.51 $p < 0.01$ PROMIS Pain, Mean (SD), 1-year follow-up: - Insured: 53.8 (8.6) - Under-/Uninsured: 60.2 (9.7) $p < 0.01$	PROMIS Function, Mean (SD), 1-year follow-up: - Insured: 45.2 (8.7) - Under-/Uninsured: 39.6 (9.1) $p < 0.01$	NR	PROMIS Mood, Mean (SD), 1-year follow-up: - Insured: 44.2 (8.5) - Under-/Uninsured: 51.3 (10.3) $p < 0.01$	Under-/uninsured patients have worse pain, patient-reported outcomes, and functional outcomes after elective foot and ankle surgery
Amendola (1996) [39]	VAS Pain, Mean (SD): - Workers Compensation: 2.7 (3.6) - Non-Workers Compensation: 6.9 (3.1)	NR	VAS Activities of Daily Living, Mean (SD): - Workers Compensation: 2.8 (3.7) - Non-Workers Compensation: 6.6 (3.2) $p = 0.001$	VAS Swelling: - Workers Compensation: 3.1 (3.6) - Non-Workers Compensation: 6.2 (2.8) $p = 0.002$ Overall: - Workers Compensation: 4.3 (4.1) - Non-Workers Compensation: 6.9 (3.2)	Patients under Workers Compensation had lower scores on VAS for pain, swelling, activities of daily living, and overall perception of benefit

Table 5. *Cont.*

Author (Year)	Pain	Functional Score	Return to Work/Activity:	Other Outcomes	Conclusion
Abdurrob (2020) [40]	NR	Mean (SD) FAAM score: - Commercial: 70.0 (24.9) - Free Care: 65.3 (22.4) - Medicaid: 59.5 (26.4) - Medicare: 64.4 (25.3) - Workers Compensation: 47.9 (23.5) PROMIS Global-Physical: - Commercial: 46.7 (8.5) - Free Care: 43.8 (8.8) - Medicaid: 40.5 (9.7) - Medicare: 43.4 (8.9) - Workers Compensation: 40.1 (7.1) PROMIS Global-Mental: - Commercial: 52.6 (9.1) - Free Care: 50.6 (9.3) - Medicaid: 44.7 (11.3) - Medicare: 48.7 (9.6) - Workers Compensation: 47.9 (10.1) Physical Function Short Form 10a: - Commercial: 44.1 (8.9) - Free Care: 43.4 (10.4) - Medicaid: 40.0 (9.1) - Medicare: 40.6 (9.2) - Workers Compensation: 36.4 (6.9)	NR	NR	PROMIS scores vary between the patients with different insurance types in an orthopaedic foot and ankle cohort. Patient insurance type may affect patient-reported outcomes

Abbreviations: AOFAS = American Orthopaedic Foot and Ankle Society, SF-36 = 36-Item Short Form Survey, SMFA-FI = Short Musculoskeletal Function Assessment Disability Index, SMFA-BI = Short Musculoskeletal Function Assessment Bother Index, OMAS = Olerud-Molander Ankle Score, PROMIS = Patient-Reported Outcomes Measurement Information System, FAAM = Foot and Ankle Ability Measure.

Functional Scores

Nine studies evaluated post-operative functional scores which included the American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Score, the Subjective Rating Scale, the 36-Item Short Form Survey (SF-36), Short Musculoskeletal Function Assessment Disability Index (SMFA-FI), the Short Musculoskeletal Function Assessment Bother Index (SMFA-BI), the Olerud-Molander Ankle Score (OMAS), Maryland Score, the Patient-Reported Outcomes Measurement Information System (PROMIS) Function Score, PROMIS Global Physical Score, PROMIS Global Mental Score, Physical Function Short Form, and the Foot and Ankle Ability Measure (FAAM) Score (Table 5). Similar to pain, all studies found that Worker Compensation, Medicaid, and under- or uninsured patients had overall worse functional scores [21,24,27–29,33,37,38,40].

Return to Work and Activity

Two studies evaluated return-to-work and activity following foot and ankle procedures (Table 5). Flemister Jr et al. and Amendola et al. both found that Workers Compensation patients have poorer return-to-work outcomes as well as worse scores on VAS activities of daily living [28,39].

Other Scoring

Other scoring systems that were evaluated included PROMIS Mood, VAS swelling, and the Clinical Assessment Rating System, which is used to record the severity of a condition. Similar to other scoring modalities, three studies found that Workers Compensation and underinsured patients had worse outcomes (Table 5) [26,38,39].

3.3. Meta-Analysis of Outcomes

Due to heterogeneity of data, only nine studies qualified for meta-analysis [19,20,22,25,30,35,36,38,41]. Analysis was subcategorized into studies that described insured versus uninsured patients as well as patients who were on government versus private insurance. Studies were then further classified based on indication for operation (trauma versus elective surgery).

3.3.1. Insured vs. Uninsured

Five of the studies compared insured patients to uninsured patients [19,20,30,36,38]. When analyzing risk of any post-operative complications, three studies found that uninsured patients had a slightly increased risk of complications following foot and ankle surgery with a pooled Risk Ratio (RR) of 1.2 (Figure 2) [19,30,38]. However, this increase was not statistically significant. There were also no significant differences between trauma versus elective surgery patients. In regard to Emergency Department (ED) and Urgent Care (UC) visits within 30 days of surgery, two studies found a statistically significant increased frequency of post-operative ED and UC visits amongst uninsured patients with a pooled RR of 1.59 [95% CI = 1.18 to 2.12, $p < 0.05$] (Figure 3) [20,36]. While trauma patients did not have a significantly increased utilization of ED/UC post-operatively, uninsured elective surgery patients demonstrated an increased risk [RR = 1.56, 95% CI = 1.12 to 2.17, $p < 0.01$].

3.3.2. Government vs. Private Insurance

Seven studies analyzed patients with government versus private insurance [19,20,22,25,35,36,41]. In regard to Emergency Department (ED) and Urgent Care (UC) visit within 30 days post-operatively, pooled analysis found that privately insured patients were more likely to use ED or UC; however, this finding was not statistically significant (Figure 4). When considering access to care, four studies found that privately insured patients were significantly more likely to be seen earlier by a physician compared to

patients with government insurance (Figure 5). Privately insured patients were seen on average 3.65 days earlier [95% CI = 2.02 to 5.27, $p < 0.00001$]. Privately insured patients were also found to have surgery on average 5.44 days earlier in pooled analysis; however, this difference was not statistically significant (Figure 6).

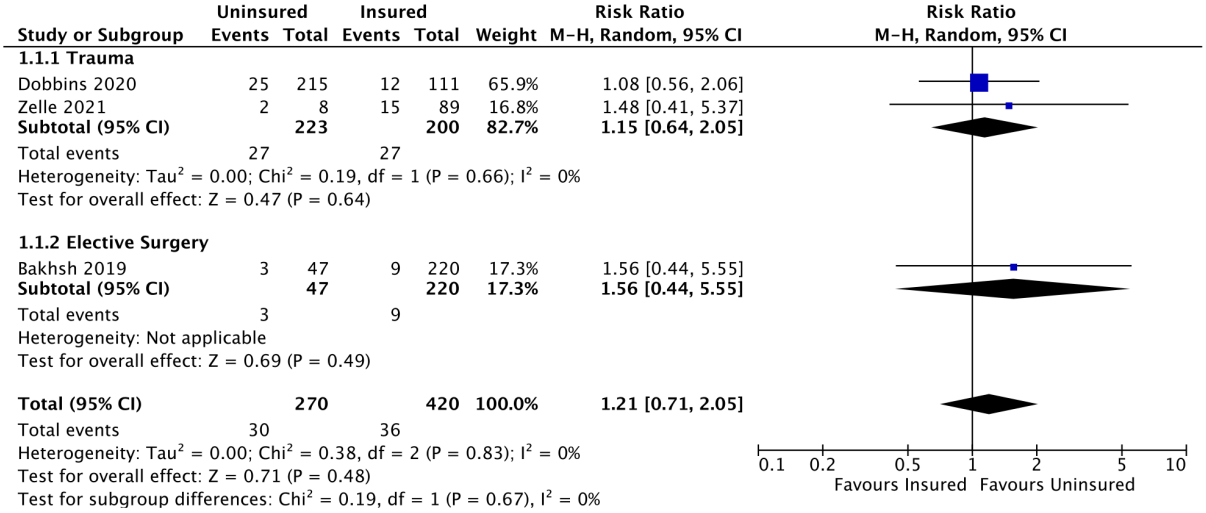

Figure 2. Insured vs. uninsured, any complications.

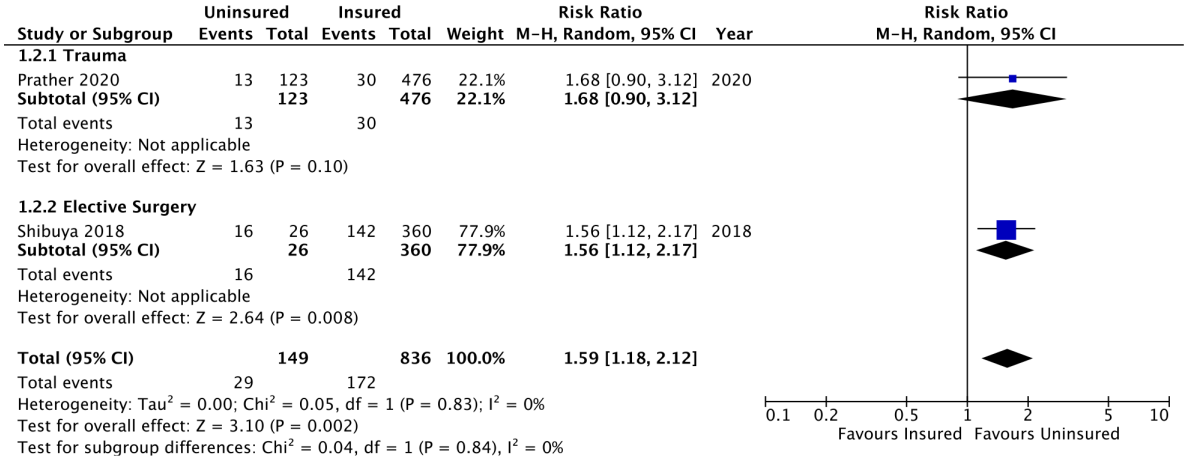

Figure 3. Insured vs. uninsured, Emergency Department and Urgent Care Visit within 30 days.

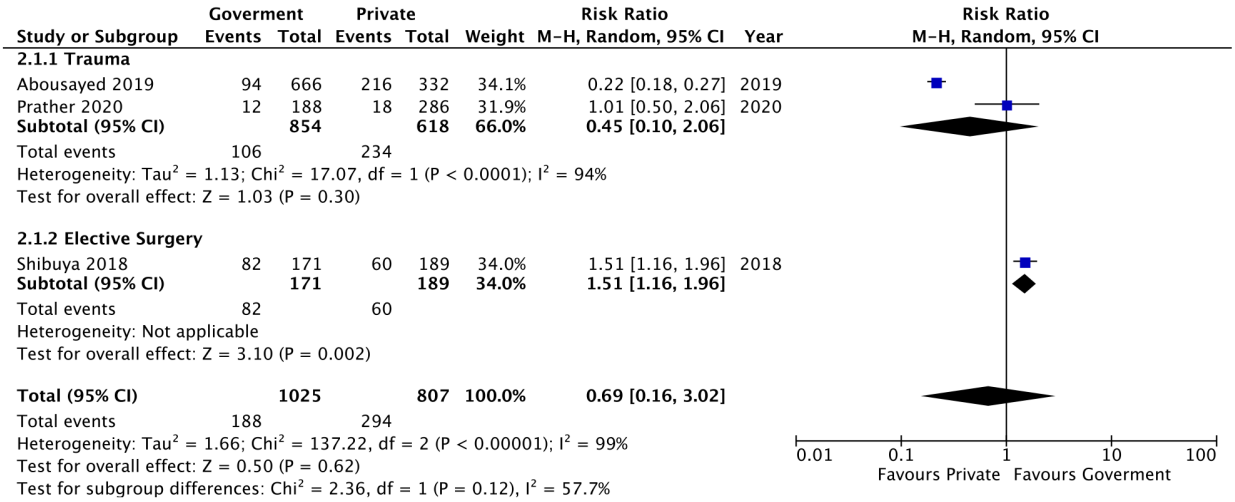

Figure 4. Government vs. private insurance, Emergency Department and Urgent Care Visit within 30 days.

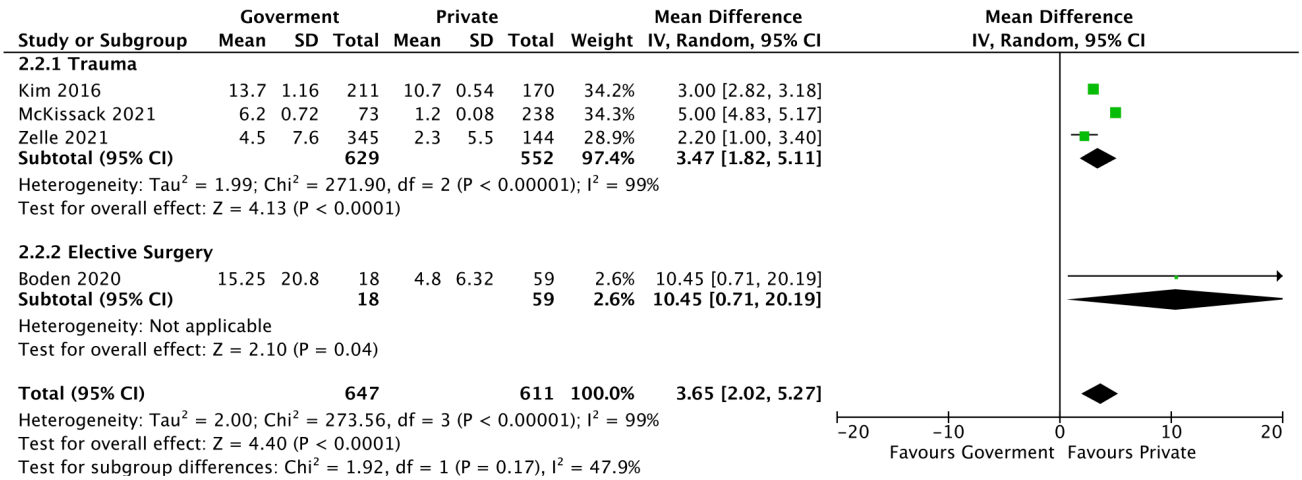

Figure 5. Government vs. private insurance, time from injury to first appointment.

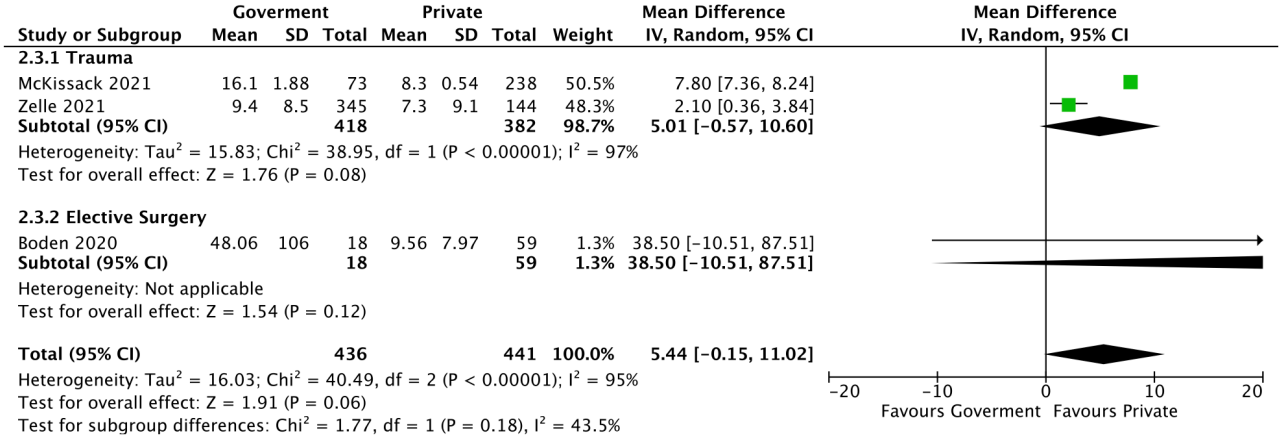

Figure 6. Government vs. private insurance, time from injury to surgery.

4. Discussion

4.1. Overview

In this first-of-its-kind systematic review and meta-analysis, we demonstrate that patients without private insurance, particularly Workers Compensation patients and those that are under-/uninsured, generally have overall worse post-operative pain and functional outcomes and delayed access to treatment following foot and ankle surgery. Our study reflects trends in insurance-related patient outcomes that have been observed in other subspecialties of orthopaedic surgery such as in total joint and upper extremity procedures [42,43].

While research on equity and social determinants of health factors within orthopaedic care has steadily gained traction, insurance payor status and its effect on foot and ankle patient outcomes remains a relatively understudied topic [44]. Historically, this domain has been difficult to study, especially when considering the potential for stigmatization of groups such as Workers Compensation patients in regard to healthcare resource [45]. Additionally, amongst Medicaid patients, there may be significant regional/statewide differences in Medicaid coverage, thus adding to the complexity of studying the impact of government insurance on patient outcomes. However, our study nevertheless demonstrates that there remain significant differences in treatment access and post-operative outcomes based on insurance payor status.

Interestingly, a majority of studies did not find statistically significant differences in post-operative complications, including surgical complications, revision surgery, Emer-

gency Department/Urgent Care visit, or readmission rates. These findings could be due to heterogeneity of procedures analyzed. Future studies should prioritize analyzing post-operative complications by surgery type to better standardize analysis. For surgeons to provide equitable and optimal orthopaedic care, it is critical to better understand the nuances behind these care discrepancies. By raising awareness for these significant differences in patient care access and outcomes based on insurance payor status, we hope to invite further discussion and research into how these inequities can be addressed.

The findings reported in this manuscript shed light on the differential impact of payor status in foot and ankle surgery, but several other works have explored this topic in other fields of orthopaedic surgery. Our findings are consistent with broader trends observed in orthopaedic subspecialties like total joint and upper extremity procedures [46,47]. Previous studies have highlighted how socioeconomic factors, including payor status, contribute to disparities in outcomes after procedures like total knee and hip arthroplasty [8]. Medicaid and non-private insurance patients typically experience delayed access to care, worse post-operative outcomes, and higher 90-day morbidity compared to patients with private insurance [8,46,47]. Further, while Medicaid patients show comparable improvements in overall function following total joint arthroplasty, they start from a lower baseline, contributing to an overall poorer health status post-operatively [46]. This pattern of disparities across other orthopaedic subspecialties suggests that insurance-related outcomes we observed in foot and ankle surgery are not isolated but rather part of a systemic issue that spans across various types of orthopaedic care.

Additionally, research focusing on Medicaid patients undergoing both hip and shoulder arthroplasty reinforces these disparities by showing higher rates of post-operative complications, readmissions, and resource utilization [48,49]. Medicaid patients are disproportionately burdened with longer hospital stays and more complex post-surgical care needs [48,49]. Despite this, complication rates such as revision surgery or emergency department visits did not significantly differ between Medicaid and non-Medicaid patients in some studies, highlighting the complexity of the issue and the need for more targeted analyses by surgery type [48,49]. Our findings, alongside these studies, point to the need for future research to investigate the specific procedures and patient characteristics that contribute most to these disparities. Our study adds to the growing body of evidence showing that insurance-related disparities persist in orthopaedic care. When considering potential interventions to address disparities based on insurance payor status in foot and ankle, there is a paucity of literature on actionable recommendations. Looking to other literature within orthopaedics, possible methods to address disparities could include expanding Medicaid coverage, raising reimbursement rates to incentivise providers to accept public insurance, and reducing pre-authorization requirements/expanding provider networks to accept Medicaid in order to decrease delays in diagnostic and surgical care [12,50].

4.2. Strengths and Limitations

Our review was primarily limited by heterogeneity of data, as there were a wide array of foot and ankle procedures included, which precluded meta-analysis to a total of nine studies. Given the few number of studies in our pooled analysis, we also did not perform formal publication-bias assessments. Heterogeneity of data may have also limited our overall systematic review and descriptive analysis, as there was a diverse array of methods for patient-reported outcomes, particularly for metrics such as return to work, in which we only had one study that discussed this measure. Improved standardization of survey instruments and patient reporting is critical for future studies and reviews. Additionally, while most studies were of moderate to higher quality based on MINORS scoring, there were a few studies of lower quality, which may reflect a lack of prospective design, stan-

dardized outcomes, or complete follow-up and thus contribute to bias. However, studies involving insurance payor status are often limited by these factors. Furthermore, we chose to specifically exclude procedures and conditions that overlap significantly with vascular surgery and podiatry, such as amputations, diabetic ulcers, and other vascular-related pathology, in order to focus specifically on the field of orthopaedic foot and ankle surgery. However, these conditions and procedures are known to disproportionately affect patients of lower socioeconomic status and those who are underinsured/uninsured [49]. A more focused review specifically on this topic is necessary for a comprehensive understanding of the impacts of insurance payor status. The major strength of our review is the diversity of insurance payor groups in conjunction with a wide array of foot and ankle procedures and outcomes analyzed. Additionally, our meta-analysis does offer a novel, quantitative understanding of the relationship between insurance payor status and patient outcomes in foot and ankle procedures.

5. Conclusions

Our systematic review and meta-analysis is the first of its kind to evaluate the relationship between insurance payor status and outcomes in foot and ankle surgery. Our study highlights that there are significant differences in treatment access, treatment course, and post-operative outcomes based on insurance payor status, with Workers Compensation and underinsured/uninsured patients most negatively affected. These results align with research across other orthopaedic surgical subspecialities that reveal a trend of care and patient outcomes discrepancies. Further research is necessary in order to better understand these differences, particularly in the context of various regional, procedure-, and/or injury-related factors. Additionally, future research should focus on understanding the causative factors behind these insurance payor status-based differences on procedure-specific outcomes to help better inform providers on actionable changes that can be made. In summary, our findings demonstrate that careful consideration of insurance payor status is needed, with the ultimate goal of reducing socioeconomic disparities and improving outcomes for foot and ankle patients.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/osteology6020007/s1, Table S1: PRISMA 2020 Checklist [51].

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

Appendix A

Database (including vendor/platform): MEDLINE (via PubMed)

Set #	Search Strategy	Results
#1 Insurance	"Insurance coverage"[Mesh] OR "Medicare"[Mesh] OR "Medicaid"[Mesh] OR "Insurance, Health"[Mesh] OR "Insurance"[Mesh] OR Medicaid[tiab] OR Medicare[tiab] OR insurance[tiab] OR insurances[tiab] OR insured[tiab] OR insurer[tiab] OR insurers[tiab] OR uninsured[tiab] OR underinsured[tiab] OR underinsurance[tiab] OR "workers comp"[tiab] OR "workers' comp"[tiab] OR "Workers' Compensation"[tiab] OR "Workers Compensation"[tiab]	299,883
#2 Ankle	(("Ankle Fractures"[Mesh] OR "Ankle Joint"[Mesh] OR ankle[tiab] OR ankles[tiab] OR foot[tiab] OR feet[tiab]) AND ("Surgical Procedures, Operative"[mesh] OR "arthroplasty"[mesh] OR "surgery"[sh] OR surgery[tiab] OR surgeries[tiab] OR surgical[tiab] OR procedure[tiab] OR procedures[tiab] OR procedural[tiab] OR operation[tiab] OR operations[tiab] OR arthroplasty[tiab] OR arthroplasties[tiab] OR reoperate[tiab] OR reoperation[tiab])) OR "Arthroplasty, Replacement, Ankle"[Mesh]	58,415
#3	#1 AND #2	360
Validation string	33546990 OR 27756868 OR 30628476 OR 31741131 OR 32769725	5/5

Database (including vendor/platform): Embase

Set #	Search Strategy	Results
#1 Insurance	'health insurance'/exp OR Medicaid:ti,ab OR Medicare:ti,ab OR insurance:ti,ab OR insurances:ti,ab OR insured:ti,ab OR insurer:ti,ab OR insurers:ti,ab OR uninsured:ti,ab OR underinsured:ti,ab OR underinsurance:ti,ab OR 'workers comp':ti,ab OR 'Workers Compensation':ti,ab	416,521
#2 Ankle	(('ankle fracture'/exp OR 'ankle'/exp OR ankle:ti,ab OR ankles:ti,ab OR foot:ti,ab OR feet:ti,ab) AND (surgery:ti,ab OR surgeries:ti,ab OR surgical:ti,ab OR procedure:ti,ab OR procedures:ti,ab OR procedural:ti,ab OR operation:ti,ab OR operations:ti,ab OR arthroplasty:ti,ab OR arthroplasties:ti,ab)) OR 'ankle arthroplasty'/exp	57,858
#3	#1 AND #2	420

Database (including vendor/platform): Scopus

Set #	Search Strategy	Results
#1 Insurance	TITLE-ABS-KEY(Medicaid OR Medicare OR insurance OR insurances OR insured OR insurer OR insurers OR uninsured OR underinsured OR underinsurance OR "workers comp" OR "workers' comp" OR "Workers' Compensation" OR "Workers Compensation")	41,9058
#2 Ankle	TITLE-ABS-KEY((ankle OR ankles OR foot OR feet) AND (surgery OR surgeries OR surgical OR procedure OR procedures OR procedural OR operation OR operations OR arthroplasty OR arthroplasties))	95,384
#3	#1 AND #2	567

Database (including vendor/platform): SPORTSDiscus

Set #	Search Strategy	Results
#1 Insurance	DE "HEALTH insurance" OR (TI "Medicaid" OR AB "Medicaid") OR (TI "Medicare" OR AB "Medicare") OR (TI "insurance" OR AB "insurance") OR (TI "insurances" OR AB "insurances") OR (TI "insured" OR AB "insured") OR (TI "insurer" OR AB "insurer") OR (TI "insurers" OR AB "insurers") OR (TI "uninsured" OR AB "uninsured") OR (TI underinsured OR AB underinsured) OR (TI underinsurance OR AB underinsurance) OR (TI "workers comp" OR AB "workers comp") OR (TI "workers' comp" OR AB "workers' comp") OR (TI "Workers' Compensation" OR AB "Workers' Compensation") OR (TI "Workers Compensation" OR AB "Workers Compensation")	11,617
#2 Ankle	((DE "ANKLE" OR DE "ANKLE fractures" OR (TI "ankle" OR AB "ankle") OR (TI "ankles" OR AB "ankles") OR (TI "foot" OR AB "foot") OR (TI "feet" OR AB "feet")) AND (DE "SURGERY" OR (TI "surgery" OR AB "surgery") OR (TI "surgeries" OR AB "surgeries") OR (TI "surgical" OR AB "surgical") OR (TI "procedure" OR AB "procedure") OR (TI "procedures" OR AB "procedures") OR (TI "procedural" OR AB "procedural") OR (TI "operation" OR AB "operation") OR (TI "operations" OR AB "operations") OR (TI "arthroplasty" OR AB "arthroplasty") OR (TI "arthroplasties" OR AB "arthroplasties")))	6325
#3	S1 AND S2	54

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