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Review

The health economics of ankle and foot sprains and fractures: A systematic review of English-language published papers. Part 2: The direct and indirect costs of injury

Iwona A. Bielska[a,*], Xiang Wang[a], Raymond Lee[b], Ana P. Johnson[a]

[a] Department of Public Health Sciences, Queen's University, Canada
[b] Department of Kinesiology and Health Studies, Queen's University, Canada

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ABSTRACT

Background: Ankle and foot sprains and fractures are prevalent injuries, which may result in substantial physical and economic consequences for the patient and place a financial burden on the health care system. Therefore, the objectives of this paper are to examine the direct and indirect costs of treating ankle and foot injuries (sprains, dislocations, fractures), as well as to provide an overview of the outcomes of full economic analyses of different treatment strategies.

Methods: A systematic review was carried out among seven databases to identify English language publications on the health economics of ankle and foot injury treatment published between 1980 and 2014. The direct and indirect costs were abstracted by two independent reviewers. All costs were adjusted for inflation and reported in 2016 US dollars (USD).

Results: Among 2047 identified studies, 32 were selected for analysis. The direct costs of ankle sprain management ranged from $292 to $2268 per patient (2016 USD), depending on the injury severity and treatment strategy. The direct costs of managing ankle fractures were higher ($1908–$19,555). Foot fracture treatment had similar direct costs ranging from $998 to $21,801. The economic evaluations were conducted from the societal or payer's perspectives.

Conclusion: The costs of treating ankle and foot sprains and fractures varied among the studies, mostly due to differences in injury type and study characteristics, which impacted the ability of directly comparing the financial burden of treatment. Nonetheless, the review showed that the costs experienced by the patient and the health care system increased with injury complexity.

1. Introduction

Ankle and foot sprains are one of the most prevalent soft-tissue injuries in the emergency department, representing up to 5% of all visits in studies conducted in the United States, the United Kingdom, and Denmark [1–3]. Depending on the severity and type of injury, sprains and fractures at the ankle or foot can have significant economic consequences for the affected individual resulting in both direct and indirect costs [1,4–7]. Direct health system costs include the costs covered by the payer (health care system or insurer) including remuneration for physician services, diagnostic imaging, and hospital use [8]. Out-of-pocket and indirect costs encompass money spent on services that are not covered by the payer, including the costs of travel, patient expenses, and productivity loss − both paid and unpaid labour [8]. In particular, absenteeism from school, work, or sports are major indirect sources of economic loss for patients with ankle and foot injuries [1,5,9,10].

However, the direct and indirect costs of treating these injuries, as well as the cost-effectiveness of various treatment strategies, have not been comprehensively summarized. A systematic review published in 2013 by Lin et al. [11] provided a synthesis of the economic literature on lateral ankle sprains only. Due to the small number of studies dealing with the treatment of these injuries (n = 4), the ability of the current literature to provide meaningful evidence regarding the costs of diagnostic treatments for ankle and foot injuries is limited [11].

In order to guide physicians and decision makers in the adoption of various treatments and the planning of sustainable health care resource utilization, such economic information is required. To address this, a systematic review (described in *Part I*) [12] was undertaken to overview the economic literature on ankle and foot injuries (sprains and

* Corresponding author at: Department of Public Health Sciences, Queen's University, Abramsky Hall, Kingston, ON K7L 3N6, Canada.
E-mail address: iwona.bielska@queensu.ca (I.A. Bielska).

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fractures). The objectives of this paper are to examine the direct and indirect costs of treating ankle and foot injuries (sprains, dislocations, fractures), as well as to provide an overview of the outcomes of full economic analyses of different treatment strategies for ankle and foot injuries.

2. Materials and methods

A systematic review, described in detail in *Part I* [12], was carried out to identify publications on the health economics of ankle and foot injury treatment. Briefly, papers published between 1980 and 2014 in the English language were searched for according to established guidelines [13] in seven databases (Ovid MEDLINE, Ovid Healthstar, Embase, Cumulative Index to Nursing and Allied Health Literature, Allied and Complementary Medicine, Cochrane Database of Systematic Reviews, American College of Physicians Journal Club). Data from the chosen studies were abstracted by two independent reviewers and included: the study characteristics, the economic methodology used, and the direct and indirect cost data reported. The two reviewers also assessed the quality of the economic studies using pre-determined criteria [14,15].

The costs reported in the articles were divided into direct health system costs, out-of-pocket and indirect costs, and overall costs per patient, if available. The sources for the costs were abstracted. All costs were converted to United States dollars (USD) using the average yearly currency exchange rates [16]. If a date was not provided for when the costs were valued, the year of article submission for publication was used. All values were adjusted for inflation using the Consumer Price Index data and are reported in 2016 USD [17].

3. Results

The search yielded 32 articles after applying the inclusion and exclusion criteria. Some papers reviewed more than one ankle or foot injury type. The costs of treatment were assessed in the following papers:

- Ankle sprains: 5 studies [1,4–7]
- Ankle dislocations: 1 study [18]
- Ankle fractures: 22 studies — 2 on undisplaced or stable ankle fractures, 20 on unstable ankle fractures, displaced unimalleolar, bimalleolar, or trimalleolar fractures of the ankle, or ankle fractures requiring operative management [7,19–29,31–39,30]
- Foot fractures: 8 studies — 3 on calcaneus fractures, 3 on talus fractures, 4 on metatarsal, tarsal, or phalanges fractures [7,23,28,32,35,40–43]
- Limb threatening ankle and/or foot fractures: 3 studies [42,43,44]

3.1. Direct and indirect costs of injury

The direct and indirect cost results, as well as the mean productivity loss, are summarized in Table 1 by injury type. Detailed study conclusions can be found in Table 2.

3.2. Full economic analyses of treatment strategies

Seven papers conducted full economic evaluations of ankle or foot treatment methods. There were two cost minimization analyses [22,25], two cost-effectiveness analyses [4,19], and three cost-utility analyses [1,39,40]. The results from the studies are presented by injury type in Table 3.

4. Discussion

The direct and indirect costs of treatment for ankle and foot injuries varied greatly between studies depending on the methodology used, the

Table 1
Direct and indirect cost summary by injury type (2016 USD).

	Ankle sprain [1,4–7]	Ankle dislocation [18]	Ankle fracture [7,19–29,31–39,30]		Foot and toe fractures [28,32,35,40–43,45]			Limb threatening fractures (ankle and/or foot) [42,43,44]
			Undisplaced ankle fracture [19,20]	Unstable, displaced, or operative ankle fracture [7,21–29,31–39,30]	Calcaneus fracture [23,40,41]	Talus fracture [23]	Metatarsal, tarsal, phalanges fractures [23,28,32,35]	
Number of papers (%)[a]	5/32 (16%)	1/32 (3%)	2/32 (6%)	20/32 (63%)	3/32 (9%)	1/32 (3%)	4/32 (13%)	3/32 (9%)
Direct costs (2016 USD)	$292–$2268 (n = 5)	$1437 (n = 1)	$79–$268 (n = 2)	$2860–$19,555 (n = 18)	$1437–$21,801 (n = 3)	$10,644 (n = 1)	$998–$16,142 (n = 4)	$86,170–$106,379 (n = 3)
Out-of-pocket and indirect costs (2016 USD)	$1482–$4343 (n = 2)	Not assessed	$105–$130 (n = 1)	$3681–$12,465 (n = 3)	$2109–$11,391 (n = 2)	Not assessed	Not assessed	Not assessed
Overall costs (direct and indirect) (2016 USD)	$1809–$5271 (n = 2)	Not applicable	$294–$340 (n = 1)	$8688–$20,414 (n = 5)	$6434–$46,371 (n = 1)	Not applicable	Not applicable	Not applicable
Mean duration of unemployment	7–29 days (n = 2)	Not assessed	Not provided (n = 1)	53–90 days (n = 4)	3.5–18 weeks (n = 2)	Not assessed	Not assessed	Not assessed

[a] Some reviewed papers assessed multiple injury types.

Table 2
Cost results and study conclusions.

Authors	Reported currency	Year of costs	Direct costs per patient (2016 USD)	Indirect costs per patient (2016 USD)	Overall costs per patient[a] (2016 USD)	Conclusions
Audenaert et al. [5]	Euro	2007	Average: 681 No adjuvant therapy: 327 Adjuvant therapy: 928	Average: 3171 No adjuvant therapy: 1482 Adjuvant therapy: 4343	Average: 3852 No adjuvant therapy: 1809 Adjuvant therapy: 5271	The average cost for patients prescribed immobilization, adjuvant support or physical therapy was $5271 compared to $1809 among those without adjuvant therapy
Avilucea et al. [44]	U.S. Dollar	Not stated	Controls (median, interquartile range: IQR): overall costs: 61,386 (41,174–99,863); professional costs (operative, radiology, evaluation, management): 8385 (6646–11,218); technical costs (diagnostic, hospital stay, materials, pharmacy): 37,143 (31,528–58,222); Cases (median, IQR): overall costs: 86,170 (54,000–141,909); professional costs: 16,684 (13,686–27,021); technical costs: 70,130 (40,407–113,723)	Not assessed	Not applicable	The cost of treating ankle fractures without complications was $61,386. The treatment of individuals with complications was higher at $86,170 with the most expensive complication being an infection followed by hardware pain
Bhandari et al. [36]	U.S. Dollar	2002	Total cost: 2860 (inpatient: 2403, outpatient: 444)	Not assessed	Not applicable	The average cost of treating the ankle fractures was $2860 per patient
Böstman [21]	Finnish Markka	1991	a. Uni/bimalleolar: 5299, trimalleolar: 6221 b. Uni/bimalleolar: 7087, trimalleolar: 7949	Uni/bimalleolar: 9141, trimalleolar: 12,465	a. Uni/bimalleolar: 14,440, trimalleolar: 15,362 b. Uni/bimalleolar: 19,552, trimalleolar: 20,414	In general, using absorbable pins and screws for internal fixation of ankle fractures was less costly than metallic implants for all fracture types
Böstman [22]	U.S. Dollar	1993	Not stated	Not stated	a. Unimalleolar: 9698, trimalleolar: 14,151 b. Unimalleolar: 11,199, trimalleolar: 15,252	The use of absorbable implants was less costly compared to metallic fixation (with hardware removal) of ankle fractures
Boutis et al. [19]	Canadian Dollar	Not stated	Brace: 79 ± 4 Cast: 136 ± 9	Brace: 130 ± 41 (lost productivity), 38 ± 8 Cast: 105 ± 15 (lost productivity), 35 ± 5	Brace: 294 ± 44 Cast: 340 ± 29	The brace was cost-effective compared to the cast
Brauer et al. [40]	Canadian Dollar	2002	a. Year 1: 1700 (IQR:1530), with complications: 3400 (IQR:5610); year 2–4: 841 (IQR:0), with complications: 1,530 (IQR:2465); b. year 1: 3825 (IQR:2465), with complications: 3315 (IQR:1445); year 2–4: 484 (IQR:0), with complications: 2550 (IQR:2635); Arthrodesis after treatment: year 1: 2516, 2975 (with complications); year 2–4: 2278, 3655 (with complications)	a. 31,449 (IQR:25,500), b. 19,550 (IQR:11,900), Arthrodesis after treatment: 73,099 (IQR:52,699)	Not applicable	After the inclusion of direct and indirect costs, operative treatment cost $16,150 less compared to nonoperative treatment. The incremental cost-utility ratio was $33,999 per quality-adjusted life year (QALY) when comparing operative to nonoperative treatment of displaced intra-articular calcaneal fractures
Cooke et al. [1]	Pound Sterling	2005	a. 302; b. 382; c. 373; d. 817	a. 1802; b. 2048; c. 2568; d. 1840	Total cost — mean (median): a. 2104 (275); b. 2430 (254), c. 2941 (278), d. 2657 (576)	The most cost-effective supports were the Aircast brace ($673/QALY) and the below knee cast ($758/QALY) compared to the other ankle supports — Bledsoe boot ($4734/QALY) and the referent treatment, tubular bandage
Coughlin [41]	U.S. Dollar	Not stated	Extra-articular fracture: 1437 (range: 380–3114); operative treatment: 21801 (range: 6874–47,769); nonoperative treatment: 10,697 (range: 808–41,826)	Extra-articular fracture: 2109 (range: 0–7513); operative treatment: 11,391 (range: 2124–26,530); nonoperative treatment: 5202 (range: 1256–13,284)	Total costs including impairment costs: extra-articular fracture: 6434; operative treatment: 46,371; nonoperative treatment: 21,283	The average total cost, including medical, compensation, and impairment costs, for nonoperative calcaneal fractures was $21,283 with 18 weeks off from work. For fractures requiring operative treatment, the total cost was $46,371 with an average of 35 weeks off from work
Cumps et al. [6]	Euro	2003	Ankle sprains: 292, ankle injuries: 230, foot injuries: 78, toe injuries: 93	Not assessed	Not applicable	The medical costs of treating ankle sprains was $292 compared to other ankle injuries at $230, foot injuries at $78, and toe injuries at $93

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Table 2 (*continued*)

Authors	Reported currency	Year of costs	Direct costs per patient (2016 USD)	Indirect costs per patient (2016 USD)	Overall costs per patient[a] (2016 USD)	Conclusions
DeBoer et al. [7]	Euro	2010	Osseous foot injury: 8882 ± 2143 (admitted), 1220 ± 184 (non-admitted); ligamentous foot injury: 3767 ± 290 (admitted), 999 ± 140 (non-admitted); osseous ankle injury: 10,771 ± 2363 (admitted), 1908 ± 225 (non-admitted); ligamentous ankle injury: 4056 ± 410 (admitted), 998 ± 120 (non-admitted)	Not assessed	Not applicable	Overall cost for osseous foot injuries was $1554 ± 268, for ligamentous foot injuries was $1018 ± 142, for osseous ankle injury was $5049 ± 982, and for ligamentous ankle injury was $1201 ± 134. Costs differed by sex and age. Costs were most affected by hospitalization, rehabilitation, and nursing care
Dischinger et al. [23]	U.S. Dollar	Not stated	Ankle fracture (median cost): 8436, medial malleolus (7252), bi/trimalleolar (10,227); foot fractures (median cost): calcaneus (6721), talus (10,644), metatarsal/tarsal (6815)	Not assessed	Not applicable	The average in-hospital cost of treating ankle fractures was $8436. The most expensive treatment costs were those for bi- or trimalleolar fractures and talus fractures among foot and ankle injuries
Eekman et al. [24]	Euro	Not stated	Total direct costs: 4071 (which includes medical costs of 3677, 95% Confidence Interval, CI: 1833–6172)	Total indirect costs: 7547 (95% CI: 3304–14,651)	Total costs: 11,618 (95% CI: 5689–20,152)	The total cost associated with ankle fractures was $11,618 per patient of which 65% were indirect costs
Ganesh et al. [31]	U.S. Dollar	Not stated	Overall: 13,415 ± 33, Not diabetic: 13,267 ± 33, diabetic: 15,853 ± 152, unimalleolar fracture: 10,995 ± 756, 13,254 ± 1232 (diabetic), bimalleolar/trimalleolar fracture: 11,329 ± 954, 13,576 ± 1224 (diabetic), dislocation/open fracture: 11,201 ± 907, 13,507 ± 1241 (diabetic)	Not assessed	Not applicable	The average cost of ankle fracture treatment was $13,415 among all patients with the costs being $15,853 among individuals with diabetes and $13,267 among individuals without diabetes
Grimm & Fallat [32]	U.S. Dollar	Not stated	No surgery: 1230 (range: 153–9813), surgery (n = 11): 13,961 (range: 7440–22,294), metatarsal fracture (n = 4): 16,142, ankle fracture (n = 3): 16,475	Not assessed	Not applicable	Average cost for treating foot and ankle injuries was $1230 if no surgery was required and $13,961 if surgery was involved
Hartholt et al. [28]	Euro	Not stated	Ankle fracture: 8118, foot/toe fracture: 2883	Not assessed	Not applicable	Fall-related ankle fracture treatment costs an average of $8118 while foot or toe fractures cost an average of $2883 among individuals, 65 years of age and older
Hartholt et al. [29]	Euro	2009	Average: 10,642 (men: 7974, women: 13,309)	Not assessed	Not applicable	Fall-related ankle fracture treatment costs an average of $10,642 among individuals, 65 years of age and older
Hewitt et al. [37]	U.S. Dollar	Not stated	a. 6963 ± 1726 b. 6179 ± 2102	Not assessed	Not applicable	The implant cost for the Sidewinder plate was higher compared to interfragmentary screw and one-third tubular neutralization plate, however, the operating room costs were significantly lower with shorter average time to healing (75 versus 97 days)
Høiness et al. [33]	Euro	2000	Not stated	Not stated	18,687 (range: 12,512–55,358)	Average cost (treatment and sickness benefits) was $18,687 per patient. There were no statistically significant differences in total cost between men and women, those ≪50 years old and ≥50 years old, or between fracture types. Those with syndesmosis-positioning screws and major complications had higher treatment costs
Jain et al. [20]	Pound Sterling	Not stated	After implementation of treatment guidelines: 268 (previously 643)	Not assessed	Not applicable	The cost of treating patients with stable ankle fractures was reduced to $268 from $643 after the adoption of a new management protocol
Juutilainen et al. [25]	Pound Sterling	1994	Self-reinforced polyglycolideacid (SR-PGA) screws: 5008, Self-reinforcedpoly-L-lactide acid (SR-PLLA) screws: 4735, metallic: 6934	SR-PGA: 3681, SR-PLLA: 4953, metallic: 4263	SR-PGA: 8688, SR-PLLA: 9688, metallic: 11,196	Absorbable implants were more economical than metallic fixation of ankle fractures
Kheir et al. [26]	Pound Sterling	Not stated	a. 5444, b. 7547, c. 13562	Not assessed	Not applicable	The average cost of treating patients with early open reduction and internal fixation (ORIF) was $5444, with plaster cast (back slab) was $7547, and with temporary external fixation was $13,562
Kilgore et al. [27]	U.S. Dollar	2007	Attributable cost to ankle fracture: 7098	Not assessed	Not applicable	The average cost attributable to treating ankle fractures among individuals 65 years of age and older was $7098 with the total health care costs during this time being $21,659. The total incremental health care cost (difference before and after fracture) was $16,209

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Table 2 (*continued*)

Authors	Reported currency	Year of costs	Direct costs per patient (2016 USD)	Indirect costs per patient (2016 USD)	Overall costs per patient[a] (2016 USD)	Conclusions
Kleweno et al. [34]	U.S. Dollar	Not stated	Ankle fracture: 10,761	Not assessed	Not applicable	The inpatient care cost for ankle fracture patients was $10,761 with the hospital's direct margin being $15,079 (95% CI: 13,659–16,500) for a total net revenue of $25,840
MacKenzie et al. [42]	U.S. Dollar	2002	Foot fracture (limb-threatening): 87,207	Not assessed	Not applicable	The health care costs for patients who underwent reconstruction following a severe foot fracture were $87,207 over two years of follow-up
Meerding et al. [35]	Euro	1999	Ankle fracture: 3328, foot/toe fracture: 998	Not assessed	Not applicable	The average cost of treating ankle fracture patients was $3328 while for foot or toe fracture patients it was $998. The most common mechanism of injury for ankle fractures was a fall at home
Murray et al. [30]	Pound Sterling	2008	Average: 9784 ± 4842, external fixation: 19,555 ± 7016, ORIF: 9237 ± 4065	Not assessed	Not applicable	The average cost of treating patients with open reduction and internal fixation was $9237 and with external fixation was $19,555
Roudsari et al. [38]	U.S. Dollar	2004	Average: 15,125 ± 19,969, 16,773 ± 11,602 (with E-code of fall)	Not assessed	Not applicable	The average hospitalization cost for ankle fractures was $15,125 for individuals without an E-code of a fall compared to $16,773 for individuals with an E-code of a fall
Sanders et al. [43]	U.S. Dollar	Not stated	106,379 (range: 57,378–246,120)	Not assessed	Not applicable	The average in-hospital cost of treatment for open fractures (grade IIIB) of the ankle or talus was $106,379
Slobogean et al. [39]	Canadian Dollar	2008	One year horizon: a. 6737, b. 1990; lifetime horizon: a. 6883, b. 2741	Not assessed	Not applicable	For the one year horizon, nonoperative treatment was favoured with ORIF having an incremental cost-effectiveness ratio (ICER) of $215,743/QALY gained. For the lifetime horizon, ORIF was favoured over nonoperative treatment (ICER of $17,256/QALY) if it reduced ankle arthrosis incidence by more than 3%
Soboroff et al. [4]	U.S. Dollar	Not stated	a. 767, b. 839, c. 830, d. 1355, e. 2268	Not stated	Not applicable	The cost-effectiveness analysis showed that the stress film strategy and the wrap strategy were more cost-effective than the other management strategies
Yang et al. [18]	New Taiwan Dollar	Not stated	Average: 1437 ± 1574	Not assessed	Not applicable	The average cost of treating ankle dislocations was $1437, which increased when the injury was a dislocation–fracture

[a] Total costs include direct and indirect costs where provided by the authors.

Table 3
Summary of full economic analyses of treatment strategies for ankle and foot injuries.

Injury	Type of economic analysis	Study results
Severe ankle sprain (grade II or III) [1]	Cost-utility analysis	Aircast ankle brace and below the knee cast were more cost-effective than tubular bandage
Severe ankle sprain (grade not provided) [4]	Cost-effectiveness analysis	Stress film strategy and wrap strategy were more cost-effective than wrapping ankle immediately
Undisplaced distal fibular types I and II Salter-Harris fractures and avulsion fractures of distal fibula or fibular epiphysis [19]	Cost-effectiveness analysis	Aircast Air-stirrup ankle brace was more cost-effective than below-knee fiberglass walking cast
Unstable, isolated, lateral malleolus fracture (Weber Type B) [39]	Cost-utility analysis	For a one year horizon, the nonoperative treatment was favored; for the lifetime horizon, open reduction and internal fixation was favored
Displaced unimalleolar and trimalleolar ankle fractures [22]	Cost minimization analysis	Use of absorbable implants was less costly when compared to metallic fixation with hardware removal
Unimalleolar, bimalleolar, and trimalleolar ankle fractures requiring operative treatment [25]	Cost minimization analysis	Absorbable implants were more economical than metallic fixation
Displaced intra-articular calcaneal fracture [40]	Cost-utility analysis	Operative treatment was favored when compared to nonoperative treatment

severity of the injury assessed, and whether productivity loss was included. The overall costs (combined direct and indirect costs) of ankle sprain treatment ranged from $1809 to $5271 (2016 USD) in five papers. Direct health system costs alone were found to be between $292 and $2268 with higher costs among hospitalized patients ($4056). Ankle fracture costs were assessed in twenty-four studies. The direct health system costs for unstable or displaced fractures ranged from $2860 to $19,555, while the overall costs varied from $8688 to $20,414 (2016 USD) per patient. For calcaneus fractures, direct health system costs were between $1437 and $21,801 as found in three studies. Talus fracture treatment, assessed in one study, amounted to $10,644. Four papers evaluated metatarsal, tarsal, and phalanges fractures with direct health system costs varying from $998 to $16,142. Lastly, direct health system costs were pointedly higher for severe, limb-threatening fractures as assessed in three studies ($86,170 to $106,379).

The major strength of this systematic review is that the methodology used to conduct the literature search, evaluate the articles, and abstract the data, as well as the use of two reviewers throughout, ensure that the methodology is transparent and follows accepted guidelines. In addition, the cost results of the studies have been adjusted for inflation to ensure that they are current. In terms of the available literature, although Lin et al. conducted a systematic review that included four studies on the treatment costs of ankle sprains, they did not critically compare the costs of treatment between the studies [11]. No other reviews of ankle or foot treatment costs could be identified to compare the results of this systematic review.

One limitation of the review is the presentation of costs from a wide range of dates, including six studies published before 2000. To account for this, the costs for all studies have been adjusted for inflation and converted to 2016 United States dollars. However, the treatment methods may have changed and the current guidelines for the management of ankle and foot sprains and fractures may differ from the older studies. Furthermore, many of the included studies evaluated different types of fractures which may limit the comparability between the results. In addition, trials with negative findings such as those with treatment strategies that were not cost-effective may have been less likely to be published, and as such, would not have been included in this review.

The findings of this systematic review have multiple implications. Firstly, the paper overviews the economic analyses of studies investigating numerous treatment options for ankle and foot injury management. It provides a summary of the methods deemed to be most effective in terms of immobilization and surgery. The systematic review indicates that the injuries, especially complicated fractures, are costly to treat. This information, in addition to injury prevalence, may provide physicians and policy makers with guidance on the allocation of resources. Furthermore, the implications for patients with foot and ankle injuries, in terms of out-of-pocket and indirect costs, should be considered when informing them about the recovery process and its costs, particularly in terms of productivity loss. Lastly, this systematic review highlights possible directions for future studies investigating ankle and foot injury management. These studies, especially randomized controlled trials, should incorporate economic analyses in the form of cost-effectiveness or cost-utility analyses in their methodology.

5. Conclusions

This systematic review has demonstrated that the definition of ankle and foot injuries varies between studies and as such, it is difficult to group them into homogeneous categories to compare the financial burdens of treatment. As such, the direct health system, out-of-pocket, and indirect costs differ among the studies. Nonetheless, the review shows that the greater the injury severity, the more costs can be expected to the patient and to the health care system.

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