Dog walking-related injuries of the hand and wrist: a systematic review

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ABSTRACT

Background Dog walking creates the risk of falls which can lead to musculoskeletal injuries.

Objectives This review aims to evaluate the epidemiology of dog walking-related hand and wrist injuries, discuss their estimated economic impact, and identify gaps in research and legislation.

Methods Embase, Web of Science, PubMed, CINAHL, and Scopus databases were searched. Outcomes of interest were the incidence of dog-related hand and wrist injuries. The quality of studies was analysed using the Newcastle-Ottawa Scale (NOS).

Results Five studies consisting of 491 400 injuries among 491 373 patients were included. Among these, 364 904 (74.3%) were female, and at least 152 247 (31.0%) were older than 65 years of age. A total of 110 722 specific fractures or soft tissue injuries to the hand and wrist were reported. Finger fractures were the most common injury among hand and wrist injuries (n=34 051; 30.8%). Being pulled by a leash was the most common cause of a direct dog-related injury (n=314 189; 68.5%).

Conclusions This review highlights a significant number of dog walking-related hand and wrist injuries, particularly in the elderly and female population. While finger fractures were the most frequently reported injury, the cost analysis in this review focused on distal radius fractures due to their substantial economic impact. We estimated the potential annual cost of dog walking-related wrist fractures in the UK to exceed £23 million. Preventative measures, including safer leash practices and public safety guidance, should be implemented to reduce injury risk.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ A large number of dog walking-related injuries of the hand and wrist present to the emergency department each year.

WHAT THIS STUDY ADDS

⇒ Dog walking-related hand and wrist injuries are more common in elderly women, with finger fractures being the most frequent injury, and being pulled by a leashed dog being the most common mechanism.

⇒ We estimate the potential annual cost of dog walking-related wrist fractures in the UK to exceed £23 million.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Future primary research studies should consider factors such as dog breeds, leash type and walking environments, as well as perform cost analyses to quantify accurately the economic burden of dog walking-related hand and wrist injuries.

⇒ Policies should teach dog owners optimal dog walking practices to minimise injuries and enforce adequate dog training to reduce the risk of dogs injuring the person walking them.

INTRODUCTION

Hand and wrist injuries constitute around 10–30% of emergency department presentations.[1] Distal radius fractures are the most common adult fracture, accounting for 17.5% of all skeletal fractures.[2 3] In the UK, Willmott *et al* estimated the incidence of dog walking-related injuries of the hand and wrist to be up to 42/100 000 population/year.[4] In the USA, between 2001 and 2020, dog walking-related injuries were responsible for 21 000 adult emergency department presentations annually.[5]

Dog-related injuries that present to the emergency department are often associated with walking leashed dogs.[5] The increase in injury incidence associated with dog-walking injuries can be attributed to a rise in dog ownership and dog walking to improve fitness.[5] In the UK, there are around 8.5 million dogs, one dog for every seven to eight people.[6] In the USA, there are 89.7 million dogs owned as pets,[7] with 53% of households owning at least one dog.[5] Dog owners who walk their dogs reported significantly more total walking, total physical activity and higher total functional ability than dog owners who do not walk their dogs and non-dog owners.[8] Dog walking is also associated with benefits such as motivating owners to walk regularly, enabling weight loss and improving cardiovascular health.[5] Dog ownership is also associated with a slower deterioration in cognitive function with age, and dog owners who walk their dogs experience a slower deterioration than those who do not.[9]

Despite the physical and cognitive benefits, dog walking also creates the risk of injuries through mechanisms such as being pulled by the leashed dog or tripping over the dog or the leash, leading to musculoskeletal trauma.[4] A study of 7456 cases estimated that 86 629 fall injuries each year are associated with cats and dogs, with dog-related injuries being 7.5 times more than cat-related injuries.[10] Falls occurred in all ages, but rates of injuries such as fractures, contusions or abrasions, especially to the extremities, were highest among those over 75 years old;[10] 31.3% of dog-related falls were caused by falling or tripping over the dog, while an additional 21.2% were due to being pushed or pulled.[10]

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The majority of patients over 50 years old with a distal radius fracture suffer from pain and functional limitation >6 months post-fracture, have a 10–20% increase in healthcare encounters in the first 12 months post-fracture which incurs increased healthcare costs, and generally experience a reduced quality of life.[11] Although there have been studies that evaluate dog-related trauma or dog-related musculoskeletal injuries, the literature reporting on hand and wrist injuries due to dog walking-related incidents specifically, however, is scarce.[4]

This systematic review aims to: (1) evaluate the current literature related to hand and wrist injuries associated with dog walking; (2) evaluate the demographics and impact of dog walking-related hand and wrist injuries; (3) estimate the economic impact of dog walking-related hand and wrist injuries; and (4) identify gaps in the literature regarding research and legislation.

METHODS

The protocols for this systematic review adhere to the guidelines prescribed by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).[12]

Search strategy

We conducted a comprehensive systematic review of the literature. A search was performed in the following databases: Scopus, Web of Science, Embase, and PubMed from their respective inceptions to 2 December 2024. We used the following keywords: (dog walking OR dog-walking OR dog leash OR leashed dog) AND (wrist OR radius OR ulna OR hand OR carpal OR finger OR digit OR thumb). A hand-search of bibliographies from selected articles was also performed. Search results were imported into the Covidence online software tool and duplicates were automatically removed.

Study selection

Two reviewers independently reviewed the titles and abstracts, followed by full-text versions of the search results for inclusion. Disagreements during the article inclusion process were resolved by a discussion between reviewers. Articles were included (a) if they were published in a peer-reviewed journal and (b) if they described upper limb injuries sustained during recreational dog walking. We excluded editorials, non-English studies, studies that were not original research, and studies reporting dog-related injuries associated with professions such as veterinarians and military or competitive dog-handlers.

Definition of outcome

The main outcome of this review was the incidence of hand and wrist injuries caused by a dog walking-related fall or tripping on a leashed dog.

Study selection and data abstraction

Studies identified as relevant after full-text review underwent data abstraction. Relevant data included study design, sample sizes, gender and age distribution among the population, total number of dog walking injuries, number of dog walking-related hand and wrist injuries, mechanism of injury, and a rating of each study's methodological quality.

Assessment of the quality of studies

The Newcastle-Ottawa Scale (NOS) was used to assess the methodological quality and risk of bias in eligible studies.[13] This system assesses the quality of studies based on selection, comparability, and outcome/exposure criteria. NOS was originally developed to assess cohort and case-control studies but has been adapted to assess the quality of cross-sectional studies as well. The adapted version for cross-sectional studies was used in other

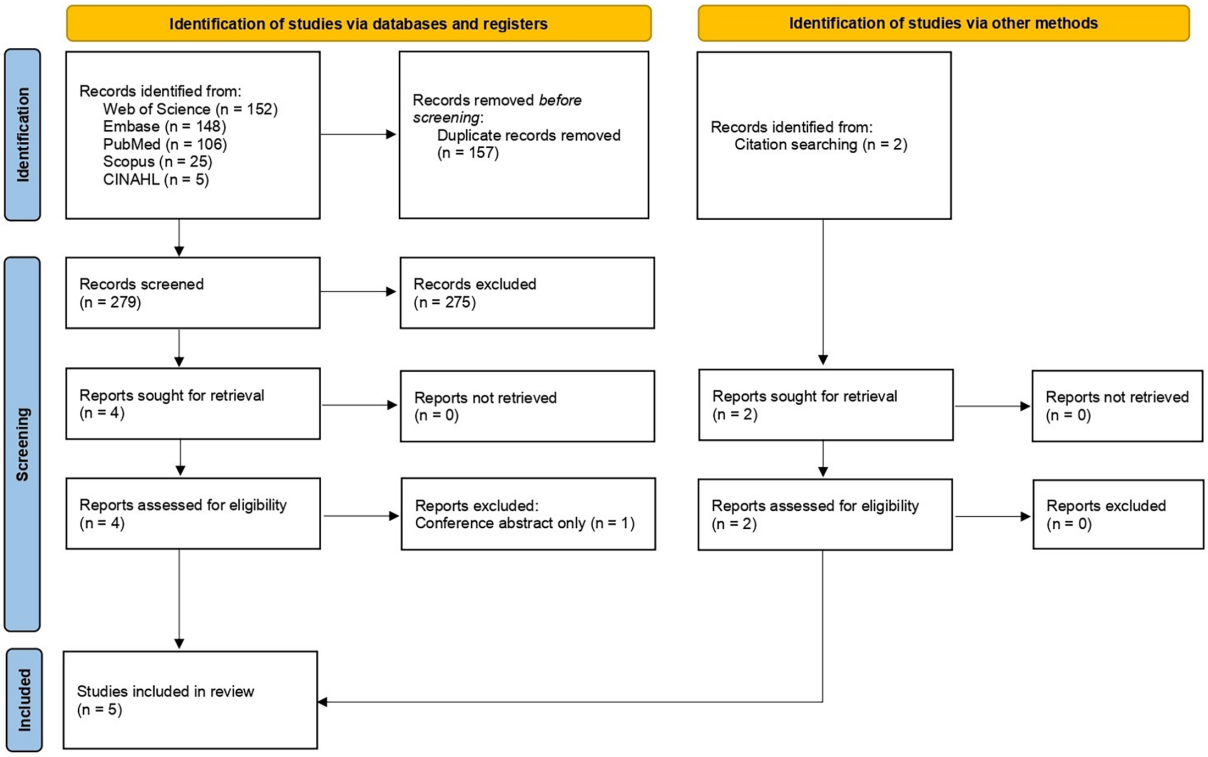

Figure 1 PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow chart.

Table 1 Characteristics of studies selected for qualitative synthesis

Author (year)	Origin	Study design	Method of data collection	Period over which data were collected	Age, mean±SD (years)	Total injuries, N	Most common hand and wrist injury, N (%)
Maxson *et al* (2024)[18]	USA	Retrospective, cross-sectional	Database review	2001–2020	11.1±0.18	35 610	Forearm fracture, 10 291 (28.9)
Plusch *et al* (2024)[19]	USA	Retrospective, cohort	Database review	1 Jan 2016–5 Oct 2021	51.7 (10 – 88)*	470 (443 patients)	Proximal phalanx fracture, 75 (16)
Maxson *et al* (2023)[5]	USA	Retrospective, cross-sectional	Database review	2001–2020	53.0±0.5	422 659	Finger fracture, 29 163 (6.9)
Pirruccio *et al* (2019)[20]	USA	Retrospective, cross-sectional	Database review	2004–2017	>65†	32 624	Wrist fracture, 4469 (13.7)
Willmott *et al* (2012)[4]	UK	Prospective cohort	Patient interviews	Jan–Feb 2010	56.1±14.8	37	Distal radius fracture, 6 (16.2)

*Mean (range).
†Mean±SD not provided.

systematic reviews[14–16] and was shown not to differ from other tools in assessing the methodological quality of cross-sectional studies (eg, Appraisal Tool for Cross-Sectional Studies).[17] The original NOS for cohort studies ranges from 0 to 9 and the adapted NOS for cross-sectional studies ranges from 0 to 10. Studies with higher NOS scores indicate a lower risk of bias.

RESULTS

The literature search from all databases provided 105 potentially relevant articles from Embase (n=60), Web of Science (n=21), PubMed (n=19), CINAHL (n=3), and Scopus (n=2). After excluding 25 duplicates, 80 records were further analysed. After reviewing titles and abstracts, 72 publications were removed. Citation searching yielded two studies. This identified a total of five relevant studies for inclusion in this systematic review. The details of this selection process are illustrated in figure 1.

The characteristics of the studies selected for qualitative synthesis can be found in table 1. The five included studies included a total of 491 400 injuries.[4 5 18–20] Four studies were retrospective and relied on database reviews,[5 18–20] and one was prospective and relied on patient interviews.[4] Three studies were cross-sectional,[5 18 20] and two were cohort studies.[4 19] Four studies reported on patients presenting to the emergency department,[4 5 18 20] and one reported on patients reporting in an outpatient setting.[19] Regarding the inclusion criteria of each study, one only included patients between 5 and 18 years old,[18] one only included patients over 18 years old,[5] one only included patients over 65 years old,[20] and two did not specify age restrictions.[4 19] Among 491 373 patients, 364 904 (74.3%) were female, 65 623 (13.4%) were younger than 18 years, and at least 152 247 (31.0%) were older than 65 years. Willmott did not specify how many patients in their study were older than 65 years.[4]

Among the 491 400 injuries reported, a total of 110 722 (22.5%) specific fractures or soft tissue injuries to the hand and wrist were reported across the five studies (table 2). Finger fractures were the most common injury (n=34 051; 30.8%), followed by wrist fractures (n=27 904; 25.2%), finger soft tissue injuries (n=26 959; 24.3%), and wrist soft tissue injuries (n=18 920; 17.1%).

The role of the dog in the injury was reported in four of the five included studies, totalling 458 749 patients.[4 5 18 19] The dog could either be a direct cause of the injury through physical contact or by pulling on a leash, or an indirect cause where, although there was no physical contact, the injury would not have happened without the dog being present.[4] Being pulled by a leash was the most common cause of a direct dog-related injury (n=314 189; 68.5%). The frequency of injuries directly caused by dogs reported across 458 735 injuries is summarised in table 3. Wilmott *et al* further reported 14 injuries where the dog was an indirect cause, 11 of which occurred while walking the dog but were not caused by the dog pulling the patient on the leash.[4]

Quality assessment

NOS scores for three cross-sectional studies ranged from 7 to 9 out of a total possible score of 10 (table 4). All three studies utilised data from the National Electronic Injury Surveillance System (NEISS), a statistically validated probability sample from US hospital emergency departments, ensuring the representativeness of the sample, there were no non-respondents given the complete dataset, and reliable ascertainment of the exposure to dog-walking injuries.[5 18 20] Sample sizes were large.[5 18 20] Two studies controlled for potential confounders such as age and gender.[5 18] Outcomes were well-defined and based on validated NEISS diagnostic codes (product code 1715: injuries associated with pet supplies).[5 18 20] Statistical tests were clearly described and data were presented appropriately.[5 18 20]

Table 2 Frequency of injuries reported across 110 722 hand and wrist injuries

Injury	N (%)
Finger fractures	34 051 (30.8)
Wrist fractures	27 904 (25.2)
Finger soft tissue injuries	26 959 (24.3)
Wrist soft tissue injuries	18 920 (17.1)
Hand soft tissue injuries	1531 (1.4)
Hand fracture	1357 (1.2)

Table 3 Frequency of injuries directly caused by dogs reported across 458 735 injuries

Mechanism of injury	N (%)
Pulled by a leash, no fall	207 441 (45.2)
Pulled by a leash, fall	106 748 (23.3)
Tripped by a leash/dog, fall	92 896 (20.3)
Tangled in a leash, fall	51 255 (11.2)
Tangled in a leash, no fall	334 (0.07)
Other causes	61 (0.01)

Table 4 Newcastle-Ottawa Scale scores for cross-sectional studies

Study	Representativeness of the sample	Sample size	Non-respondents	Ascertainment of exposure	Comparability	Assessment of outcome	Statistical test	Total score (10/10)
Maxson *et al* (2024)[18]	1	1	1	1	2	1	2	9
Maxson *et al* (2023)[5]	1	1	1	1	2	1	2	9
Pirruccio *et al* (2019)[20]	1	1	1	1	0	1	2	7

Both cohort studies had an NOS score of 5 out of a total possible score of 9 (table 5). Both studies were representative of the exposed cohort, patients presenting with dog walking-related injuries, and there were no non-exposed cohorts in both studies.[4 19] The exposure to dog walking-related injuries was clearly ascertained.[4 19] Regarding demonstrating that outcomes were not present at the start of the study, studies only included patients after the injury had occurred, making the baseline injury status implicit.[4 19] Neither study mentioned statistical adjustments for confounding factors such as age or gender.[4 19] Outcomes were clearly defined and reported in both studies with adequately sized and complete cohorts and long enough follow-up times.[4 19]

DISCUSSION

It is estimated that the number of dogs registered as pets in the UK is 11 million.[21] Assuming an estimated adult population of 45 million and our understanding of the all-cause incidence of distal radius fractures provided by Viberg *et al*,[22] we may establish an approximate calculation for the relative risk of dog walking and distal radius fractures when using the general population as the control group. Regarding whether the act of dog walking poses a relative risk of injury versus all causes of injury, Viberg *et al* report that the relative risk of dog walking versus all causes is 0.0921 (95% CI 0.0884 to 0.0960).[22] Thus, dog-walking does not present a greater risk of sustaining a distal radius fracture when compared with all causes in an adult population. However, this calculation assumes that each dog in the UK is only walked by their respective owner and no other members of the household.

Maxson *et al* and Willmott *et al* demonstrated that women and older adults were disproportionately impacted by dog walking-related injuries.[4 5] In 60% of US households, women were the primary caretakers responsible for dog walking, and women were 50% more likely to sustain a dog walking-related fracture than men because women >50 years old had a higher prevalence of osteoporosis, attributed to perimenopausal reductions in bone mass.[5] Dog walkers >65 years old mostly sustained traumatic brain injuries and hip fractures and were at greater risk than adults aged 18 to 64 years because of a higher risk of falls, attributed to balance and gait disorders, weakness, and visual impairment.[5] Furthermore, the higher prevalence of osteoporosis in the elderly population is a known cause for the higher risk of fall-related fractures.[23] A dog placing substantial or sudden axial traction on a person's upper extremity via a leash potentially leading to a fall is hypothesised to explain the higher incidence of finger fractures, traumatic brain injuries and shoulder injuries common in dog walking-related injuries compared with lower extremity injuries sustained from regular, low-to-moderate intensity walking.[5]

The cost of treating hand and wrist injuries constitutes several factors, including and beyond the initial operation. In the Netherlands, where the population is 17 million, de Putter *et al* estimated the annual medical and societal cost of hand injuries to be US$740 million.[24] Adjusting this estimate for a population of 67 million, Lane *et al* estimated the annual cost of hand and wrist injuries in the UK to be US$2920 million.[25] Using distal radius fractures as an example, the UK DRAFFT2 trial reported that the average National Health Service (NHS) resource and personal social services cost of fixing a distal radius fracture in an adult with a volar locking plate is £4145 per patient, compared with cast immobilisation costing £1835 per patient, using 2012 unit costs.[26–28] Adjusting for inflation, this equates to £5673 and £2511 for locking plate fixation and cast immobilisation, respectively, in 2024 (Bank of England Inflation Calculator, https://www.bankofengland.co.uk/monetary-policy/inflation/inflation-calculator). When applying this value to the incidence rate of 21 dog walking-related distal radius fractures/100 000 population/year calculated by Wilmott *et al*, the potential annual cost of managing dog walking-related distal radius fractures in the NHS in England could exceed £23 million annually when assuming an estimated adult population of 45 million people.[4]

The economic cost of distal radius fractures, however, cannot be simply derived from the monetary value of managing such injuries. In the Netherlands, de Putter *et al* reported the annual productivity cost of hand and wrist injuries to be US$411 million, 56% of the total US$740 million per year in 2007, and showed that the working population aged 20–64 years were responsible for 75% of all costs due to hand and wrist injuries.[24] Distal radius fractures are known to have a bimodal age distribution, with a noticeable spike in incidence in perimenopausal women who are likely still in employment.[22] Consequently, the wider economic burden of these patients being unable to work, and with potentially increased care demands due to their fracture, must also be considered, something that is often difficult to quantify.

Although this review does not show dog-walking to be an outstanding risk factor for causing hand and wrist injuries within the adult population compared with all other causes, it does highlight a significant number of such injuries to be attributable to dog ownership, particularly in the elderly and female

Table 5 Newcastle-Ottawa Scale scores for cohort studies

Study	Representativeness of exposed cohort	Selection of non-exposed cohort	Ascertainment of exposure	Demonstration that outcome not present at the start of the study	Comparability	Assessment of outcome	Adequacy of follow-up time	Adequacy of follow-up cohort	Total score (9/9)
Plusch *et al* (2024)[19]	1	0	1	0	0	1	1	1	5
Willmott *et al* (2012)[4]	1	0	1	0	0	1	1	1	5

population. Understanding the practices that may limit dog walking-related distal radius fractures could be used to generate specific public advisory guidance for current and prospective pet dog owners. The mechanism of injury deemed most likely to cause upper extremity fractures in dog walkers is due to a fall secondary to the generation of sudden or sustained axial traction to the upper extremity by the dog.[5]

Combatting such events may occur through adaptation of both owner and dog behaviours through teaching or training. Maxson *et al* and Pirruccio *et al* advocate discussing the risks of leash-dependent dog walking with prospective pet dog owners to raise awareness of potential injury.[5 20] Teaching safer leash-holding practices, such as holding the leash in the palm as opposed to finger or wrist wrapping, or leash choice, such as avoiding retractable devices that can lead to sudden increases in tensile force at the end of their working range, may be recommended.[5] Advice regarding dog breed choice and more general suggestions for avoiding falls, such as avoiding slippery or uneven ground, especially during the winter months, should also be included in pre-pet ownership discussions, especially with those predisposed to such injuries.[4 20] In terms of pet dog training, the American Veterinary Medical Association (AVMA) recommends obedience practices to discourage hazardous behaviours, such as lunging, that can lead to a mechanism of sudden axial load to the upper limb of the dog walker resulting in falls.[5 10] This advice remains relevant regardless of whether one is walking with a dog or not. Also, it would be ideal for those >65 years old to undergo a clinical assessment of their risk of falls and fractures. However, this may not be economically feasible. Although ideal, having all dogs undergo obedience training may also not be economically feasible. As such, the onus is on dog owners to take extra precautions while walking dogs to minimise the risk of falls.

The main strength of this systematic review is its methodology. Five databases were screened and included studies were hand-searched to further identify relevant studies. Furthermore, screening, data extraction and quality assessment were completed by two independent reviewers. This review is not without limitations. Most studies were conducted in the USA, with one study in the UK. Furthermore, three studies utilised the same data source (NEISS). The inherent nature of the search strategy may have resulted in relevant non-English studies and studies not indexed in the five databases being excluded. Furthermore, factors like trends in dog ownership, dog breeds, leash type and walking environments are not analysed in depth by included studies. Future research should consider these risk factors to provide deeper insights into the risk of injury. Although our review estimates the economic burden of injuries, our estimates rely on secondary data and assumptions such as dog ownership patterns and inflation adjustments. Validation through future primary research would be valuable in further analysing the economic burden of dog walking-related hand and wrist injuries.

CONCLUSION

Hand and wrist injuries associated with dog walking are an understudied topic. Despite a rise in dog ownership in recent years, studies that discuss dog walking-related falls and hand and wrist injuries are few. Dog walking-related hand and wrist injuries occur more in women and the elderly. As such, interventions screening potential dog owners for fall risk and educating them on how to hold leashes properly could help manage the risk of dog walking-related falls and trauma. Dog obedience training to discipline dogs could also reduce dog misbehaviour during walks.

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