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Australian children's foot, ankle, and leg problems in primary care: a secondary analysis of the Bettering the Evaluation and Care of Health (BEACH) data

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Australian children's foot, ankle, and leg problems in primary care: a secondary analysis of the Bettering the Evaluation and Care of Health (BEACH) data

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Abstract

Objectives:

To explore children's foot, ankle and leg consultation patterns and management practices in Australian primary care.

Design:

Cross-sectional, retrospective study

Setting:

Australia Bettering the Evaluation and Care of Health program dataset.

Participants:

Data were extracted for GPs and patients ≤ 18 years from April 2000 to March 2016 inclusive.

Main outcome measures:

Demographic characteristics: sex, GP age groups (i.e. <45, 45-54, 55+ years), GP country of training, patient age grouping (0-4, 5-9, 10-14, 15-18 years), postcode, concession card status, Indigenous status, up to three patient encounter reasons, up to four encounter problems/diagnoses, and the clinical management actioned by the GP.

Results:

Children's foot, ankle or leg problems were managed at a rate of 2.05 (95% CI 1.99 to 2.11) per 100 encounters during 229,137 GP encounters with children. There was a significant increase in the rate of foot, ankle and leg problems managed per 100 children in the population, from 6.1 (95% CI: 5.3-6.8) in 2005-06 to 9.0 (95% CI: 7.9-10.1) in 2015-16. Management of children's foot, ankle and leg problems were independently associated with male patients (30% more than female), older children (15-18 years were 7.1 times more than <1 years), male GPs (13% more) and younger GPs (<45 years of age 13% more than 55+). The top four most frequently managed problems were injuries (755.9 per 100,000 encounters), infections (458.2), dermatological conditions (299.4) and unspecified pain (176.3). The most frequently managed problems differed according to age grouping.

Conclusions:

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3 Children commonly present to GPs for foot, ankle, and leg problems. Presentation frequencies
4 varied according to age. Unexpectedly, conditions presenting commonly in adults, but rarely in
5 children, were also frequently recorded. This data highlights the importance of initiatives
6 supporting contemporary primary care knowledge of diagnoses and management of paediatric
7 lower limb problems to minimise childhood burden of disease.
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15 **Article Summary**

16 *Strengths and limitations of this study:*

- 17 - This study examines the full spectrum of childhood foot, ankle, or leg presentations in primary
18 care and how these are managed
- 19 - This study also provides information about how foot, ankle and leg GP presentations and
20 management patterns differ as children get older
- 21 - This dataset provides a robust baseline on which future guidelines and implementation
22 studies can measure the outcomes of practice change over time.
- 23 - This study may be limited by how GPs coded the presentation and management data
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36 *Word count: 3742*

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39 Key words: child, adolescent, musculoskeletal pain, foot; foot injuries; foot diseases; primary health
40 care; general practice;
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Background

Childhood foot, ankle and leg concerns are thought to be common, but their prevalence and incidence vary widely according to age and are inconsistently reported. For example, the prevalence estimates for flexible flat foot vary from 2 to 44% of children^{1 2}, while the incidence of calcaneal apophysitis ranges from 0.37 to 0.60 per 100 person-years³. These wide variations seem to depend on age, developmental stage, sporting participation or differences in epidemiological study setting. Similarly, little is known about the frequencies of conditions relating to the foot, ankle or leg in children that cause pain or functional impact or trouble their parents enough to result in families seeking management in primary care.

Key developmental stages in childhood present opportunities for optimal foot and leg condition management, particularly for conditions relating to musculoskeletal complaints, neurological conditions, or inflammatory disease. Early interventions for these higher burden conditions are important to initiate early to reduce long term disability and prevent chronic pain development. Conversely, delayed diagnosis, delayed access to care or provision of non-evidence informed care can be detrimental to long term outcomes⁴, family burden⁵ and permanent disability⁶. Primary care providers are commonly the first contact for non-emergency health care. Therefore, understanding contemporary practice in primary care allows for improved focus for finite health care resources, training and guidelines, to improve health outcomes⁷, reduce health care waste⁸, and design effective public policies or prevention strategies to minimise long term impacts⁹.

In Australia, primary care services are frequently provided by general practitioners (GPs) on a 'fee for service' model with fees primarily covered through Medicare, the Australian Government funded medical insurance scheme¹⁰. Medicare also provides subsidies for other healthcare services including diagnostic imaging and pathology tests. The Pharmaceutical Benefits Scheme provides subsidies for prescribed medicines¹¹. GPs can also provide referrals to medical specialists for subsidised medical specialist care, such as to orthopaedic surgeons, and in limited circumstances (e.g. for chronic medical conditions) to subsidised allied health professional care, such as to podiatrists¹¹. Therefore, GP presentation and management data provides rich information about health problems in Australia.

Despite this, little is known about how GPs manage foot and leg problems in children in Australia, and even less about their management practices. It is important to know the frequencies of children's foot, ankle, and leg problems and how commonly they present to GPs, as highly prevalent specific

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3 foot, ankle, or leg conditions in childhood may impact on health care costs now or in the future.
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5 Conservative estimates indicate that management of foot, ankle or leg conditions by GPs in Australia
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7 across all ages are estimated to be approximately A\$255m per annum¹². Also unknown, is how many
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9 foot, ankle or leg conditions appear in childhood requiring medical care from GPs. To our knowledge,
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11 only four studies have examined presentations for primary care management in children that
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13 included lower limb presentations. These studies were in Spain, Australia, and the United Kingdom
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15 ¹³⁻¹⁶, yet only one of these studies provided data on all children between the ages of 0-18 years¹⁴.
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17 Whilst studies have investigated the most frequent presenting conditions by children to GPs, they
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19 rarely delineate by body region such as foot, ankle and leg problems. One Australian study reported
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21 data on all GP encounters by children aged between 0-17 years for any health condition and found
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23 frequent presentations for skin concerns and musculoskeletal concerns¹⁴. Both skin and
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25 musculoskeletal concerns are two problems likely to include foot, ankle, or leg problems. However,
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27 there were no additional data on skin complaints relating to body region, and where musculoskeletal
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29 data according to body regions were explored in detail, lower limb concerns were managed at a rate
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31 between 0.62 to 5.33 per 100 children encounters. These insights warrant further detailed
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33 exploration given the frequency of presentations.

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35 Therefore, the primary aim of this study was to determine the rate of GP encounters where foot,
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37 ankle, and leg (defined as below the knee) conditions were managed in children aged between 0-18
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39 years. Secondary aims included exploring the patient and GP characteristics associated with these
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41 encounters, the rate of these encounters for children in different age groups, and the most frequent
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43 management practices for these encounters among the different age groups.

44 45 **Methods**

46 47 *Dataset*

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49 Data were extracted from the Bettering the Evaluation and Care of Health (BEACH) study. This data
50
51 set was constructed from a continuous, nationally representative study of GP clinical activity. Details
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53 of the BEACH study and methods of data coding and collection are published in detail elsewhere¹⁷.
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55 Each year, a random sample of approximately 1,000 Australian GPs completed the BEACH study.
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57 These GPs recorded details from 100 consecutive patient encounters on structured paper data
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59 collection forms. Data captured included demographic characteristics such as patient's age, sex,
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61 postcode, concession card status, Indigenous status, up to three patient reasons for the encounter,

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3 up to four problems/diagnoses managed during the encounter, and the clinical management
4 actioned by the GP. Management strategies were coded, such as medications (supplied, advised, or
5 prescribed), referrals for pathology or diagnostic imaging, referrals to other health professionals and
6 any procedures provided by the GP during the clinical encounter. Pharmaceutical data were coded
7 using the Coding Atlas of Pharmaceutical Substances (CAPS) ¹⁸ which maps to the Anatomical
8 Therapeutic Chemical Classification System ¹⁹. All other data (including problems managed, non-
9 pharmaceutical treatments, referrals and investigations) were coded using the Australian GP
10 interface terminology known as ICPC-2 PLUS ²⁰ by the BEACH research team, with automated
11 classification to the International Classification of Primary Care, Version 2 (ICPC-2) ²¹.

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20 Ethical approvals for ongoing BEACH dataset research purposes were provided by the Human
21 Research Ethics Committee of the University of Sydney (Ref: 2012/130) and (from 2000 to 2010) the
22 Ethics Committee of the Australian Institute of Health and Welfare. GPs provided implied informed
23 consent to collect unidentified data about patients through return of information. Patients (or their
24 parents or guardians) provided informed oral consent to the GP for their de-identified data to be
25 included in the dataset.

26 27 28 29 30 31 32 *Participants and data elements*

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35 We initially identified all GP encounters for children and adolescents aged 0-18 years recorded from
36 April 2000 until March 2016 within the dataset. We selected ICPC-2 PLUS terms that primarily related
37 to problems specifically affecting the foot and ankle, but also included conditions that manifest below
38 the knee (such as restless leg syndrome), dermatological conditions (such as tinea pedis), and
39 congenital lower limb conditions (such as pes planus or genu valgum) through a previously reported
40 expert consensus process (Supplementary dataset 1) ¹².

41 42 43 44 45 46 47 *Statistical analysis*

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50 The BEACH dataset forms a single-stage cluster sample study design. The GP is the sampling unit, and
51 the GP-patient encounter is the unit of inference. We used Survey procedures in SAS v9.4 to adjust
52 for this cluster in all analyses. We initially extracted data from all encounters where the patient was
53 aged 18 years or less. We then extrapolated the rate of management per encounter recorded in
54 BEACH to the number of annual Medicare Benefits Scheduled GP items of services claimed for
55 children to calculate the total number of foot/ankle/leg problems in children managed that year. We
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3 then divided this figure by the number of children in the population (Australian Bureau of Statistics
4 population statistics) ²² to calculate the rate per child in the population. We calculated the rate of
5 foot, ankle or leg problems managed per 100 encounters for children aged 0-18 years (with the age
6 groups <1, 1-4, 5-9, 10-14 and 15-18 years) and analysed this by both GP and patient characteristics.
7 Patient encounters were then grouped into comparable age clusters. Due to the low numbers of foot,
8 ankle and leg problems managed at encounters, the <1 and 1-4 years ages were combined so that
9 our final age groups were: 0-4, 5-9, 10-14, and 15-18 years. The most common types of foot, ankle
10 and leg problems were examined and reported per 100,000 encounters for all ages, and for each age
11 group. We also examined how these foot, ankle and leg problems were managed by GPs. Significant
12 differences were determined through non-overlapping 95% confidence intervals (95% CI). This
13 provided a conservative estimate of significance compared with the traditional alpha of <0.05 ²³.

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15 We used multivariate logistic regression to determine the GP and patient characteristics
16 independently associated with a foot, ankle and leg problem being managed at an encounter. All GP
17 and patient characteristics were included in the model.
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24 *Patient and public involvement*

25 Patients and the public were not involved in the development of the research question, design or
26 conduct of the study.
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33 **Results**

34 *GP management rate for foot, ankle, and leg problems*

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36 Between April 2000 and March 2016, 15,472 GPs recorded 229,137 encounters meeting the
37 extraction criteria (children aged 0-18 years), of which 4,694 were related to foot, ankle or leg
38 problems. The foot, ankle, and leg problems were managed at a rate of 2.05 (95% CI 1.99 to 2.11) per
39 100 GP encounters with children. There was a significant increase in the rate of foot, ankle and leg
40 problems managed per 100 children in the population, from 6.1 (95% CI: 5.3-6.8) in 2005-06 to 9.0
41 (95% CI: 7.9-10.1) in 2015-16 (Figure 1).
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45 *GP and child characteristics associated with management of foot, ankle, or leg problems*

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3 The highest rate of management was 4.64 (per 100 encounters) in the 10-14 years age group, the
4 lowest was infants <1 year (0.44) (Table 1). After adjustment, male patients were 30% more likely to
5 have a foot, ankle, or leg problem managed than their female peers at an encounter. Children in age
6 groups 1-4, 5-9, 10-14 and 15-18 years were all more likely to receive care for foot ankle and leg
7 conditions than children aged <1 year. Those aged 10-14 years were 10.2 times more likely than those
8 aged <1 year. Those most disadvantaged were 8% more likely than those who were most advantaged.
9 Male GPs were 13% more likely to provide care for a foot leg or ankle condition than female GPs. GPs
10 aged <45 years were 13% more likely than those aged >55 years. Concession card status, being from
11 a non-English speaking background, Indigenous status, practice location or GP country of training did
12 not have a significant effect on whether a foot, ankle, and leg condition was managed.
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Table 1. Child and GP specific management rate of foot/ankle/leg problems per 100 encounters, 2010-16.

Patient characteristics	Sample size (n=229,137)	Number of problems managed (n = 4694)	Distribution (%) (95% CI) of problems managed by patient and GP characteristics	Characteristic specific rate of problems per 100 encounters	Adjusted odds ratios of a problem being managed at encounter (95% CIs)
Sex (<i>missing</i>)	(1,734)	(38)			p = <0.001
Male	111,448	2490	53.48 (53.5-53.5)	2.23 (2.1-2.3)	1.304 (1.215-1.399)
Female	115,955	2166	46.52 (46.5-46.5)	1.77 (1.8-1.9)	Reference group
Age (<i>missing</i>)		-			p < 0.001
<1 year	30,722	134	2.85 (2.9-2.9)	0.44 (0.4-0.5)	Reference group
1-4 years	68,704	543	11.57 (11.6-11.6)	0.79 (0.7-0.9)	1.746 (1.413-2.157)
5-9 years	45,333	772	16.45 (16.4-16.5)	1.70 (1.6-1.8)	3.776 (3.073-4.640)
10-14 years	39,310	1824	38.86 (38.9-38.9)	4.64 (4.4-4.9)	10.244 (8.412-12.475)
15-18 years	45,068	1421	30.27 (30.3-30.3)	3.15 (3.0-3.3)	7.067 (5.787-8.629)
Socioeconomic level (<i>missing</i>)	(5859)	(122)			p = 0.0498
Most disadvantaged	82,797	1825	39.92 (39.9-39.9)	2.20 (2.1-3.8)	1.080 (1.000-1.166)
Most advantaged	140,481	2747	60.08 (60.1-60.1)	1.96 (1.9-2.0)	Reference group
Health care card (<i>missing</i>)	(19,844)	(410)			p = 0.1716
Health care card	61,166	1293	30.18 (29.9- 30.2)	2.00 (2.0-2.2)	1.092 (1.047-1.138)
No health care card	148,127	2991	69.82 (69.1-69.8)	2.02 (1.9-2.1)	Reference group
Language background (<i>missing</i>)	(24,052)	(502)			p = 0.1477
Non-English speaking	16,009	273	6.51 (6.5-6.5)	1.71 (1.5-1.9)	Reference group
English speaking	189,076	3919	93.49 (93.5-93.5)	2.07 (2.0-2.1)	1.124 (1.051-1.201)
Indigenous status (<i>missing</i>)	(339,873)	(841)			p = 0.9918
Indigenous	5,924	121	3.14 (3.1-3.1)	2.0 (1.7-2.4)	0.999 (0.812-1.229)
Non-Indigenous	183,340	3732	96.86 (96.9-96.9)	2.04 (2.0-2.1)	Reference group
GP sex (<i>missing</i>)	(0)	(0)			p = 0.0013
Male	135,116	2999	63.89 (63.9-63.9)	2.13 (2.1-2.3)	1.131 (1.049-1.218)
Female	94,021	1695	36.10 (36.1-36.1)	1.80 (1.7-1.9)	Reference group
GP age (<i>missing</i>)	(1319)	(21)			p = 0.0076
<45 years	82,041	1660	32.61 (32.6-32.6)	2.02 (1.9-2.1)	1.13 (1.033-1.237)
45-54 years	76,784	1524	31.86 (31.9-31.9)	1.98 (1.9-2.1)	1.027 (0.939-1.123)
55+ years	68,993	1489	35.52 (35.5-35.5)	2.16 (2.0-2.2)	Reference group
Practice location (<i>missing</i>)	(234)	(2)			p = 0.1379
Major cities	166,932	3264	69.57 (69.6-69.6)	1.95 (1.9-2.0)	1.007 (0.0894-1.133)
Inner regional	39,571	928	19.78 (19.8-19.8)	2.36 (2.2-2.5)	1.078 (0.948-1.226)
Outer regional / remote	22,400	500	10.7 (10.7-10.7)	2.25 (2.0-2.5)	Reference group
Country of graduation (<i>missing</i>)	(536)	(8)			p = 0.7471
Australian graduate	157,881	3203	68.35 (68.3-68.4)	2.10 (2.0-2.2)	1.054 (1.010-1.100)
Overseas graduate	70,720	1483	31.65 (31.6-31.7)	2.03 (2.0-2.1)	Reference group
Year					p = 0.0222
					1.010 (1.001-1.018)
Total	229,137		100.0%	2.05 (2.0-2.1)	

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3 *Rate of specific foot, ankle, and leg problems*
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6 Table 2 presents the child- and GP-specific management rate for the most common foot, ankle, and
7 leg problem groups and specific conditions. The most frequently managed problem groupings were
8 injuries (755.9 per 100,000 encounters), followed by infections (458.2) and dermatological conditions
9 (299.4). The most frequent specific conditions were ankle sprains (310.3 per 100,000 encounters),
10 ingrown toenails (272.3) or infected ingrown toenails (135.6), tinea or fungal skin infections (184.6),
11 injuries to the foot/feet (76.4) and foot/feet pain (69.4). In general, management rates for problem
12 groups and specific conditions increased with age until the 10 to 14 years age group, and then
13 reduced in the 15-18 years group, except for the congenital problem groupings.
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Table 2. Management rate of foot/ankle/leg problem groups per 100,000 child encounters, 2000-16.

Specific foot/ankle/leg problem group	N=229,137	Rate per 100,000 encounters (95% CIs) for all ages
Injury	1732	755.9 (718.0-793.8)
Ankle sprain	711	310.3 (286.3-334.2)
Injury foot/feet	175	76.4 (64.9-87.8)
Injury ankle	138	60.2 (49.9-70.6)
Fracture metatarsal	138	60.2 (49.5-70.9)
Fracture ankle	103	45.0 (36.2-53.7)
Fracture toe	93	40.6 (32.4-48.8)
Foot/feet sprain	72	31.4 (24.1-38.8)
Infection	1050	458.2 (429.5-487.0)
Tinea/fungal skin infection	423	184.6 (166.5-202.8)
Infected ingrown toenail	313	136.6 (120.8-152.4)
Onychomycosis/fungus nail	179	78.1 (66.4-89.9)
Cellulitis of the leg	83	36.2 (28.0-44.4)
Pes planus	135	58.9 (45.1-72.7)
Dermatological	686	299.4 (276.0-322.7)
Ingrown toenail	624	272.3 (250.0-294.6)
Corns/callosities	60	26.2 (19.5-32.9)
Unspecified pain	404	176.3 (158.7-193.9)
Pain foot/feet	159	69.4 (58.5-80.2)
Pain leg	127	55.4 (45.6-65.2)
Pain ankle	90	39.3 (31.1-47.5)
Congenital	354	154.5 (135.7-173.3)
Pes planus (flat foot)	135	58.9 (45.1-72.7)
Musculoskeletal	194	84.7 (72.4-96.9)
Plantar fasciitis	64	27.9 (21.0-34.9)
Calcaneal apophysitis (Sever's)	52	22.7 (16.3-29.1)
Non-specific foot/ankle/leg problem	105	45.8 (36.8-54.8)
Management of foot/ankle/leg	42	18.3 (12.8-23.9)
Venous/swelling	34	14.8 (9.9-19.8)
Ischaemia	30	13.1 (8.4-17.8)
Ulceration	27	11.8 (7.3-16.2)
Venous/varicose leg ulcer	21	9.2 (5.2-13.1)
Leg ulcer	19	8.3 (4.6-12.0)
Foot ulcer	6	2.6 (0.5-4.7)
Neuropathy	20	8.7 (4.9-12.5)
Cramps	15	6.5 (3.2-9.9)
Amputation	1	0.4 (0.0-1.3)

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3 Table 3 outlines the management rate for foot, ankle, and leg problem groupings and specific
4 conditions according to age group. The top three most frequently managed problem groupings were
5 similar for all four age groups, with some exceptions in the younger age groups. Injuries (677.2 to
6 1835.7 per 100,000 encounters), infection (386.0 to 905.62), and dermatological conditions (101.5
7 to 877.6) were typically the top three in the older age groups (5 to 9 years, 10 to 14 years, and 15 to
8 19 years), although unspecified pain was the third most common problem group in those aged 5-9
9 years (257.1). For the youngest age group (0 to 4 years), the top three problem groupings were
10 congenital (195.1), infection (191.1) and unspecified pain (57.3).
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19 The top three specific conditions were also similar for the older age groups (10-14 and 15-18 years)
20 with ankle sprains (594.7 to 594.7), ingrown toenails (525.9 to 824.2) and infected ingrown toenails
21 (308.4 to 371.4) being the top three in all those age groups. However, for the 0 to 4 years age group,
22 the top three specific conditions were tinea or fungal skin infections (117.0), onychomycosis/fungal
23 nail (56.2), and injuries to the foot/feet (39.2), while in the 5 to 9 years group, they were ankle sprains
24 (308.8), tinea or fungal skin infections (209.7) and leg pain (92.6).
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Table 3. Management rate of paediatric foot/ankle/leg problem groups per 100,000 encounters, 2000-16 for age groupings

Specific foot, ankle, and leg problem group	0-4 years n= 99426	Rate per 100,000 encounters (95% CIs) 0-4 years	5-9 years n=45333	Rate per 100,000 encounters (95% CIs) 5-9 years	10-14 years n=39310	Rate per 100,000 encounters (95% CIs) 10-14 years	15-18 years n=45068	Rate per 100,000 encounters (95% CIs) 15-18 years
Injury	142	142.8 (118.4-167.3)	307	677.2 (600.3-754.1)	772	1836.7 (1693.3-1980.0)	561	1244.8 (1138.4-1351.2)
Ankle sprain	31	31.2 (19.9-42.5)	140	308.8 (256.3-361.4)	272	691.9 (605.5-778.0)	268	594.7 (521.9-667.4)
Injury foot/feet	38	38.2 (25.5-51.0)	31	68.4 (44.4-92.4)	66	167.9 (127.2-208.3)	40	88.8 (61.3-116.2)
Injury ankle	7	7.0 (1.8-12.3)	18	39.7 (21.4-58.0)	57	145.0 (105.5-184.5)	56	124.3 (91.2-157.3)
Fracture metatarsal	12	12.1 (5.2-18.9)	12	26.5 (11.5-41.4)	93	236.6 (184.4-288.4)	21	46.6 (25.8-67.4)
Fracture ankle	5	5.0 (0.6-9.4)	20	44.1 (24.8-63.4)	43	109.3 (76.8-142.0)	35	77.7 (52.0-103.3)
Fracture toe	3	3.0 (0.0-6.4)	13	28.7 (13.1-44.3)	46	117.0 (83.3-150.7)	31	68.8 (44.6-93.0)
Foot/feet sprain	6	6.0 (1.2-10.9)	23	50.7 (30.0-71.4)	30	76.3 (48.2-104.5)	13	28.9 (13.2-44.5)
Infection	190	191.1 (164.6-218.6)	175	386.0 (325.9-446.1)	356	905.62 (810.1-1000.8)	329	730.0 (649.7-810.3)
Tinea/fungal skin infection	117	117 (95.9-139.4)	95	209.7 (166.3-252.8)	114	290.0 (236.6-343.4)	97	215.2 (172.6-257.9)
Onychomycosis/fungus nail	56	56.2 (41.1-71.6)	39	86.0 (59.1-113.0)	34	86.5 (57.5-115.5)	50	110.9 (80.3-141.6)
Infected ingrown toenail	10	10.1 (3.8-16.3)	18	39.7 (21.4-58.0)	146	371.4 (310.4-432.5)	139	308.4 (254.6-362.3)
Cellulitis of the leg	14	14.1 (6.2-22.0)	20	44.1 (23.9-64.4)	28	71.2 (42.2-100.3)	21	46.6 (26.7-66.5)
Dermatological	33	33.2 (21.9-44.4)	46	101.5 (72.2-130.7)	345	877.6 (781.1-973.7)	262	581.3 (508.9-653.7)
Ingrown toenail	30	30.2 (19.4-41.0)	33	72.8 (48.0-97.6)	324	824.2 (731.1-917.1)	237	525.9 (457.5- 594.3)
Corns/callosities	2	2.0 (0.0-4.8)	13	28.7 (13.1-44.3)	21	53.4 (30.6-76.3)	24	53.3 (31.1-75.4)
Unspecified pain	57	57.3 (42.2-72.4)	112	247.1 (199.9-294.2)	143	363.8 (304.4-423.4)	92	204.1 (161.3-247.0)
Pain foot/feet	15	15.1 (7.0-23.2)	39	86.0 (59.1-113.0)	66	167.9 (127.6-208.3)	39	86.5-59.4-113.7)
Pain leg	36	36.2 (24.4-48.0)	42	92.6 (63.4-121.9)	24	61.1 (36.7-85.5)	25	55.5 (32.9-78.0)
Pain ankle	4	4.0 (0.1-8.0)	22	48.5 (28.3-68.8)	37	94.1 (63.9-124.4)	27	59.9 (37.3-82.5)
Congenital	194	195.1 (167.4-222.9)	56	123.5 (90.1-157.0)	80	203.5 (147.8-259.3)	24	53.3 (27.2-79.3)
Pes planus (flat foot)	34	34.2 (22.4-46.0)	32	70.6 (45.4-95.8)	54	137.4 (87.6-187.1)	15	33.3 (10.7-55.9)
Musculoskeletal	11	11.0 (4.5-17.6)	41	90.4 (62.8-118.1)	92	234.0 (183.4-284.2)	50	110.9 (80.3-141.6)
Plantar fasciitis	2	2.0 (0.0-4.8)	15	33.1 (16.4-49.8)	35	89.0 (58.8-119.3)	12	26.6 (11.6-41.7)
Calcaneal apophysitis (Sever's)	-	-	18	39.7 (21.4-58.0)	32	81.4 (52.4-110.4)	2	4.4 (0.0-10.6)
Non-specific foot/ankle/leg problem	34	34.2 (22.4-46.0)	18	39.7 (21.3-58.0)	32	81.4 (53.3-109.6)	21	46.6 (25.8-67.4)
Management of foot/ankle/leg	3	3.0 (0.0-6.4)	2	4.4 (0.0-10.5)	16	40.7 (20.8-60.6)	21	46.6 (26.7-66.5)
Venous/swelling	6	6.0 (1.2-10.9)	5	11.0 (1.4-20.7)	11	28.0 (11.5-44.5)	12	26.6 (11.6-41.7)
Ischaemia	1	1.0 (0.0-3.0)	1	2.2 (0.0-6.5)	8	20.4 (6.3-34.4)	20	44.4 (25.0-63.8)
Ulceration	1	1.00 (0.0-3.0)	6	13.2 (2.6-23.8)	12	30.5 (13.3-47.8)	8	17.8 (5.5-30.0)
Leg ulcer	1	1.0 (0.0-3.0)	3	6.6 (0.0-14.1)	9	22.9 (7.9-37.8)	6	13.3 (2.7-24.0)
Venous/varicose leg ulcer	1	1.0 (0.0-3.0)	4	8.8 (0.18-17.5)	9	22.9 (7.9-37.8)	7	15.5 (4.0-27.0)

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2	Foot ulcer	-	-	2	4.4 (0.0-10.5)	3	7.6 (0.0-15.3)	1	2.2 (0.0-6.6)
3	Neuropathy	1	1.0 (0.0-3.0)	1	2.2 (0.0-6.5)	4	10.2 (0.2-20.1)	14	31.1 (14.8-47.3)
4	Cramps	3	3.0 (0.0-6.4)	2	4.4 (0.0-10.5)	3	7.6 (0.0-15.3)	7	25.5 (4.0-27.0)
5	Amputation	1	6.0 (1.2-10.9)	-	-	-	-	-	-

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Foot, ankle, and leg management strategies

Table 4 reports the most frequently used management strategies by GPs for foot, ankle, and leg problems. The top three most frequent action groupings were provision of medication (47.0 per 100 problems), counselling, advice, or education (25.4) and imaging (25.2). The most specific actions were referral for x-ray (22.7), prescription of antibiotics for systemic use (17.6), and prescription of analgesics (7.9).

Table 4. Management actions used by GPs for paediatric foot/ankle/leg problems, 2000-2016.

Management action	n	Rate per 100 problems (95% CIs)
Medication (any)	2205	47.0 (45.2-48.8)
<i>Antibiotics for systemic use</i>	824	17.6 (16.4-18.7)
Cephalexin	480	10.2 (9.2-11.1)
Flucloxacillin	104	2.2 (1.8-2.7)
Dicloxacillin	58	1.2 (0.9-1.6)
<i>Analgesics</i>	370	7.9 (7.6-8.6)
Non-opioid analgesics	311	6.6 (5.9-7.4)
Paracetamol	277	5.9 (5.2-6.6)
Opioid analgesics	59	1.3 (0.9-1.6)
Codeine/paracetamol	55	1.2 (0.9-1.5)
Oxycodone	4	0.1 (0.0-0.2)
Tramadol	3	0.1 (0.0-0.1)
<i>Anti-inflammatory and antirheumatic products</i>	228	4.9 (4.2-5.5)
Ibuprofen	163	3.5 (2.9-4.0)
Meloxicam	11	0.3 (0.1-0.4)
Diclofenac (oral)	26	0.6 (0.3-0.8)
Diclofenac (topical)	35	0.8 (0.5-1.0)
<i>Antifungals for dermatological use</i>	354	7.5 (6.7-8.3)
Terbinafine (oral)	27	0.6 (0.4-0.8)
Terbinafine (topical)	67	1.4 (1.1-1.8)
Clotrimazole	117	2.5 (2.0-2.9)
<i>Corticosteroids for dermatological use</i>	120	2.6 (2.1-3.0)
Hydrocortisone	16	0.3 (0.2-0.5)
Procedures	997	21.2 (19.9-22.6)
Imaging	1185	25.2 (23.8-26.7)
Ultrasound	75	1.6 (1.2-2.0)
Xray	1064	22.7 (21.3-24.0)
Pathology	272	5.8 (4.6-7.0)
Full blood count	38	0.8 (0.5-1.1)
C-reactive protein	13	0.3 (0.1-0.4)
Nail scraping/culture	19	0.4 (0.2-0.6)
Skin swab/culture	16	0.3 (0.2-0.5)
Fungal scraping/culture	41	0.9 (0.6-1.1)
Counselling/advice/education	1192	25.4 (24.0-26.8)
Referral	749	16.0 (14.8-17.1)
Podiatrist	182	3.9 (3.3-4.5)
Orthopaedic surgeon	158	3.4 (2.8-3.9)
General surgeon	65	1.4 (1.0-1.7)
Physiotherapist	167	3.5 (3.0-4.1)

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3 Table 5 outlines the management strategies used according to age group. The top three most
4 frequent management strategies were similar for the 5 to 9 years and 10 to 14 years age groups,
5 although both the 0 to 4 years and 15 to 18 years exhibited different management patterns. For the
6 5 to 9 years and 10 to 14 years groups, the top three management strategies included medication
7 prescription or advice (43.3 and 45.3 per 100 problems), imaging referral (27.2 and 30.7) and
8 counselling, advice or education (25.8 and 27.7). In the 0 to 4 years group, the top three management
9 strategies were medication prescription or advice (38.2), referral to another health professional
10 (23.2) and counselling, advice, or education (21.2), whereas in the 15-18 years age group, it was
11 medication prescription or advice (55.3), procedures, 24.4) and imaging referral (24.3). The top
12 specific management strategies were similar for the 5 to 9 years and 10-14 years age groups. These
13 were referrals for x-rays (24.6 to 28.4 per 100 problems), prescription of antibiotics for systemic use
14 (11.1 to 20.4) and analgesics (7.7 to 9.5). The 0 to 4 age group top management strategies were
15 referral for x-ray (15.2), antifungals for dermatological use (12.7) and prescriptions of antibiotics for
16 systemic use (9.0), whereas, in the 15 to 18 years age group, the top three were prescription of
17 antibiotics for systemic use (21.1), referral for x-ray (20.6) and analgesia (9.1).
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Table 5. Management actions used by GPs for paediatric foot/ankle/leg problems, 2000-2016 for age groupings

Management action	0-4 years n=677	Rate per 100 problems (95% CIs) for 0-4 years	5-9 years n=772	Rate per 100 problems (95% CIs) for 5-9 years	10-14 years n=1824	Rate per 100 problems (95% CIs) for 10-14 years	15-18 years n=1421	Rate per 100 problems (95% CIs) or 15-18 years
Medication (any)	259	38.2 (34.0-42.5)	334	43.3 (39.0-47.5)	826	45.3 (42.5-48.1)	786	55.3 (52.0-58.6)
<i>Antibiotics for systemic use</i>	61	9.0 (6.8-11.2)	86	11.1 (8.9-13.4)	373	20.4 (18.5-22.4)	304	21.4 (19.2-23.6)
Cephalexin	36	5.3 (3.6-7.0)	45	5.8 (4.2-7.5)	216	11.8 (10.2-13.3)	183	12.9 (11.1-14.7)
Flucloxacillin	6	0.9 (0.2-1.6)	14	1.8 (0.9-2.8)	48	2.6 (1.3-3.4)	36	2.5 (1.7-3.4)
Dicloxacillin	-	-	-	-	30	1.6 (1.0-2.2)	28	2.0 (1.2-2.7)
<i>Analgesics</i>	27	4.0 (2.5-5.5)	73	9.5 (7.3-11.6)	140	7.7 (6.4-9.0)	130	9.1 (7.6-10.7)
Non-opioid analgesics	26	3.8 (2.4-5.3)	71	9.2 (7.0-11.4)	123	6.7 (5.8-7.9)	91	6.4 (5.1-7.7)
Paracetamol	22	3.2 (1.9-4.6)	62	8.0 (6.1-10.0)	114	6.3 (5.4-7.4)	79	5.6 (4.3-6.8)
Opioid analgesics	1	0.1 (0.0-0.4)	2	0.3 (0.0-0.6)	17	0.9 (0.0-1.4)	39	2.7 (1.9-3.6)
Codeine/paracetamol	3	0.4 (0.00-0.9)	1	0.1 (0.0-0.4)	16	0.9 (0.7-1.3)	35	2.5 (1.6-3.3)
Oxycodone	-	-	1	0.1 (0.0-0.4)	1	0.1 (0.0-0.2)	2	0.1 (0.0-0.3)
Tramadol	-	-	-	-	1	0.1 (0.0-0.2)	2	0.1 (0.0-0.3)
<i>Anti-inflammatory and antirheumatic products</i>	10	1.5 (0.6-2.4)	32	4.1 (2.7-5.6)	86	4.7 (3.5-5.7)	100	7.0 (5.7-8.4)
Ibuprofen	6	0.9 (0.2-1.6)	31	4.0 (2.6-5.4)	69	3.8 (2.6-4.7)	57	4.0 (3.0-5.0)
Meloxicam	1	0.1 (0.0-0.4)	-	-	2	-	8	0.6 (0.2-1.0)
Diclofenac (oral)	1	0.1 (0.0-0.4)	-	-	10	0.5 (0.0-0.9)	15	1.1 (0.5-1.6)
Diclofenac (topical)	2	0.3 (0.0-0.7)	5	0.6 (0.1-1.2)	15	0.8 (0.0-1.2)	13	0.9 (0.4-1.4)
<i>Antifungals for dermatological use</i>	86	12.7 (10.2-15.3)	73	9.5 (7.3-11.6)	97	5.3 (4.4-6.4)	98	6.9 (5.5-8.3)
Terbinafine (oral)	5	0.7 (0.1-1.4)	5	0.6 (0.1-1.2)	10	0.5 (0.0-0.9)	7	0.5 (0.1-0.9)
Terbinafine (topical)	6	0.9 (0.2-1.6)	19	2.5 (1.4-3.6)	19	1.0 (0.3-1.5)	23	1.6 (1.0-2.3)
Clotrimazole	42	6.2 (4.4-8.0)	21	2.7 (1.6-3.9)	31	1.6 (1.0-2.3)	8	1.6 (1.0-2.3)
<i>Corticosteroids for dermatological use</i>	38	5.6 (3.8-7.4)	30	3.8 (2.5-5.3)	26	1.4 (0.9-2.0)	26	1.8 (1.1-2.6)
Hydrocortisone	9	1.3 (0.5-2.2)	4	0.5 (0.01-1.0)	2	-	1	0.1 (0.0-0.2)
Procedures	60	8.9 (1.2-6.4)	138	17.9 (14.8-20.9)	452	24.8 (22.5-27.1)	347	24.4 (21.8-27.0)
Imaging	107	15.8 (12.8-18.8)	236	30.7 (27.8-34.3)	496	27.2 (24.9-29.5)	346	24.3 (21.9-26.8)
Ultrasound	4	0.6 (0.01-1.2)	10	1.3 (0.5-2.1)	33	1.8 (1.1-2.4)	25	2.0 (1.2-2.7)
Xray	103	15.2 (12.3-18.2)	219	28.4 (24.8-31.9)	449	24.6 (19.0-26.8)	293	20.6 (18.6-22.8)
Pathology	41	6.1 (2.8-9.3)	61	7.9 (4.4-11.4)	86	4.7 (3.0-6.5)	84	5.9 (3.8-8.0)
Full blood count	6	0.8 (0.4-1.6)	13	1.0 (0.8-2.6)	10	0.5 (0.0-0.9)	9	0.6 (0.2-1.0)
C-reactive protein	4	0.6 (0.01-1.2)	3	0.4 (0.0-0.8)	3	0.2 (0.0-0.4)	3	0.2 (0.0-0.4)
Nail scraping/culture	2	0.3 (0.1-0.7)	3	0.4 (0.0-0.8)	4	0.2 (0.0-0.4)	10	0.2 (0.3-0.4)

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2	Skin swab/culture	1	0.1 (0.0-0.4)	1	0.1 (0.0-0.4)	11	0.6 (0.0-1.0)	3	0.1 (0-0.5)
3	Fungal scraping/culture	8	1.2 (0.4-2.0)	8	1.0 (0.3-1.8)	16	0.9 (0.0-1.3)	9	0.6 (0.2-1.0)
4	Counselling/advice/education	179	21.2 (19.9-22.6)	214	27.7 (24.4-31.1)	471	25.8 (23.6-28.0)	328	23.1 (20.7-25.4)
5	Referral	157	23.2 (19.8-26.6)	112	14.5 (11.9-17.2)	277	15.2 (13.4-16.9)	203	14.3 (12.4-16.2)
6	Podiatrist	18	2.7 (1.3-4.1)	39	5.1 (3.5-6.6)	85	4.7 (3.2-6.3)	40	2.8 (2.0-3.7)
7	Orthopaedic surgeon	51	7.5 (5.5-9.5)	23	3.0 (1.8-4.2)	44	2.4 (1.7-3.1)	40	2.8 (1.9-3.7)
8	General surgeon	1	0.1 (0.0-0.4)	3	0.2 (0.0-0.8)	32	1.8 (1.0-2.4)	29	2.0 (1.3-2.8)
9	Physiotherapist	26	3.8 (2.4-5.3)	21	2.7 (1.5-3.9)	61	3.3 (2.0-4.2)	59	4.2 (3.1-5.2)

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Discussion

This study was one of the first to investigate the national management of children's foot, ankle, and leg conditions by GPs. Findings suggest Australian GPs commonly manage children's lower limb problems, and more frequently in males and older children. Injury, infection, and dermatological conditions presented most frequently to GPs across all ages and medications were the most frequently used management strategy. The frequency of specific problems managed, and the management strategies used, varied across the different age groupings, such as differing rates of congenital problems, or differing prescription or advice of medications. GPs also commonly provided counselling, advice and education for all ages, an appropriate management strategy for concerned parents, and a common first stage management strategy for many benign congenital, or undefined foot, ankle, or leg problems or while undergoing further testing to refine diagnosis.

Children from more disadvantaged socioeconomic areas had a significantly higher GP management rate of foot, leg and ankle conditions than their peers in more advantaged areas. This presentation is consistent with other studies on children's healthcare in countries with socialised medicine, and reflects a complex interaction between health literacy of parents or the knowledge or financial ability for parents to seek health care information or alternate care providers without a GP recommendation, such as seeing a podiatrist or physiotherapist for their children's foot, ankle or leg concerns^{25 26}.

Foot, ankle, and leg problems differed across age groupings and in general, increased with age. The presentations patterns extracted from this dataset related to foot, ankle, or leg concerns potentially reflect the different key skeletal and developmental stages. Younger children presented more with congenital lower limb concerns, while older children presented with more dermatological (e.g., tinea or ingrown toenails) or injury (e.g., ankle sprain) concerns. These presentation patterns align with key gross motor or developmental stages and may also align with the different health professional referral patterns. For example, there were higher numbers of congenital foot problems in younger children, and more frequent referrals to orthopaedic surgeons than in older age groups. In contrast, injuries were more common in older children, who were referred more often to podiatrists and physiotherapists. These patterns may reflect the more emergent nature of ensuring right timed surgical care at key osseous stages versus providing rehabilitation during injury recovery or individualised skin or nail care advice.

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3 Injury was the primary problem managed in all ages. This may be due to different mechanisms of
4 injuries occurring across childhood such as those occurring in the playground, or during social or
5 organised sport ²⁷⁻³⁰. Despite how injuries may have occurred, common management strategies
6 extracted from this dataset included frequent medical imaging. Ultrasound and x-rays were the most
7 common imaging methods, with fewer ordered than frequency of injury presentations. This suggests
8 conservative and judicious imaging referrals, and potential use of injury imaging referral guidelines,
9 such as the Ottawa Ankle Rules ³¹.

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12 Antibiotic stewardship and pain management medication strategies elicited from this dataset also
13 mirror prescribing guidelines established for general practice relating to childhood presentations
14 involving the lower limb for the timeframe data were extracted ³². For example, at the time of data
15 collection, cephalexin was commonly prescribed in a suspension for children to treat mild skin
16 infections (e.g., cellulitis) while narrow spectrum antibiotics such as flucloxacillin and dicloxacillin
17 were the recommended antibiotics for infected skin relating to infected ingrown toenail
18 presentations ³². Similarly, the use of non-opioid pain medications exceeded opioid prescriptions,
19 consistent with recommended actions for pain management practices ³². We did not undertake direct
20 comparisons between the problem managed and corresponding management strategy during this
21 analysis; however, these patterns suggest that medication management practices align with best
22 practice clinical guidelines.

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25 Contrary to this, it was surprising to see fewer musculoskeletal conditions recorded within the
26 dataset, despite epidemiological studies finding that 12% of children report or seek care for leg or
27 foot pain relating to specific musculoskeletal conditions ³³. The low frequency rates we observed
28 within this dataset may be related to several factors. The most likely reason is how these problems
29 were recorded by the GP. Underpinning how problems were recorded may be limited knowledge
30 about less common foot, ankle or leg conditions, lower presentation rates of foot, ankle or leg
31 conditions to GPs compared with hospital outpatients, the single point data collection used in the
32 BEACH dataset that captures a problem as a symptom with as yet unknown diagnosis (e.g., waiting
33 test results for confirmation) and relevant management guidelines of the time.

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36 The low frequency of musculoskeletal concerns recorded within this dataset may also reflect
37 different health literacy in parents and its association with not seeking care from GPs, or
38 misdiagnosis. One potential example of this was the frequency of plantar fasciitis diagnoses recorded
39 across younger ages (33.1 per 100,000 in the 5-9 year group and 89.0 per 100,000 in the 10 to 14
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3 year group). Plantar fasciitis is rarely reported in contemporary paediatric orthopaedic literature, and
4 if diagnosed on ultrasound, associated with being an older and highly athletic adolescent than the
5 ages in this dataset ³⁴. Heel pain in older children is more likely to be calcaneal apophysitis. This
6 diagnosis was recorded as 39.1 per 100,000 encounters in 5-9 year grouping and 81.4 in 10-14 year
7 grouping, and at a less frequent rate than plantar fasciitis in the 10-14 year age grouping, despite this
8 being the age when foot apophyseal injuries are most prevalent ³. Other conditions also resulting in
9 childhood plantar heel pain include inflammatory disease, infection (including osteomyelitis) or post-
10 viral joint pain, all presenting more commonly than plantar fasciitis in younger age groupings ³⁵.
11 Management strategies of these heel pain conditions differ significantly, making it imperative for
12 timely and accurate diagnosis to minimise health care wastage, and prevent development of chronic
13 pain ²⁴.
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18 Recently there has been a global call to action on improving primary care diagnosis and assessment
19 of musculoskeletal conditions in childhood to minimise misdiagnosis and reduce the development of
20 disability and chronic pain ³⁶. Simple assessments and screening tools have been implemented to
21 support general practice, such as the paediatric Gait, Legs and Spine (p-GALS) screen ³⁷, and free
22 online generic health professionals training to improve paediatric musculoskeletal condition
23 diagnoses ³⁸. These resources have been developed in acknowledgement of limited exposure to
24 paediatric musculoskeletal conditions during medical training ³⁹, less common presentations in
25 childhood compared to other childhood complaints such as ear infections or upper respiratory tract
26 infection leading to low confidence in diagnostic skills of musculoskeletal conditions ⁴⁰, knowledge
27 deficits of the types of common paediatric musculoskeletal presentations ⁴¹, and serious long term
28 consequences of some musculoskeletal conditions missed or misdiagnosed ³⁶. Our findings of GPs
29 reporting unspecified pain or conditions known to be more prevalent in adults than children suggests
30 that Australian GPs may require additional support to diagnose and manage musculoskeletal
31 conditions in childhood. Future research may include development of guidelines and supporting
32 models of care for children's foot, ankle, or leg problems to determine if these improve health
33 outcomes, reduce the progressive nature of many musculoskeletal conditions and pain syndromes
34 and if these are cost-effective.
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56 This study is the first to our knowledge, to examine the full spectrum of childhood foot, ankle, or leg
57 presentations in primary care and how these are managed. The data extracted from a large and
58 representative sample of Australian GPs provides an extensive snapshot of practice to guide future
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3 directions for education, guideline development and models of care for childhood foot, ankle, or leg
4 conditions. A limitation of this study is the historical nature of the data and that education, practice
5 and models of care may have evolved between the 2016 end date of BEACH and data analysis. Known
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7 paediatric model of care and referral changes in some Australian state and territories occurred in late
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9 2015⁴², which may have resulted in improved management of conditions through several guidelines,
10 recommended assessments and when to refer to orthopaedic surgeons for several specific
11 musculoskeletal conditions. Regardless, this dataset of encounters and management strategies
12 provides a robust baseline on which future guidelines and implementation studies can measure the
13 outcomes of practice change over time.
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23 **Conclusion**

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25 Childhood foot, ankle and leg conditions are a common reason parents bring their children to a GP in
26 Australia. Frequencies of presentations vary according to developmental stage with potential under
27 reporting of musculoskeletal conditions. Future studies should consider how to support GPs in
28 managing childhood musculoskeletal conditions to minimise disability and development of chronic
29 pain. These actions have the potential to reduce long term burden of disease.
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Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

The data that support the findings of this study are available from BEACH, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of BEACH.

Author Contributions

CW and PL conceived this study with authors HBM, JG and CH contributing to data extraction plan. CH undertook data extraction and analysis; CW developed the first draft of the manuscript with all authors providing critical review. All authors approved the final draft for submission

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3 Award number: N/A; Aventis Pharma Pty Ltd, Award number: N/A; Bayer Australia Ltd, Award
4 number: N/A; bioCSL (Australia) Pty Ltd, Award number: (N/A); GlaxoSmithKline Australia Pty Ltd,
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11 and Medical Research Council Early Career Research Fellow (ID: 1143435).
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23 *Competing interest's statement:*

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25 The authors declare no competing interests.
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3 **Figure 1.** The management rate of children's foot, ankle and leg problems managed by Australian GPs
4 between April 2000 and March 2016 (aged 0-18 years). Blue line represents problems per 100
5 encounters, orange line represents problems per 100 children (Error bars = 95% CI).
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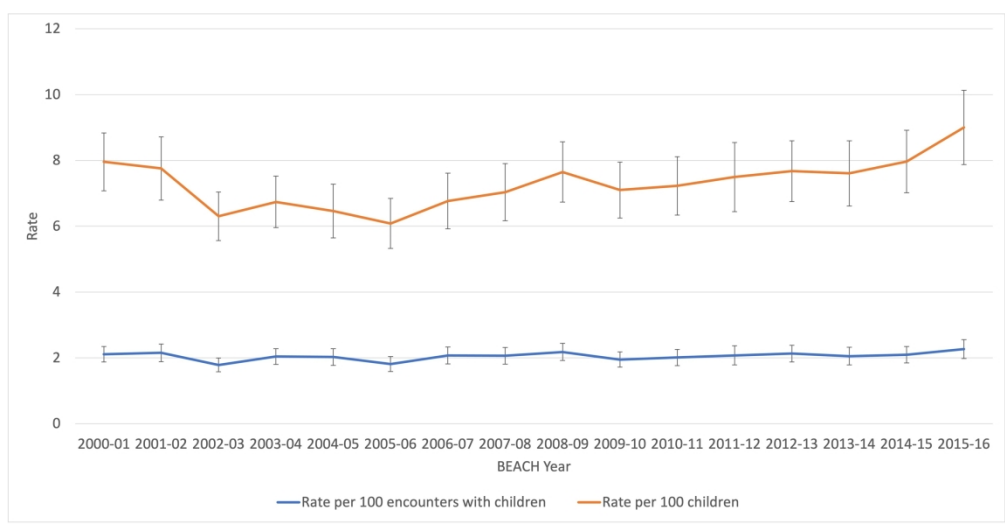


Figure 1.

314x160mm (300 x 300 DPI)

Supplementary dataset 1: ICPC2-Plus codes related to foot, ankle, and lower leg conditions.

ICPC-2 Plus code	Label	Category
A29030	Problem;foot/feet;diabetes	Non-specific foot/ankle/lower leg disorder
A31033	Exam;foot/feet	Management
A66020	Referral;podiatrist/chiroprapist	Management
A67028	Referral;foot clinic	Management
K07001	Oedema;ankle/foot/feet	Venous / swelling
K07002	Swollen;ankle	Venous / swelling
K07003	Dropsy	Venous / swelling
K07004	Swollen;foot/feet	Venous / swelling
K07005	Swollen;ankle;non-traumatic	Venous / swelling
K07008	Oedema;dependent	Venous / swelling
K07009	Oedema;leg	Venous / swelling
K07010	Swollen;leg	Venous / swelling
K07013	Oedema;peripheral	Venous / swelling
K07014	Oedema;ankle	Venous / swelling
K07014	Oedema;ankles	Venous / swelling
K07015	Oedema;feet	Venous / swelling
K07015	Oedema;feet	Venous / swelling
K92001	Disease;Buerger's	Ischaemia
K92002	Disease;Raynauds	Ischaemia
K92003	Disease;peripheral vascular	Ischaemia
K92004	Gangrene	Ischaemia
K92006	Ischaemia;limb (gangrene)	Ischaemia
K92010	Raynauds phenomenon	Ischaemia
K92016	Vasospasm;peripheral	Ischaemia
K92017	Claudication;intermittent	Ischaemia
K92031	Disease;small vessel	Ischaemia
K95001	Eczema;varicose	Venous / swelling
K95002	Stasis;venous	Venous / swelling
K95004	Insufficiency;venous	Venous / swelling
K95005	Varicose veins;inflamed;leg	Venous / swelling
K95006	Varicose veins;leg	Venous / swelling
K95007	Dermatitis;stasis	Venous / swelling
K95008	Rupture;varicose vein	Venous / swelling
L14005	Pain;musculoskeletal;leg	Unspecified pain
L14006	Pain;leg	Unspecified pain
L14008	Cramp(s);nocturnal/night	Cramps
L14010	Sympt/complaint;leg	Non-specific foot/ankle/lower leg disorder
L14014	Cramp(s);leg	Cramps
L14016	Cramp(s);calf	Cramps
L16001	Pain;ankle	Unspecified pain
L16002	Pain;musculoskeletal;ankle	Unspecified pain
L16004	Sympt/complaint;ankle	Non-specific foot/ankle/lower leg disorder
L16005	Unstable;ankle	Musculoskeletal

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3	L16006	Stiffness;ankle	Non-specific foot/ankle/lower leg disorder
4	L17001	Pain;foot/feet	Unspecified pain
5	L17002	Pain;musculoskeletal;foot/feet	Unspecified pain
6	L17003	Pain;toe(s)	Unspecified pain
7	L17004	Pain;musculoskeletal;toe(s)	Unspecified pain
8	L17007	Sympt/complaint;foot/feet	Non-specific foot/ankle/lower leg disorder
9	L17008	Sympt/complaint;toe(s)	Non-specific foot/ankle/lower leg disorder
10	L17011	Metatarsalgia	Non-specific foot/ankle/lower leg disorder
11	L17012	Pain;heel	Unspecified pain
12	L17013	Cramp(s);foot/feet	Cramps
13	L17014	Stiffness;toe(s)	Non-specific foot/ankle/lower leg disorder
14	L17015	Swelling;toe(s)	Non-specific foot/ankle/lower leg disorder
15	L40003	Arthroscopy;ankle	Management
16	L40005	Arthroscopy;foot/feet	Management
17	L41026	X-ray;foot/feet	Management
18	L41027	X-ray;ankle	Management
19	L41037	X-ray;toe(s)	Management
20	L41038	X-ray;heel	Management
21	L41039	X-ray;tibia/fibula	Management
22	L41066	X-ray;leg lower	Management
23	L41068	X-ray;metatarsal	Management
24	L41071	Ultrasound;ankle	Management
25	L41076	Ultrasound;foot/toe(s)	Management
26	L41094	CT scan;foot/feet	Management
27	L41095	CT scan;ankle	Management
28	L41114	MRI;ankle	Management
29	L41115	MRI;foot/feet	Management
30	L45006	Advice/education;footwear	Management
31	L52009	Amputation;non-traumatic	Amputation
32	L52012	Amputation;below knee	Amputation
33	L52013	Amputation;above knee	Amputation
34	L52016	Amputation;foot	Amputation
35	L52019	Amputation;toe(s)	Amputation
36	L54002	Adjusting;orthopaedic shoes	Management
37	L54023	Fitting (of);brace;leg	Management
38	L54025	Fitting (of);orthopaedic shoe	Management
39	L54029	Reconstruction;ankle	Management
40	L54032	Reconstruction;foot/feet	Management
41	L54032	Reconstruction;foot/feet	Management
42	L54039	Adjusting;brace;leg	Management
43	L54051	Treat;fract/disloc;ankle	Management
44	L54058	Treat;fract/disloc;fibula	Management
45	L54066	Treat;fract/disloc;metatarsal	Management
46	L54082	Treat;fract/disloc;tibia	Management
47	L54083	Treat;fract/disloc;toe(s)	Management
48	L54092	Replace;joint;ankle	Management
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L73001	Fracture;fibula	Injury
L73002	Fracture;ankle	Injury
L73003	Fracture;Potts	Injury
L73004	Fracture;tibia	Injury
L73005	Fracture;malleolus;medial	Injury
L73006	Fracture;malleolus;lateral	Injury
L73007	Fracture;malleolus	Injury
L73009	Fracture;tibia and fibula	Injury
L74002	Fracture;foot/feet	Injury
L74005	Fracture;metatarsal(s)	Injury
L74007	Fracture;tarsal(s)	Injury
L74010	Fracture;toe(s)	Injury
L74012	Fracture;calcaneus	Injury
L77001	Sprain;ankle	Injury
L77002	Strain;ankle	Injury
L79014	Sprain;foot/feet	Injury
L79018	Strain;foot/feet	Injury
L79036	Shin splints	Musculoskeletal
L80004	Dislocation;foot/feet	Injury
L80012	Dislocation;ankle	Injury
L80023	Dislocation;toe(s)	Injury
L81019	Injury;toe	Injury
L81022	Injury;ankle	Injury
L81025	Injury;foot/feet	Injury
L81030	Haemarthrosis;ankle	Injury
L82003	Clubfoot	Congenital
L82005	Bowlegged;congenital	Congenital
L82008	Knock-knee;congenital	Congenital
L82009	Pigeon toed	Congenital
L82014	Talipes	Congenital
L82016	Feet turned in	Congenital
L82017	Genu valgum;congenital	Congenital
L82025	Deformity;foot;congenital	Congenital
L82029	Hemimelia	Congenital
L82032	Feet turned out	Congenital
L82033	Deformity;ankle;congenital	Congenital
L87017	Calcaneal spur	Musculoskeletal
L87024	Fasciitis;plantar	Musculoskeletal
L87029	Bursitis;heel	Musculoskeletal
L91016	Arthritis;ankle	Musculoskeletal
L91017	Osteoarthritis;ankle	Musculoskeletal
L91018	Arthritis;foot/feet	Musculoskeletal
L91019	Osteoarthritis;foot/feet	Musculoskeletal
L91021	Osteoarthritis;toe(s)	Musculoskeletal
L91023	Arthritis;toe(s)	Musculoskeletal
L94014	Severs disease	Musculoskeletal

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L98001	Bunion	Musculoskeletal
L98002	Clubfoot;acquired	Musculoskeletal
L98003	Bowlegged	Congenital
L98004	Pes planus (flat foot)	Congenital
L98006	Hammer toe	Musculoskeletal
L98007	Hallux;valgus	Musculoskeletal
L98008	Hallux;rigidus	Musculoskeletal
L98011	Pes cavus (claw foot)	Congenital
L98013	Genu valgum;knock knee	Congenital
L98015	Deformity;limb;acquired	Musculoskeletal
L98017	Deformity;foot;acquired	Musculoskeletal
L98018	Deformity;ankle;acquired	Musculoskeletal
L99105	Arthropathy;Charcot	Neuropathy
N04001	Restless legs syndrome	Neuropathy
N05001	Burning;sensation;extremities	Neuropathy
N05005	Tingling;feet/toes	Neuropathy
N05006	Paraesthesia	Neuropathy
N06022	Numbness;toe(s)	Neuropathy
N06023	Numbness;foot	Neuropathy
N06024	Numbness;leg	Neuropathy
N18002	Footdrop	Neuropathy
N94012	Neuropathy; diabetic	Neuropathy
N94016	Mononeuritis;legs	Neuropathy
N94018	Neuritis;peripheral	Neuropathy
S09005	Infection;toe(s)	Infection
S09010	Abscess;toe(s)	Infection
S09011	Cellulitis;toe(s)	Infection
S11019	Infection;ingrown toenail	Infection
S20001	Corns	Dermatological
S20002	Callosities	Dermatological
S21021	Sympt/complaint;skin;heel	Dermatological
S46002	Consult;podiatrist	Management
S52022	Resection;ingrown toenail(s)	Management
S52026	Removal;toenail(s)	Management
S59002	Podiatry	Management
S74001	Athletes foot	Infection
S74004	Infection;fungus;nail(s)	Infection
S74005	Infection;fungus;skin	Infection
S74006	Mycosis;skin	Infection
S74009	Tinea	Infection
S74015	Onychomycosis	Infection
S74018	Tinea pedis	Infection
S74025	Mycetoma	Infection
S76009	Pitted keratolysis	Infection
S76015	Cellulitis;leg	Infection
S76016	Cellulitis;foot/feet	Infection

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3	S94002	Ingrown;toenail(s)	Dermatological
4	S97004	Ulcer;varicose	Ulceration
5	S97008	Ulcer;leg	Ulceration
6	S97012	Ulcer;foot	Ulceration
7	S97013	Ulcer;diabetic	Ulceration
8	S97014	Ulcer;venous	Ulceration
9	S97016	Ulcer;toe(s)	Ulceration
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Australian children's foot, ankle, and leg problems in primary care: a secondary analysis of the Bettering the Evaluation and Care of Health (BEACH) data

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Australian children's foot, ankle, and leg problems in primary care: a secondary analysis of the Bettering the Evaluation and Care of Health (BEACH) data

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Abstract

Objectives:

To explore children's foot, ankle and leg consultation patterns and management practices in Australian primary care.

Design:

Cross-sectional, retrospective study

Setting:

Australia Bettering the Evaluation and Care of Health program dataset.

Participants:

Data were extracted for GPs and patients ≤ 18 years from April 2000 to March 2016 inclusive.

Main outcome measures:

Demographic characteristics: sex, GP age groups (i.e. <45, 45-54, 55+ years), GP country of training, patient age grouping (0-4, 5-9, 10-14, 15-18 years), postcode, concession card status, Indigenous status, up to three patient encounter reasons, up to four encounter problems/diagnoses, and the clinical management actioned by the GP.

Results:

Children's foot, ankle or leg problems were managed at a rate of 2.05 (95% CI 1.99 to 2.11) per 100 encounters during 229,137 GP encounters with children. There was a significant increase in the rate of foot, ankle and leg problems managed per 100 children in the population, from 6.1 (95% CI: 5.3-6.8) in 2005-06 to 9.0 (95% CI: 7.9-10.1) in 2015-16. Management of children's foot, ankle and leg problems were independently associated with male patients (30% more than female), older children (15-18 years were 7.1 times more than <1 years), male GPs (13% more) and younger GPs (<45 years of age 13% more than 55+). The top four most frequently managed problems were injuries (755.9 per 100,000 encounters), infections (458.2), dermatological conditions (299.4) and unspecified pain (176.3). The most frequently managed problems differed according to age grouping.

Conclusions:

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3 Children commonly present to GPs for foot, ankle, and leg problems. Presentation frequencies
4 varied according to age. Unexpectedly, conditions presenting commonly in adults, but rarely in
5 children, were also frequently recorded. This data highlights the importance of initiatives
6 supporting contemporary primary care knowledge of diagnoses and management of paediatric
7 lower limb problems to minimise childhood burden of disease.
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15 **Article Summary**

16 *Strengths and limitations of this study:*

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20 - This study uses data extracted from the Bettering the Evaluation and Care of Health (BEACH)
21 dataset between 2010-2016 to examine the full spectrum of childhood foot, ankle, or leg
22 presenting to, and managed by Australian general practitioners (GPs).
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- 26 - This method allows for a nationally representative sample of presentations for children, and
27 characteristics of GPs who manage these presentations.
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- 30 - It is not possible to estimate the impact of these conditions on children, how individual cases
31 were managed or the outcome of management with this dataset.
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- 34 - This study may be limited by how GPs recorded children's foot, ankle and leg problem
35 presentation and management data.
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40 *Word count:* 3897

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43 **Key words:** child, adolescent, musculoskeletal pain, foot; foot injuries; foot diseases; primary health
44 care; general practice;
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Background

Childhood foot, ankle and leg concerns are thought to be common, but their prevalence and incidence vary widely according to age and are inconsistently reported. For example, the prevalence estimates for flexible flat foot vary from 2 to 44% of children,[1, 2] while the incidence of calcaneal apophysitis ranges from 0.37 to 0.60 per 100 person-years,[3] These wide variations seem to depend on age, developmental stage, sporting participation or differences in epidemiological study setting. Similarly, little is known about the frequencies of conditions relating to the foot, ankle or leg in children that cause pain or functional impact or trouble their parents enough to result in families seeking management in primary care.

Key developmental stages in childhood present opportunities for optimal foot and leg condition management, particularly for conditions relating to musculoskeletal complaints, neurological conditions, or inflammatory disease. Early interventions for these higher burden conditions are important to initiate early to reduce long term disability and prevent chronic pain development. Conversely, delayed diagnosis, delayed access to care or provision of non-evidence informed care can be detrimental to long term outcomes,[4] family burden[5] and permanent disability[6]. Primary care providers are commonly the first contact for non-emergency health care. Therefore, understanding contemporary practice in primary care allows for improved focus for finite health care resources, training and guidelines, to improve health outcomes[7], reduce health care waste[8], and design effective public policies or prevention strategies to minimise long term impacts.[9].

In Australia, primary care services are frequently provided by general practitioners (GPs) on a 'fee for service' model with fees primarily covered through Medicare, the Australian Government funded medical insurance scheme.[10] Medicare also provides subsidies for other healthcare services including diagnostic imaging and pathology tests. The Pharmaceutical Benefits Scheme provides subsidies for prescribed medicines.[11] GPs can also provide referrals to medical specialists for subsidised medical specialist care, such as to orthopaedic surgeons, and in limited circumstances (e.g. for chronic medical conditions) to subsidised allied health professional care, such as to podiatrists.[11] Therefore, GP presentation and management data provides rich information about health problems in Australia.

Despite this, little is known about how GPs manage foot and leg problems in children in Australia, and even less about their management practices. It is important to know the frequencies of children's

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3 foot, ankle, and leg problems and how commonly they present to GPs, as highly prevalent specific
4 foot, ankle, or leg conditions in childhood may impact on health care costs now or in the future.
5 Conservative estimates indicate that management of foot, ankle or leg conditions by GPs in Australia
6 across all ages are estimated to be approximately A\$255m per annum.[12] Also unknown, is how
7 many foot, ankle or leg conditions appear in childhood requiring medical care from GPs. To our
8 knowledge, only four studies have examined presentations for primary care management in children
9 that included lower limb presentations. These studies were in Spain, Australia, and the United
10 Kingdom[13-16], yet only one of these studies provided data on all children between the ages of 0-
11 18 years[14]. Whilst studies have investigated the most frequent presenting conditions by children
12 to GPs, they rarely delineate by body region such as foot, ankle and leg problems. One Australian
13 study reported data on all GP encounters by children aged between 0-17 years for any health
14 condition and found frequent presentations for skin concerns and musculoskeletal concerns.[14].
15 Both skin and musculoskeletal concerns are two problems likely to include foot, ankle, or leg
16 problems. However, there were no additional data on skin complaints relating to body region, and
17 where musculoskeletal data according to body regions were explored in detail, lower limb concerns
18 were managed at a rate between 0.62 to 5.33 per 100 children encounters. These insights warrant
19 further detailed exploration given the frequency of presentations.

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21 Therefore, the primary aim of this study was to determine the rate of GP encounters where foot,
22 ankle, and leg (defined as below the knee) conditions were managed in children aged between 0-18
23 years. Secondary aims included exploring the patient and GP characteristics associated with these
24 encounters, the rate of these encounters for children in different age groups, and the most frequent
25 management practices for these encounters among the different age groups.

26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 **Methods**

46 47 48 *Dataset*

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50 Data were extracted from the Bettering the Evaluation and Care of Health (BEACH) study. This data
51 set was constructed from a continuous, nationally representative study of GP clinical activity. Details
52 of the BEACH study and methods of data coding and collection are published in detail elsewhere [17].
53 Each year, a random sample of approximately 1,000 Australian GPs completed the BEACH study.
54 These GPs recorded details from 100 consecutive patient encounters on structured paper data
55 collection forms. Data captured included demographic characteristics such as patient's age, sex,
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postcode, concession card status, Indigenous status, up to three patient reasons for the encounter, up to four problems/diagnoses managed during the encounter, and the clinical management actioned by the GP. Management strategies were coded, such as medications (supplied, advised, or prescribed), referrals for pathology or diagnostic imaging, referrals to other health professionals and any procedures provided by the GP during the clinical encounter. Pharmaceutical data were coded using the Coding Atlas of Pharmaceutical Substances (CAPS) [18] which maps to the Anatomical Therapeutic Chemical Classification System [19]. All other data (including problems managed, non-pharmaceutical treatments, referrals and investigations) were coded using the Australian GP interface terminology known as ICPC-2 PLUS [20] by the BEACH research team, with automated classification to the International Classification of Primary Care, Version 2 (ICPC-2)[21]. ICPC-2 is a member of the World Health Organization Family of International Classifications[21] and is mapped to the International Classification of Disease, Version 10 (ICD-10).[22]

Ethical approvals for ongoing BEACH dataset research purposes were provided by the Human Research Ethics Committee of the University of Sydney (Ref: 2012/130) and (from 2000 to 2010) the Ethics Committee of the Australian Institute of Health and Welfare. GPs provided implied informed consent to collect unidentified data about patients through return of information. Patients (or their parents or guardians) provided informed oral consent to the GP for their de-identified data to be included in the dataset.

Participants and data elements

We initially identified all GP encounters for children and adolescents aged 0-18 years recorded from April 2000 until March 2016 within the dataset. We selected ICPC-2 PLUS terms that primarily related to problems specifically affecting the foot and ankle, but also included conditions that manifest below the knee (such as restless leg syndrome), dermatological conditions (such as tinea pedis), and congenital lower limb conditions (such as pes planus or genu valgum) through a previously reported expert consensus process (Supplementary dataset 1).[12]

Statistical analysis

The BEACH dataset forms a single-stage cluster sample study design. The GP is the sampling unit, and the GP-patient encounter is the unit of inference. We used Survey procedures in SAS v9.4 to adjust for this cluster in all analyses. We initially extracted data from all encounters where the patient was

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3 aged 18 years or less. We then extrapolated the rate of management per encounter recorded in
4 BEACH to the number of annual Medicare Benefits Scheduled GP items of services claimed for
5 children to calculate the total number of foot/ankle/leg problems in children managed that year. We
6 then divided this figure by the number of children in the population (Australian Bureau of Statistics
7 population statistics)[23] to calculate the rate per child in the population. We calculated the rate of
8 foot, ankle or leg problems managed per 100 encounters for children aged 0-18 years (with the age
9 groups <1, 1-4, 5-9, 10-14 and 15-18 years) and analysed this by both GP and patient characteristics.
10 Patient encounters were then grouped into comparable age clusters. Due to the low numbers of foot,
11 ankle and leg problems managed at encounters, the <1 and 1-4 years ages were combined so that
12 our final age groups were: 0-4, 5-9, 10-14, and 15-18 years. The most common types of foot, ankle
13 and leg problems were examined and reported per 100,000 encounters for all ages, and for each age
14 group. We also examined how these foot, ankle and leg problems were managed by GPs. Significant
15 differences were determined through non-overlapping 95% confidence intervals (95% CI). This
16 provided a conservative estimate of significance compared with the traditional alpha of <0.05.[24]

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18 We used multivariate logistic regression to determine the GP and patient characteristics
19 independently associated with a foot, ankle and leg problem being managed at an encounter. All GP
20 and patient characteristics were included in the model.
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38 *Patient and public involvement*

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40 Patients and the public were not involved in the development of the research question, design or
41 conduct of the study.
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48 **Results**

49 *GP management rate for foot, ankle, and leg problems*

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53 Between April 2000 and March 2016, 15,472 GPs recorded 229,137 encounters meeting the
54 extraction criteria (children aged 0-18 years), of which 4,694 were related to foot, ankle or leg
55 problems. The foot, ankle, and leg problems were managed at a rate of 2.05 (95% CI 1.99 to 2.11) per
56 100 GP encounters with children. There was a significant increase in the rate of foot, ankle and leg
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3 problems managed per 100 children in the population, from 6.1 (95% CI: 5.3-6.8) in 2005-06 to 9.0
4 (95% CI: 7.9-10.1) in 2015-16 (Figure 1).
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7 *GP and child characteristics associated with management of foot, ankle, or leg problems*
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10 The highest rate of management was 4.64 (per 100 encounters) in the 10-14 years age group, the
11 lowest was infants <1 year (0.44) (Table 1). After adjustment, male patients were 30% more likely to
12 have a foot, ankle, or leg problem managed than their female peers at an encounter. Children in age
13 groups 1-4, 5-9, 10-14 and 15-18 years were all more likely to receive care for foot ankle and leg
14 conditions than children aged <1 year. Those aged 10-14 years were 10.2 times more likely than those
15 aged <1 year. Those most disadvantaged were 8% more likely than those who were most advantaged.
16 Male GPs were 13% more likely to provide care for a foot leg or ankle condition than female GPs. GPs
17 aged <45 years were 13% more likely than those aged >55 years. Concession card status, being from
18 a non-English speaking background, Indigenous status, practice location or GP country of training did
19 not have a significant effect on whether a foot, ankle, and leg condition was managed.
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Table 1. Child and GP specific management rate of foot/ankle/leg problems per 100 encounters, 2010-16.

Patient characteristics	Sample size (n=229,137)	Number of problems managed (n = 4694)	Distribution (%) (95% CI) of problems managed by patient and GP characteristics	Characteristic specific rate of problems per 100 encounters	Adjusted odds ratios of a problem being managed at encounter (95% CIs)
Sex (<i>missing</i>)	(1,734)	(38)			p = <0.001
Male	111,448	2490	53.48 (53.5-53.5)	2.23 (2.1-2.3)	1.304 (1.215-1.399)
Female	115,955	2166	46.52 (46.5-46.5)	1.77 (1.8-1.9)	Reference group
Age (<i>missing</i>)		-			p < 0.001
<1 year	30,722	134	2.85 (2.9-2.9)	0.44 (0.4-0.5)	Reference group
1-4 years	68,704	543	11.57 (11.6-11.6)	0.79 (0.7-0.9)	1.746 (1.413-2.157)
5-9 years	45,333	772	16.45 (16.4-16.5)	1.70 (1.6-1.8)	3.776 (3.073-4.640)
10-14 years	39,310	1824	38.86 (38.9-38.9)	4.64 (4.4-4.9)	10.244 (8.412-12.475)
15-18 years	45,068	1421	30.27 (30.3-30.3)	3.15 (3.0-3.3)	7.067 (5.787-8.629)
Socioeconomic level (<i>missing</i>)	(5859)	(122)			p = 0.0498
Most disadvantaged	82,797	1825	39.92 (39.9-39.9)	2.20 (2.1-3.8)	1.080 (1.000-1.166)
Most advantaged	140,481	2747	60.08 (60.1-60.1)	1.96 (1.9-2.0)	Reference group
Health care card (<i>missing</i>)	(19,844)	(410)			p = 0.1716
Health care card	61,166	1293	30.18 (29.9- 30.2)	2.00 (2.0-2.2)	1.092 (1.047-1.138)
No health care card	148,127	2991	69.82 (69.1-69.8)	2.02 (1.9-2.1)	Reference group
Language background (<i>missing</i>)	(24,052)	(502)			p = 0.1477
Non-English speaking	16,009	273	6.51 (6.5-6.5)	1.71 (1.5-1.9)	Reference group
English speaking	189,076	3919	93.49 (93.5-93.5)	2.07 (2.0-2.1)	1.124 (1.051-1.201)
Indigenous status (<i>missing</i>)	(339,873)	(841)			p = 0.9918
Indigenous	5,924	121	3.14 (3.1-3.1)	2.0 (1.7-2.4)	0.999 (0.812-1.229)
Non-Indigenous	183,340	3732	96.86 (96.9-96.9)	2.04 (2.0-2.1)	Reference group
GP sex (<i>missing</i>)	(0)	(0)			p = 0.0013
Male	135,116	2999	63.89 (63.9-63.9)	2.13 (2.1-2.3)	1.131 (1.049-1.218)
Female	94,021	1695	36.10 (36.1-36.1)	1.80 (1.7-1.9)	Reference group
GP age (<i>missing</i>)	(1319)	(21)			p = 0.0076
<45 years	82,041	1660	32.61 (32.6-32.6)	2.02 (1.9-2.1)	1.13 (1.033-1.237)
45-54 years	76,784	1524	31.86 (31.9-31.9)	1.98 (1.9-2.1)	1.027 (0.939-1.123)
55+ years	68,993	1489	35.52 (35.5-35.5)	2.16 (2.0-2.2)	Reference group
Practice location (<i>missing</i>)	(234)	(2)			p = 0.1379
Major cities	166,932	3264	69.57 (69.6-69.6)	1.95 (1.9-2.0)	1.007 (0.0894-1.133)
Inner regional	39,571	928	19.78 (19.8-19.8)	2.36 (2.2-2.5)	1.078 (0.948-1.226)
Outer regional / remote	22,400	500	10.7 (10.7-10.7)	2.25 (2.0-2.5)	Reference group
Country of graduation (<i>missing</i>)	(536)	(8)			p = 0.7471
Australian graduate	157,881	3203	68.35 (68.3-68.4)	2.10 (2.0-2.2)	1.054 (1.010-1.100)
Overseas graduate	70,720	1483	31.65 (31.6-31.7)	2.03 (2.0-2.1)	Reference group
Year					p = 0.0222
					1.010 (1.001-1.018)
Total	229,137		100.0%	2.05 (2.0-2.1)	

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3 *Rate of specific foot, ankle, and leg problems*
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6 Table 2 presents the child- and GP-specific management rate for the most common foot, ankle, and
7 leg problem groups and specific conditions. The most frequently managed problem groupings were
8 injuries (755.9 per 100,000 encounters), followed by infections (458.2) and dermatological conditions
9 (299.4). The most frequent specific conditions were ankle sprains (310.3 per 100,000 encounters),
10 ingrown toenails (272.3) or infected ingrown toenails (135.6), tinea or fungal skin infections (184.6),
11 injuries to the foot/feet (76.4) and foot/feet pain (69.4). In general, management rates for problem
12 groups and specific conditions increased with age until the 10 to 14 years age group, and then
13 reduced in the 15-18 years group, except for the congenital problem groupings.
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Table 2. Management rate of foot/ankle/leg problem groups per 100,000 child encounters, 2000-16.

Specific foot/ankle/leg problem group	N=229,137	Rate per 100,000 encounters (95% CIs) for all ages
Injury	1732	755.9 (718.0-793.8)
Ankle sprain	711	310.3 (286.3-334.2)
Injury foot/feet	175	76.4 (64.9-87.8)
Injury ankle	138	60.2 (49.9-70.6)
Fracture metatarsal	138	60.2 (49.5-70.9)
Fracture ankle	103	45.0 (36.2-53.7)
Fracture toe	93	40.6 (32.4-48.8)
Foot/feet sprain	72	31.4 (24.1-38.8)
Infection	1050	458.2 (429.5-487.0)
Tinea/fungal skin infection	423	184.6 (166.5-202.8)
Infected ingrown toenail	313	136.6 (120.8-152.4)
Onychomycosis/fungus nail	179	78.1 (66.4-89.9)
Cellulitis of the leg	83	36.2 (28.0-44.4)
Pes planus	135	58.9 (45.1-72.7)
Dermatological	686	299.4 (276.0-322.7)
Ingrown toenail	624	272.3 (250.0-294.6)
Corns/callosities	60	26.2 (19.5-32.9)
Unspecified pain	404	176.3 (158.7-193.9)
Pain foot/feet	159	69.4 (58.5-80.2)
Pain leg	127	55.4 (45.6-65.2)
Pain ankle	90	39.3 (31.1-47.5)
Congenital	354	154.5 (135.7-173.3)
Pes planus (flat foot)	135	58.9 (45.1-72.7)
Musculoskeletal	194	84.7 (72.4-96.9)
Plantar fasciitis	64	27.9 (21.0-34.9)
Calcaneal apophysitis (Sever's)	52	22.7 (16.3-29.1)
Non-specific foot/ankle/leg problem	105	45.8 (36.8-54.8)
Management of foot/ankle/leg	42	18.3 (12.8-23.9)
Venous/swelling	34	14.8 (9.9-19.8)
Ischaemia	30	13.1 (8.4-17.8)
Ulceration	27	11.8 (7.3-16.2)
Venous/varicose leg ulcer	21	9.2 (5.2-13.1)
Leg ulcer	19	8.3 (4.6-12.0)
Foot ulcer	6	2.6 (0.5-4.7)
Neuropathy	20	8.7 (4.9-12.5)
Cramps	15	6.5 (3.2-9.9)
Amputation	1	0.4 (0.0-1.3)

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3 Table 3 outlines the management rate for foot, ankle, and leg problem groupings and specific
4 conditions according to age group. The top three most frequently managed problem groupings were
5 similar for all four age groups, with some exceptions in the younger age groups. Injuries (677.2 to
6 1835.7 per 100,000 encounters), infection (386.0 to 905.62), and dermatological conditions (101.5
7 to 877.6) were typically the top three in the older age groups (5 to 9 years, 10 to 14 years, and 15 to
8 19 years), although unspecified pain was the third most common problem group in those aged 5-9
9 years (247.1). For the youngest age group (0 to 4 years), the top three problem groupings were
10 congenital (195.1), infection (191.1) and injury (142.8).
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19 The top three specific conditions were also similar for the older age groups (10-14 and 15-18 years)
20 with ankle sprains (594.7 to 594.7), ingrown toenails (525.9 to 824.2) and infected ingrown toenails
21 (308.4 to 371.4) being the top three in all those age groups. However, for the 0 to 4 years age group,
22 the top three specific conditions were tinea or fungal skin infections (117.0), onychomycosis/fungal
23 nail (56.2), and injuries to the foot/feet (38.2), while in the 5 to 9 years group, they were ankle sprains
24 (308.8), tinea or fungal skin infections (209.7) and leg pain (92.6).
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Table 3. Management rate of paediatric foot/ankle/leg problem groups per 100,000 encounters, 2000-16 for age groupings

Specific foot, ankle, and leg problem group	0-4 years n= 99426	Rate per 100,000 encounters (95% CIs) 0-4 years	5-9 years n=45333	Rate per 100,000 encounters (95% CIs) 5-9 years	10-14 years n=39310	Rate per 100,000 encounters (95% CIs) 10-14 years	15-18 years n=45068	Rate per 100,000 encounters (95% CIs) 15-18 years
Injury	142	142.8 (118.4-167.3)	307	677.2 (600.3-754.1)	772	1836.7 (1693.3-1980.0)	561	1244.8 (1138.4-1351.2)
Ankle sprain	31	31.2 (19.9-42.5)	140	308.8 (256.3-361.4)	272	691.9 (605.5-778.0)	268	594.7 (521.9-667.4)
Injury foot/feet	38	38.2 (25.5-51.0)	31	68.4 (44.4-92.4)	66	167.9 (127.2-208.3)	40	88.8 (61.3-116.2)
Injury ankle	7	7.0 (1.8-12.3)	18	39.7 (21.4-58.0)	57	145.0 (105.5-184.5)	56	124.3 (91.2-157.3)
Fracture metatarsal	12	12.1 (5.2-18.9)	12	26.5 (11.5-41.4)	93	236.6 (184.4-288.4)	21	46.6 (25.8-67.4)
Fracture ankle	5	5.0 (0.6-9.4)	20	44.1 (24.8-63.4)	43	109.3 (76.8-142.0)	35	77.7 (52.0-103.3)
Fracture toe	3	3.0 (0.0-6.4)	13	28.7 (13.1-44.3)	46	117.0 (83.3-150.7)	31	68.8 (44.6-93.0)
Foot/feet sprain	6	6.0 (1.2-10.9)	23	50.7 (30.0-71.4)	30	76.3 (48.2-104.5)	13	28.9 (13.2-44.5)
Infection	190	191.1 (164.6-218.6)	175	386.0 (325.9-446.1)	356	905.62 (810.1-1000.8)	329	730.0 (649.7-810.3)
Tinea/fungal skin infection	117	117 (95.9-139.4)	95	209.7 (166.3-252.8)	114	290.0 (236.6-343.4)	97	215.2 (172.6-257.9)
Onychomycosis/fungus nail	56	56.2 (41.1-71.6)	39	86.0 (59.1-113.0)	34	86.5 (57.5-115.5)	50	110.9 (80.3-141.6)
Infected ingrown toenail	10	10.1 (3.8-16.3)	18	39.7 (21.4-58.0)	146	371.4 (310.4-432.5)	139	308.4 (254.6-362.3)
Cellulitis of the leg	14	14.1 (6.2-22.0)	20	44.1 (23.9-64.4)	28	71.2 (42.2-100.3)	21	46.6 (26.7-66.5)
Dermatological	33	33.2 (21.9-44.4)	46	101.5 (72.2-130.7)	345	877.6 (781.1-973.7)	262	581.3 (508.9-653.7)
Ingrown toenail	30	30.2 (19.4-41.0)	33	72.8 (48.0-97.6)	324	824.2 (731.1-917.1)	237	525.9 (457.5- 594.3)
Corns/callosities	2	2.0 (0.0-4.8)	13	28.7 (13.1-44.3)	21	53.4 (30.6-76.3)	24	53.3 (31.1-75.4)
Unspecified pain	57	57.3 (42.2-72.4)	112	247.1 (199.9-294.2)	143	363.8 (304.4-423.4)	92	204.1 (161.3-247.0)
Pain foot/feet	15	15.1 (7.0-23.2)	39	86.0 (59.1-113.0)	66	167.9 (127.2-208.3)	39	86.5-59.4-113.7)
Pain leg	36	36.2 (24.4-48.0)	42	92.6 (63.4-121.9)	24	61.1 (36.7-85.5)	25	55.5 (32.9-78.0)
Pain ankle	4	4.0 (0.1-8.0)	22	48.5 (28.3-68.8)	37	94.1 (63.9-124.4)	27	59.9 (37.3-82.5)
Congenital	194	195.1 (167.4-222.9)	56	123.5 (90.1-157.0)	80	203.5 (147.8-259.3)	24	53.3 (27.2-79.3)
Pes planus (flat foot)	34	34.2 (22.4-46.0)	32	70.6 (45.4-95.8)	54	137.4 (87.6-187.1)	15	33.3 (10.7-55.9)
Musculoskeletal	11	11.0 (4.5-17.6)	41	90.4 (62.8-118.1)	92	234.0 (183.4-284.2)	50	110.9 (80.3-141.6)
Plantar fasciitis	2	2.0 (0.0-4.8)	15	33.1 (16.4-49.8)	35	89.0 (58.8-119.3)	12	26.6 (11.6-41.7)
Calcaneal apophysitis (Sever's)	-	-	18	39.7 (21.4-58.0)	32	81.4 (52.4-110.4)	2	4.4 (0.0-10.6)
Non-specific foot/ankle/leg problem	34	34.2 (22.4-46.0)	18	39.7 (21.3-58.0)	32	81.4 (53.3-109.6)	21	46.6 (25.8-67.4)
Management of foot/ankle/leg	3	3.0 (0.0-6.4)	2	4.4 (0.0-10.5)	16	40.7 (20.8-60.6)	21	46.6 (26.7-66.5)
Venous/swelling	6	6.0 (1.2-10.9)	5	11.0 (1.4-20.7)	11	28.0 (11.5-44.5)	12	26.6 (11.6-41.7)
Ischaemia	1	1.0 (0.0-3.0)	1	2.2 (0.0-6.5)	8	20.4 (6.3-34.4)	20	44.4 (25.0-63.8)
Ulceration	1	1.00 (0.0-3.0)	6	13.2 (2.6-23.8)	12	30.5 (13.3-47.8)	8	17.8 (5.5-30.0)
Leg ulcer	1	1.0 (0.0-3.0)	3	6.6 (0.0-14.1)	9	22.9 (7.9-37.8)	6	13.3 (2.7-24.0)
Venous/varicose leg ulcer	1	1.0 (0.0-3.0)	4	8.8 (0.18-17.5)	9	22.9 (7.9-37.8)	7	15.5 (4.0-27.0)

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2	Foot ulcer	-	-	2	4.4 (0.0-10.5)	3	7.6 (0.0-15.3)	1	2.2 (0.0-6.6)
3	Neuropathy	1	1.0 (0.0-3.0)	1	2.2 (0.0-6.5)	4	10.2 (0.2-20.1)	14	31.1 (14.8-47.3)
4	Cramps	3	3.0 (0.0-6.4)	2	4.4 (0.0-10.5)	3	7.6 (0.0-15.3)	7	25.5 (4.0-27.0)
5	Amputation	1	6.0 (1.2-10.9)	-	-	-	-	-	-

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Foot, ankle, and leg management strategies

Table 4 reports the most frequently used management strategies by GPs for foot, ankle, and leg problems. The top three most frequent action groupings were provision of medication (47.0 per 100 problems), counselling, advice, or education (25.4) and imaging (25.2). The most specific actions were referral for x-ray (22.7), prescription of antibiotics for systemic use (17.6), and prescription of analgesics (7.9).

Table 4. Management actions used by GPs for paediatric foot/ankle/leg problems, 2000-2016.

Management action	n	Rate per 100 problems (95% CIs)
Medication (any)	2205	47.0 (45.2-48.8)
<i>Antibiotics for systemic use</i>	824	17.6 (16.4-18.7)
Cephalexin	480	10.2 (9.2-11.1)
Flucloxacillin	104	2.2 (1.8-2.7)
Dicloxacillin	58	1.2 (0.9-1.6)
<i>Analgesics</i>	370	7.9 (7.6-8.6)
Non-opioid analgesics	311	6.6 (5.9-7.4)
Paracetamol	277	5.9 (5.2-6.6)
Opioid analgesics	59	1.3 (0.9-1.6)
Codeine/paracetamol	55	1.2 (0.9-1.5)
Oxycodone	4	0.1 (0.0-0.2)
Tramadol	3	0.1 (0.0-0.1)
<i>Anti-inflammatory and antirheumatic products</i>	228	4.9 (4.2-5.5)
Ibuprofen	163	3.5 (2.9-4.0)
Meloxicam	11	0.3 (0.1-0.4)
Diclofenac (oral)	26	0.6 (0.3-0.8)
Diclofenac (topical)	35	0.8 (0.5-1.0)
<i>Antifungals for dermatological use</i>	354	7.5 (6.7-8.3)
Terbinafine (oral)	27	0.6 (0.4-0.8)
Terbinafine (topical)	67	1.4 (1.1-1.8)
Clotrimazole	117	2.5 (2.0-2.9)
<i>Corticosteroids for dermatological use</i>	120	2.6 (2.1-3.0)
Hydrocortisone	16	0.3 (0.2-0.5)
Procedures	997	21.2 (19.9-22.6)
Imaging	1185	25.2 (23.8-26.7)
Ultrasound	75	1.6 (1.2-2.0)
Xray	1064	22.7 (21.3-24.0)
Pathology	272	5.8 (4.6-7.0)
Full blood count	38	0.8 (0.5-1.1)
C-reactive protein	13	0.3 (0.1-0.4)
Nail scraping/culture	19	0.4 (0.2-0.6)
Skin swab/culture	16	0.3 (0.2-0.5)
Fungal scraping/culture	41	0.9 (0.6-1.1)
Counselling/advice/education	1192	25.4 (24.0-26.8)
Referral	749	16.0 (14.8-17.1)
Podiatrist	182	3.9 (3.3-4.5)
Orthopaedic surgeon	158	3.4 (2.8-3.9)
General surgeon	65	1.4 (1.0-1.7)
Physiotherapist	167	3.5 (3.0-4.1)

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3 Table 5 outlines the management strategies used according to age group. The top three most
4 frequent management strategies were similar for the 5 to 9 years and 10 to 14 years age groups,
5 although both the 0 to 4 years and 15 to 18 years exhibited different management patterns. For the
6 5 to 9 years and 10 to 14 years groups, the top three management strategies included medication
7 prescription or advice (43.3 and 45.3 per 100 problems), imaging referral (27.2 and 30.7) and
8 counselling, advice or education (25.8 and 27.7). In the 0 to 4 years group, the top three management
9 strategies were medication prescription or advice (38.2), referral to another health professional
10 (23.2) and counselling, advice, or education (21.2), whereas in the 15-18 years age group, it was
11 medication prescription or advice (55.3), procedures, 24.4) and imaging referral (24.3). The top
12 specific management strategies were similar for the 5 to 9 years and 10-14 years age groups. These
13 were referrals for x-rays (24.6 to 28.4 per 100 problems), prescription of antibiotics for systemic use
14 (11.1 to 20.4) and analgesics (7.7 to 9.5). The 0 to 4 age group top management strategies were
15 referral for x-ray (15.2), antifungals for dermatological use (12.7) and prescriptions of antibiotics for
16 systemic use (9.0), whereas, in the 15 to 18 years age group, the top three were prescription of
17 antibiotics for systemic use (21.1), referral for x-ray (20.6) and analgesia (9.1).
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Table 5. Management actions used by GPs for paediatric foot/ankle/leg problems, 2000-2016 for age groupings

Management action	0-4 years n=677	Rate per 100 problems (95% CIs) for 0-4 years	5-9 years n=772	Rate per 100 problems (95% CIs) for 5-9 years	10-14 years n=1824	Rate per 100 problems (95% CIs) for 10-14 years	15-18 years n=1421	Rate per 100 problems (95% CIs) or 15-18 years
Medication (any)	259	38.2 (34.0-42.5)	334	43.3 (39.0-47.5)	826	45.3 (42.5-48.1)	786	55.3 (52.0-58.6)
<i>Antibiotics for systemic use</i>	61	9.0 (6.8-11.2)	86	11.1 (8.9-13.4)	373	20.4 (18.5-22.4)	304	21.4 (19.2-23.6)
Cephalexin	36	5.3 (3.6-7.0)	45	5.8 (4.2-7.5)	216	11.8 (10.2-13.3)	183	12.9 (11.1-14.7)
Flucloxacillin	6	0.9 (0.2-1.6)	14	1.8 (0.9-2.8)	48	2.6 (1.3-3.4)	36	2.5 (1.7-3.4)
Dicloxacillin	-	-	-	-	30	1.6 (1.0-2.2)	28	2.0 (1.2-2.7)
<i>Analgesics</i>	27	4.0 (2.5-5.5)	73	9.5 (7.3-11.6)	140	7.7 (6.4-9.0)	130	9.1 (7.6-10.7)
Non-opioid analgesics	26	3.8 (2.4-5.3)	71	9.2 (7.0-11.4)	123	6.7 (5.8-7.9)	91	6.4 (5.1-7.7)
Paracetamol	22	3.2 (1.9-4.6)	62	8.0 (6.1-10.0)	114	6.3 (5.4-7.4)	79	5.6 (4.3-6.8)
Opioid analgesics	1	0.1 (0.0-0.4)	2	0.3 (0.0-0.6)	17	0.9 (0.0-1.4)	39	2.7 (1.9-3.6)
Codeine/paracetamol	3	0.4 (0.00-0.9)	1	0.1 (0.0-0.4)	16	0.9 (0.7-1.3)	35	2.5 (1.6-3.3)
Oxycodone	-	-	1	0.1 (0.0-0.4)	1	0.1 (0.0-0.2)	2	0.1 (0.0-0.3)
Tramadol	-	-	-	-	1	0.1 (0.0-0.2)	2	0.1 (0.0-0.3)
<i>Anti-inflammatory and antirheumatic products</i>	10	1.5 (0.6-2.4)	32	4.1 (2.7-5.6)	86	4.7 (3.5-5.7)	100	7.0 (5.7-8.4)
Ibuprofen	6	0.9 (0.2-1.6)	31	4.0 (2.6-5.4)	69	3.8 (2.8-4.7)	57	4.0 (3.0-5.0)
Meloxicam	1	0.1 (0.0-0.4)	-	-	2	-	8	0.6 (0.2-1.0)
Diclofenac (oral)	1	0.1 (0.0-0.4)	-	-	10	0.5 (0.0-0.9)	15	1.1 (0.5-1.6)
Diclofenac (topical)	2	0.3 (0.0-0.7)	5	0.6 (0.1-1.2)	15	0.8 (0.0-1.2)	13	0.9 (0.4-1.4)
<i>Antifungals for dermatological use</i>	86	12.7 (10.2-15.3)	73	9.5 (7.3-11.6)	97	5.3 (4.4-6.4)	98	6.9 (5.5-8.3)
Terbinafine (oral)	5	0.7 (0.1-1.4)	5	0.6 (0.1-1.2)	10	0.5 (0.0-0.9)	7	0.5 (0.1-0.9)
Terbinafine (topical)	6	0.9 (0.2-1.6)	19	2.5 (1.4-3.6)	19	1.0 (0.3-1.5)	23	1.6 (1.0-2.3)
Clotrimazole	42	6.2 (4.4-8.0)	21	2.7 (1.6-3.9)	31	1.6 (1.0-2.3)	8	1.6 (1.0-2.3)
<i>Corticosteroids for dermatological use</i>	38	5.6 (3.8-7.4)	30	3.8 (2.5-5.3)	26	1.4 (0.9-2.0)	26	1.8 (1.1-2.6)
Hydrocortisone	9	1.3 (0.5-2.2)	4	0.5 (0.01-1.0)	2	-	1	0.1 (0.0-0.2)
Procedures	60	8.9 (1.2-6.4)	138	17.9 (14.8-20.9)	452	24.8 (22.5-27.1)	347	24.4 (21.8-27.0)
Imaging	107	15.8 (12.8-18.8)	236	30.7 (27.8-34.3)	496	27.2 (24.9-29.5)	346	24.3 (21.9-26.8)
Ultrasound	4	0.6 (0.01-1.2)	10	1.3 (0.5-2.1)	33	1.8 (1.1-2.4)	25	2.0 (1.2-2.7)
Xray	103	15.2 (12.3-18.2)	219	28.4 (24.8-31.9)	449	24.6 (19.0-26.8)	293	20.6 (18.6-22.8)
Pathology	41	6.1 (2.8-9.3)	61	7.9 (4.4-11.4)	86	4.7 (3.0-6.5)	84	5.9 (3.8-8.0)
Full blood count	6	0.8 (0.4-1.6)	13	1.0 (0.8-2.6)	10	0.5 (0.0-0.9)	9	0.6 (0.2-1.0)
C-reactive protein	4	0.6 (0.01-1.2)	3	0.4 (0.0-0.8)	3	0.2 (0.0-0.4)	3	0.2 (0.0-0.4)
Nail scraping/culture	2	0.3 (0.1-0.7)	3	0.4 (0.0-0.8)	4	0.2 (0.0-0.4)	10	0.2 (0.3-0.4)

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2	Skin swab/culture	1	0.1 (0.0-0.4)	1	0.1 (0.0-0.4)	11	0.6 (0.0-1.0)	3	0.1 (0-0.5)
3	Fungal scraping/culture	8	1.2 (0.4-2.0)	8	1.0 (0.3-1.8)	16	0.9 (0.0-1.3)	9	0.6 (0.2-1.0)
4	Counselling/advice/education	179	21.2 (19.9-22.6)	214	27.7 (24.4-31.1)	471	25.8 (23.6-28.0)	328	23.1 (20.7-25.4)
5	Referral	157	23.2 (19.8-26.6)	112	14.5 (11.9-17.2)	277	15.2 (13.4-16.9)	203	14.3 (12.4-16.2)
6	Podiatrist	18	2.7 (1.3-4.1)	39	5.1 (3.5-6.6)	85	4.7 (3.7-3.1)	40	2.8 (2.0-3.7)
7	Orthopaedic surgeon	51	7.5 (5.5-9.5)	23	3.0 (1.8-4.2)	44	2.4 (1.7-3.1)	40	2.8 (1.9-3.7)
8	General surgeon	1	0.1 (0.0-0.4)	3	0.2 (0.0-0.8)	32	1.8 (1.1-2.4)	29	2.0 (1.3-2.8)
9	Physiotherapist	26	3.8 (2.4-5.3)	21	2.7 (1.5-3.9)	61	3.3 (2.0-4.2)	59	4.2 (3.1-5.2)

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Discussion

This study was one of the first to investigate the national management of children's foot, ankle, and leg conditions by GPs. Findings suggest Australian GPs commonly manage children's lower limb problems, and more frequently in males and older children. Injury, infection, and dermatological conditions presented most frequently to GPs across all ages and medications were the most frequently used management strategy. The frequency of specific problems managed, and the management strategies used, varied across the different age groupings, such as differing rates of congenital problems, or differing prescription or advice of medications. GPs also commonly provided counselling, advice and education for all ages, an appropriate management strategy for concerned parents, and a common first stage management strategy for many benign congenital, or undefined foot, ankle, or leg problems or while undergoing further testing to refine diagnosis.

Children from more disadvantaged socioeconomic areas had a significantly higher GP management rate of foot, leg and ankle conditions than their peers in more advantaged areas. This presentation is consistent with other studies on children's healthcare in countries with socialised medicine, and reflects a complex interaction between health literacy of parents or the knowledge or financial ability for parents to seek health care information or alternate care providers without a GP recommendation, such as seeing a podiatrist or physiotherapist for their children's foot, ankle or leg concerns.[25, 26]

Foot, ankle, and leg problems differed across age groupings and in general, increased with age. The presentations patterns extracted from this dataset related to foot, ankle, or leg concerns potentially reflect the different key skeletal and developmental stages. Younger children presented more with congenital lower limb concerns, while older children presented with more dermatological (e.g., tinea or ingrown toenails) or injury (e.g., ankle sprain) concerns. These presentation patterns align with key gross motor or developmental stages and may also align with the different health professional referral patterns. For example, there were higher numbers of congenital foot problems in younger children, and more frequent referrals to orthopaedic surgeons than in older age groups. In contrast, injuries were more common in older children, who were referred more often to podiatrists and physiotherapists. These patterns may reflect the more emergent nature of ensuring right timed surgical care at key osseous stages versus providing rehabilitation during injury recovery or individualised skin or nail care advice.

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3 Injury was the primary problem managed in all ages. This may be due to different mechanisms of
4 injuries occurring across childhood such as those occurring in the playground, or during social or
5 organised sport.[27-30] Despite how injuries may have occurred, common management strategies
6 extracted from this dataset included frequent medical imaging. Ultrasound and x-rays were the most
7 common imaging methods, with fewer ordered than frequency of injury presentations. This suggests
8 conservative and judicious imaging referrals, and potential use of injury imaging referral guidelines,
9 such as the Ottawa Ankle Rules.[31]
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16 Antibiotic stewardship and pain management medication strategies elicited from this dataset also
17 mirror prescribing guidelines established for general practice relating to childhood presentations
18 involving the lower limb for the timeframe data were extracted.[32] For example, at the time of data
19 collection, cephalexin was commonly prescribed in a suspension for children to treat mild skin
20 infections (e.g., cellulitis) while narrow spectrum antibiotics such as flucloxacillin and dicloxacillin
21 were the recommended antibiotics for infected skin relating to infected ingrown toenail
22 presentations.[32] Similarly, the use of non-opioid pain medications exceeded opioid prescriptions,
23 consistent with recommended actions for pain management practices.[32] We did not undertake
24 direct comparisons between the problem managed and corresponding management strategy during
25 this analysis; however, these patterns suggest that medication management practices align with best
26 practice clinical guidelines.
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Contrary to this, it was surprising to see fewer musculoskeletal conditions recorded within the dataset, despite epidemiological studies finding that 12% of children report or seek care for leg or foot pain relating to specific musculoskeletal conditions.[33] The low frequency rates we observed within this dataset may be related to several factors. The most likely reason is how these problems were recorded by the GP. Underpinning how problems were recorded may be limited knowledge about less common foot, ankle or leg conditions, lower presentation rates of foot, ankle or leg conditions to GPs compared with hospital outpatients, the single point data collection used in the BEACH dataset that captures a problem as a symptom with as yet unknown diagnosis (e.g., waiting test results for confirmation) and relevant management guidelines of the time.

The low frequency of musculoskeletal concerns recorded within this dataset may also reflect different health literacy in parents and its association with not seeking care from GPs, or misdiagnosis. One potential example of this was the frequency of plantar fasciitis diagnoses recorded across younger ages (33.1 per 100,000 in the 5-9 year group and 89.0 per 100,000 in the 10 to 14

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3 year group). Plantar fasciitis is rarely reported in contemporary paediatric orthopaedic literature, and
4 if diagnosed on ultrasound, associated with being an older and highly athletic adolescent than the
5 ages in this dataset.[34] Heel pain in older children is more likely to be calcaneal apophysitis. This
6 diagnosis was recorded as 39.1 per 100,000 encounters in 5-9 year grouping and 81.4 in 10-14 year
7 grouping, and at a less frequent rate than plantar fasciitis in the 10-14 year age grouping, despite this
8 being the age when foot apophyseal injuries are most prevalent.[3] Other conditions also resulting
9 in childhood plantar heel pain include inflammatory disease, infection (including osteomyelitis) or
10 post-viral joint pain, all presenting more commonly than plantar fasciitis in younger age
11 groupings.[35] Management strategies of these heel pain conditions differ significantly, making it
12 imperative for timely and accurate diagnosis to minimise health care wastage, and prevent
13 development of chronic pain.[36]

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24 Recently there has been a global call to action on improving primary care diagnosis and assessment
25 of musculoskeletal conditions in childhood to minimise misdiagnosis and reduce the development of
26 disability and chronic pain.[37] Simple assessments and screening tools have been implemented to
27 support general practice, such as the paediatric Gait, Legs and Spine (p-GALS) screen,[38] and free
28 online generic health professionals training to improve paediatric musculoskeletal condition
29 diagnoses.[39] These resources have been developed in acknowledgement of limited exposure to
30 paediatric musculoskeletal conditions during medical training,[40] less common presentations in
31 childhood compared to other childhood complaints such as ear infections or upper respiratory tract
32 infection leading to low confidence in diagnostic skills of musculoskeletal conditions,[41] knowledge
33 deficits of the types of common paediatric musculoskeletal presentations,[42] and serious long term
34 consequences of some musculoskeletal conditions missed or misdiagnosed.[37] Our findings of GPs
35 reporting unspecified pain or conditions known to be more prevalent in adults than children suggests
36 that Australian GPs may require additional support to diagnose and manage musculoskeletal
37 conditions in childhood. Future research may include development of guidelines and supporting
38 models of care for children's foot, ankle, or leg problems to determine if these improve health
39 outcomes, reduce the progressive nature of many musculoskeletal conditions and pain syndromes
40 and if these are cost-effective.

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56 This study is the first to our knowledge, to examine the full spectrum of childhood foot, ankle, or leg
57 presentations in primary care and how these are managed. The data extracted from a large and
58 representative sample of Australian GPs provides an extensive snapshot of practice to guide future
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3 directions for education, guideline development and models of care for childhood foot, ankle, or leg
4 conditions. A limitation of this study is the historical nature of the data, and that education, practice
5 and models of care may have evolved between the 2016 end date of BEACH and data analysis. Known
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7 paediatric model of care and referral changes in some Australian state and territories occurred in late
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9 2015,[43] which may have resulted in improved management of conditions through several
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11 guidelines, recommended assessments and when to refer to orthopaedic surgeons for several
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13 specific musculoskeletal conditions. The way in which conditions were recorded by the GP, then
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15 coded and classified, presents a broad representation of the conditions, as ICPC-2 PLUS and ICPC-2
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17 do not contain sufficient specificity to capture severity. Even in ICD-10[22] for example, the code for
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19 congenital pes planus combines benign, and often asymptomatic paediatric flexible flat foot with
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21 other types of flat foot. We acknowledge that asymptomatic flat foot rarely requires treatment and
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23 is often managed by providing reassurance to families. However, the ICD-10 inclusion also captures
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25 the rigid flat foot, which is commonly symptomatic, or flat foot due to spasticity, both requiring
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27 conservative or surgical management by allied health or medical specialists. As a result of the
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29 methodology, this paper did not allow for detailed analysis of care trajectories and outcomes. Also,
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31 the single point in time data collection method means that the diagnosis may have changed with
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33 results of tests or following specialist referral. Regardless, this dataset of encounters and
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35 management strategies provides a robust baseline on which future guidelines and implementation
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37 studies can measure the outcomes of practice change over time.

41 **Conclusion**

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43 Childhood foot, ankle and leg conditions are a common reason parents bring their children to a GP in
44
45 Australia. Frequencies of presentations vary according to developmental stage with potential under
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47 reporting of musculoskeletal conditions. Future studies should consider how to support GPs in
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49 managing childhood musculoskeletal conditions to minimise disability and development of chronic
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51 pain. These actions have the potential to reduce long term burden of disease.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

The data that support the findings of this study are available from BEACH, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of BEACH.

Author Contributions

CW and PL conceived this study with authors HBM, JG and CH contributing to data extraction plan. CH undertook data extraction and analysis; CW developed the first draft of the manuscript with all authors providing critical review. All authors approved the final draft for submission

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4 number: N/A; bioCSL (Australia) Pty Ltd, Award number: (N/A); GlaxoSmithKline Australia Pty Ltd,
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23 *Competing interest's statement:*

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25 The authors declare no competing interests.
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3 **Figure 1.** The management rate of children's foot, ankle and leg problems managed by Australian GPs
4 between April 2000 and March 2016 (aged 0-18 years). Blue line represents problems per 100
5 encounters, orange line represents problems per 100 children (Error bars = 95% CI).
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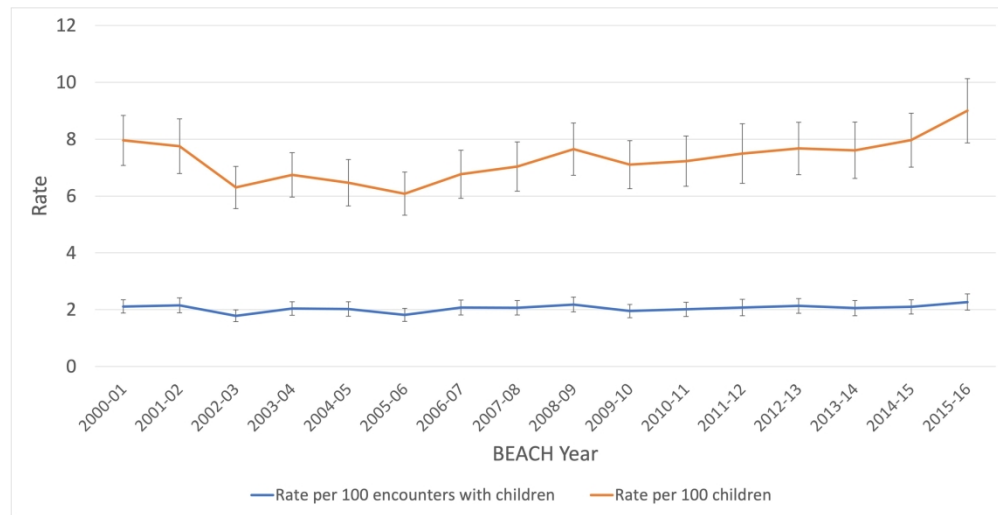


Figure 1. The management rate of children's foot, ankle and leg problems managed by Australian GPs between April 2000 and March 2016 (aged 0-18 years). Blue line represents problems per 100 encounters, orange line represents problems per 100 children (Error bars = 95% CI).

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Supplementary dataset 1: ICPC2-Plus codes related to foot, ankle, and lower leg conditions.

ICPC-2 Plus code	Label	Category
A29030	Problem;foot/feet;diabetes	Non-specific foot/ankle/lower leg disorder
A31033	Exam;foot/feet	Management
A66020	Referral;podiatrist/chiroprapist	Management
A67028	Referral;foot clinic	Management
K07001	Oedema;ankle/foot/feet	Venous / swelling
K07002	Swollen;ankle	Venous / swelling
K07003	Dropsy	Venous / swelling
K07004	Swollen;foot/feet	Venous / swelling
K07005	Swollen;ankle;non-traumatic	Venous / swelling
K07008	Oedema;dependent	Venous / swelling
K07009	Oedema;leg	Venous / swelling
K07010	Swollen;leg	Venous / swelling
K07013	Oedema;peripheral	Venous / swelling
K07014	Oedema;ankle	Venous / swelling
K07014	Oedema;ankles	Venous / swelling
K07015	Oedema;feet	Venous / swelling
K07015	Oedema;feet	Venous / swelling
K92001	Disease;Buerger's	Ischaemia
K92002	Disease;Raynauds	Ischaemia
K92003	Disease;peripheral vascular	Ischaemia
K92004	Gangrene	Ischaemia
K92006	Ischaemia;limb (gangrene)	Ischaemia
K92010	Raynauds phenomenon	Ischaemia
K92016	Vasospasm;peripheral	Ischaemia
K92017	Claudication;intermittent	Ischaemia
K92031	Disease;small vessel	Ischaemia
K95001	Eczema;varicose	Venous / swelling
K95002	Stasis;venous	Venous / swelling
K95004	Insufficiency;venous	Venous / swelling
K95005	Varicose veins;inflamed;leg	Venous / swelling
K95006	Varicose veins;leg	Venous / swelling
K95007	Dermatitis;stasis	Venous / swelling
K95008	Rupture;varicose vein	Venous / swelling
L14005	Pain;musculoskeletal;leg	Unspecified pain
L14006	Pain;leg	Unspecified pain
L14008	Cramp(s);nocturnal/night	Cramps
L14010	Sympt/complaint;leg	Non-specific foot/ankle/lower leg disorder
L14014	Cramp(s);leg	Cramps
L14016	Cramp(s);calf	Cramps
L16001	Pain;ankle	Unspecified pain
L16002	Pain;musculoskeletal;ankle	Unspecified pain
L16004	Sympt/complaint;ankle	Non-specific foot/ankle/lower leg disorder
L16005	Unstable;ankle	Musculoskeletal

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3	L16006	Stiffness;ankle	Non-specific foot/ankle/lower leg disorder
4	L17001	Pain;foot/feet	Unspecified pain
5	L17002	Pain;musculoskeletal;foot/feet	Unspecified pain
6	L17003	Pain;toe(s)	Unspecified pain
7	L17004	Pain;musculoskeletal;toe(s)	Unspecified pain
8	L17007	Sympt/complaint;foot/feet	Non-specific foot/ankle/lower leg disorder
9	L17008	Sympt/complaint;toe(s)	Non-specific foot/ankle/lower leg disorder
10	L17011	Metatarsalgia	Non-specific foot/ankle/lower leg disorder
11	L17012	Pain;heel	Unspecified pain
12	L17013	Cramp(s);foot/feet	Cramps
13	L17014	Stiffness;toe(s)	Non-specific foot/ankle/lower leg disorder
14	L17015	Swelling;toe(s)	Non-specific foot/ankle/lower leg disorder
15	L40003	Arthroscopy;ankle	Management
16	L40005	Arthroscopy;foot/feet	Management
17	L41026	X-ray;foot/feet	Management
18	L41027	X-ray;ankle	Management
19	L41037	X-ray;toe(s)	Management
20	L41038	X-ray;heel	Management
21	L41039	X-ray;tibia/fibula	Management
22	L41066	X-ray;leg lower	Management
23	L41068	X-ray;metatarsal	Management
24	L41071	Ultrasound;ankle	Management
25	L41076	Ultrasound;foot/toe(s)	Management
26	L41094	CT scan;foot/feet	Management
27	L41095	CT scan;ankle	Management
28	L41114	MRI;ankle	Management
29	L41115	MRI;foot/feet	Management
30	L45006	Advice/education;footwear	Management
31	L52009	Amputation;non-traumatic	Amputation
32	L52012	Amputation;below knee	Amputation
33	L52013	Amputation;above knee	Amputation
34	L52016	Amputation;foot	Amputation
35	L52019	Amputation;toe(s)	Amputation
36	L54002	Adjusting;orthopaedic shoes	Management
37	L54023	Fitting (of);brace;leg	Management
38	L54025	Fitting (of);orthopaedic shoe	Management
39	L54029	Reconstruction;ankle	Management
40	L54032	Reconstruction;foot/feet	Management
41	L54032	Reconstruction;foot/feet	Management
42	L54039	Adjusting;brace;leg	Management
43	L54051	Treat;fract/disloc;ankle	Management
44	L54058	Treat;fract/disloc;fibula	Management
45	L54066	Treat;fract/disloc;metatarsal	Management
46	L54082	Treat;fract/disloc;tibia	Management
47	L54083	Treat;fract/disloc;toe(s)	Management
48	L54092	Replace;joint;ankle	Management
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L73001	Fracture;fibula	Injury
L73002	Fracture;ankle	Injury
L73003	Fracture;Potts	Injury
L73004	Fracture;tibia	Injury
L73005	Fracture;malleolus;medial	Injury
L73006	Fracture;malleolus;lateral	Injury
L73007	Fracture;malleolus	Injury
L73009	Fracture;tibia and fibula	Injury
L74002	Fracture;foot/feet	Injury
L74005	Fracture;metatarsal(s)	Injury
L74007	Fracture;tarsal(s)	Injury
L74010	Fracture;toe(s)	Injury
L74012	Fracture;calcaneus	Injury
L77001	Sprain;ankle	Injury
L77002	Strain;ankle	Injury
L79014	Sprain;foot/feet	Injury
L79018	Strain;foot/feet	Injury
L79036	Shin splints	Musculoskeletal
L80004	Dislocation;foot/feet	Injury
L80012	Dislocation;ankle	Injury
L80023	Dislocation;toe(s)	Injury
L81019	Injury;toe	Injury
L81022	Injury;ankle	Injury
L81025	Injury;foot/feet	Injury
L81030	Haemarthrosis;ankle	Injury
L82003	Clubfoot	Congenital
L82005	Bowlegged;congenital	Congenital
L82008	Knock-knee;congenital	Congenital
L82009	Pigeon toed	Congenital
L82014	Talipes	Congenital
L82016	Feet turned in	Congenital
L82017	Genu valgum;congenital	Congenital
L82025	Deformity;foot;congenital	Congenital
L82029	Hemimelia	Congenital
L82032	Feet turned out	Congenital
L82033	Deformity;ankle;congenital	Congenital
L87017	Calcaneal spur	Musculoskeletal
L87024	Fasciitis;plantar	Musculoskeletal
L87029	Bursitis;heel	Musculoskeletal
L91016	Arthritis;ankle	Musculoskeletal
L91017	Osteoarthritis;ankle	Musculoskeletal
L91018	Arthritis;foot/feet	Musculoskeletal
L91019	Osteoarthritis;foot/feet	Musculoskeletal
L91021	Osteoarthritis;toe(s)	Musculoskeletal
L91023	Arthritis;toe(s)	Musculoskeletal
L94014	Severs disease	Musculoskeletal

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3	L98001	Bunion	Musculoskeletal
4	L98002	Clubfoot;acquired	Musculoskeletal
5	L98003	Bowlegged	Congenital
6	L98004	Pes planus (flat foot)	Congenital
7	L98006	Hammer toe	Musculoskeletal
8	L98007	Hallux;valgus	Musculoskeletal
9	L98008	Hallux;rigidus	Musculoskeletal
10	L98011	Pes cavus (claw foot)	Congenital
11	L98013	Genu valgum;knock knee	Congenital
12	L98015	Deformity;limb;acquired	Musculoskeletal
13	L98017	Deformity;foot;acquired	Musculoskeletal
14	L98018	Deformity;ankle;acquired	Musculoskeletal
15	L99105	Arthropathy;Charcot	Neuropathy
16	N04001	Restless legs syndrome	Neuropathy
17	N05001	Burning;sensation;extremities	Neuropathy
18	N05005	Tingling;feet/toes	Neuropathy
19	N05006	Paraesthesia	Neuropathy
20	N06022	Numbness;toe(s)	Neuropathy
21	N06023	Numbness;foot	Neuropathy
22	N06024	Numbness;leg	Neuropathy
23	N18002	Footdrop	Neuropathy
24	N94012	Neuropathy; diabetic	Neuropathy
25	N94016	Mononeuritis;legs	Neuropathy
26	N94018	Neuritis;peripheral	Neuropathy
27	S09005	Infection;toe(s)	Infection
28	S09010	Abscess;toe(s)	Infection
29	S09011	Cellulitis;toe(s)	Infection
30	S11019	Infection;ingrown toenail	Infection
31	S20001	Corns	Dermatological
32	S20002	Callosities	Dermatological
33	S21021	Sympt/complaint;skin;heel	Dermatological
34	S46002	Consult;podiatrist	Management
35	S52022	Resection;ingrown toenail(s)	Management
36	S52026	Removal;toenail(s)	Management
37	S59002	Podiatry	Management
38	S74001	Athletes foot	Infection
39	S74004	Infection;fungus;nail(s)	Infection
40	S74005	Infection;fungus;skin	Infection
41	S74006	Mycosis;skin	Infection
42	S74009	Tinea	Infection
43	S74015	Onychomycosis	Infection
44	S74018	Tinea pedis	Infection
45	S74025	Mycetoma	Infection
46	S76009	Pitted keratolysis	Infection
47	S76015	Cellulitis;leg	Infection
48	S76016	Cellulitis;foot/feet	Infection
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3	S94002	Ingrown;toenail(s)	Dermatological
4	S97004	Ulcer;varicose	Ulceration
5	S97008	Ulcer;leg	Ulceration
6	S97012	Ulcer;foot	Ulceration
7	S97013	Ulcer;diabetic	Ulceration
8	S97014	Ulcer;venous	Ulceration
9	S97016	Ulcer;toe(s)	Ulceration
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For peer review only

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	3-4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	6
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	6-7
Study size	10	Explain how the study size was arrived at	N/A
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7
		(b) Describe any methods used to examine subgroups and interactions	7
		(c) Explain how missing data were addressed	7
	7	(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	7
		(e) Describe any sensitivity analyses	N/A

Continued on next page

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-9
		(b) Indicate number of participants with missing data for each variable of interest	N/A
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	N/A
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	N/A
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	8-9
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9
		(b) Report category boundaries when continuous variables were categorized	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9-18
Discussion			
Key results	18	Summarise key results with reference to study objectives	19
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	22
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	20-21
Generalisability	21	Discuss the generalisability (external validity) of the study results	20
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	N/A

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Australian children's foot, ankle, and leg problems in primary care: a secondary analysis of the Bettering the Evaluation and Care of Health (BEACH) data

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Australian children's foot, ankle, and leg problems in primary care: a secondary analysis of the Bettering the Evaluation and Care of Health (BEACH) data

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Abstract

Objectives:

To explore children's foot, ankle and leg consultation patterns and management practices in Australian primary care.

Design:

Cross-sectional, retrospective study

Setting:

Australia Bettering the Evaluation and Care of Health program dataset.

Participants:

Data were extracted for GPs and patients ≤ 18 years from April 2000 to March 2016 inclusive.

Main outcome measures:

Demographic characteristics: sex, GP age groups (i.e. <45, 45-54, 55+ years), GP country of training, patient age grouping (0-4, 5-9, 10-14, 15-18 years), postcode, concession card status, Indigenous status, up to three patient encounter reasons, up to four encounter problems/diagnoses, and the clinical management actioned by the GP.

Results:

Children's foot, ankle or leg problems were managed at a rate of 2.05 (95% CI 1.99 to 2.11) per 100 encounters during 229,137 GP encounters with children. There was a significant increase in the rate of foot, ankle and leg problems managed per 100 children in the population, from 6.1 (95% CI: 5.3-6.8) in 2005-06 to 9.0 (95% CI: 7.9-10.1) in 2015-16. Management of children's foot, ankle and leg problems were independently associated with male patients (30% more than female), older children (15-18 years were 7.1 times more than <1 years), male GPs (13% more) and younger GPs (<45 years of age 13% more than 55+). The top four most frequently managed problems were injuries (755.9 per 100,000 encounters), infections (458.2), dermatological conditions (299.4) and unspecified pain (176.3). The most frequently managed problems differed according to age grouping.

Conclusions:

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3 Children commonly present to GPs for foot, ankle, and leg problems. Presentation frequencies
4 varied according to age. Unexpectedly, conditions presenting commonly in adults, but rarely in
5 children, were also frequently recorded. This data highlights the importance of initiatives
6 supporting contemporary primary care knowledge of diagnoses and management of paediatric
7 lower limb problems to minimise childhood burden of disease.
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15 **Article Summary**

16 *Strengths and limitations of this study:*

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20 - This study uses data extracted from the Bettering the Evaluation and Care of Health (BEACH)
21 dataset between 2010-2016 to examine the full spectrum of childhood foot, ankle, or leg
22 presenting to, and managed by Australian general practitioners (GPs).
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- 26 - This method allows for a nationally representative sample of presentations for children, and
27 characteristics of GPs who manage these presentations.
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- 30 - It is not possible to estimate the impact of these conditions on children, how individual cases
31 were managed or the outcome of management with this dataset.
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- 34 - This study may be limited by how GPs recorded children's foot, ankle and leg problem
35 presentation and management data.
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40 *Word count:* 3897

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43 **Key words:** child, adolescent, musculoskeletal pain, foot; foot injuries; foot diseases; primary health
44 care; general practice;
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Background

Childhood foot, ankle and leg concerns are thought to be common, but their prevalence and incidence vary widely according to age and are inconsistently reported. For example, the prevalence estimates for flexible flat foot vary from 2 to 44% of children,[1, 2] while the incidence of calcaneal apophysitis ranges from 0.37 to 0.60 per 100 person-years,[3] These wide variations seem to depend on age, developmental stage, sporting participation or differences in epidemiological study setting. Similarly, little is known about the frequencies of conditions relating to the foot, ankle or leg in children that cause pain or functional impact or trouble their parents enough to result in families seeking management in primary care.

Key developmental stages in childhood present opportunities for optimal foot and leg condition management, particularly for conditions relating to musculoskeletal complaints, neurological conditions, or inflammatory disease. Early interventions for these higher burden conditions are important to initiate early to reduce long term disability and prevent chronic pain development. Conversely, delayed diagnosis, delayed access to care or provision of non-evidence informed care can be detrimental to long term outcomes,[4] family burden[5] and permanent disability[6]. Primary care providers are commonly the first contact for non-emergency health care. Therefore, understanding contemporary practice in primary care allows for improved focus for finite health care resources, training and guidelines, to improve health outcomes[7], reduce health care waste[8], and design effective public policies or prevention strategies to minimise long term impacts.[9].

In Australia, primary care services are frequently provided by general practitioners (GPs) on a 'fee for service' model with fees primarily covered through Medicare, the Australian Government funded medical insurance scheme.[10] Medicare also provides subsidies for other healthcare services including diagnostic imaging and pathology tests. The Pharmaceutical Benefits Scheme provides subsidies for prescribed medicines.[11] GPs can also provide referrals to medical specialists for subsidised medical specialist care, such as to orthopaedic surgeons, and in limited circumstances (e.g. for chronic medical conditions) to subsidised allied health professional care, such as to podiatrists.[11] Therefore, GP presentation and management data provides rich information about health problems in Australia.

Despite this, little is known about how GPs manage foot and leg problems in children in Australia, and even less about their management practices. It is important to know the frequencies of children's

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3 foot, ankle, and leg problems and how commonly they present to GPs, as highly prevalent specific
4 foot, ankle, or leg conditions in childhood may impact on health care costs now or in the future.
5 Conservative estimates indicate that management of foot, ankle or leg conditions by GPs in Australia
6 across all ages are estimated to be approximately A\$255m per annum.[12] Also unknown, is how
7 many foot, ankle or leg conditions appear in childhood requiring medical care from GPs. To our
8 knowledge, only four studies have examined presentations for primary care management in children
9 that included lower limb presentations. These studies were in Spain, Australia, and the United
10 Kingdom[13-16], yet only one of these studies provided data on all children between the ages of 0-
11 18 years[14]. Whilst studies have investigated the most frequent presenting conditions by children
12 to GPs, they rarely delineate by body region such as foot, ankle and leg problems. One Australian
13 study reported data on all GP encounters by children aged between 0-17 years for any health
14 condition and found frequent presentations for skin concerns and musculoskeletal concerns.[14].
15 Both skin and musculoskeletal concerns are two problems likely to include foot, ankle, or leg
16 problems. However, there were no additional data on skin complaints relating to body region, and
17 where musculoskeletal data according to body regions were explored in detail, lower limb concerns
18 were managed at a rate between 0.62 to 5.33 per 100 children encounters. These insights warrant
19 further detailed exploration given the frequency of presentations.

20
21 Therefore, the primary aim of this study was to determine the rate of GP encounters where foot,
22 ankle, and leg (defined as below the knee) conditions were managed in children aged between 0-18
23 years. Secondary aims included exploring the patient and GP characteristics associated with these
24 encounters, the rate of these encounters for children in different age groups, and the most frequent
25 management practices for these encounters among the different age groups.

26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 **Methods**

46 47 48 *Dataset*

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50 Data were extracted from the Bettering the Evaluation and Care of Health (BEACH) study. This data
51 set was constructed from a continuous, nationally representative study of GP clinical activity. Details
52 of the BEACH study and methods of data coding and collection are published in detail elsewhere [17].
53 Each year, a random sample of approximately 1,000 Australian GPs completed the BEACH study.
54 These GPs recorded details from 100 consecutive patient encounters on structured paper data
55 collection forms. Data captured included demographic characteristics such as patient's age, sex,
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postcode, concession card status, Indigenous status, up to three patient reasons for the encounter, up to four problems/diagnoses managed during the encounter, and the clinical management actioned by the GP. Management strategies were coded, such as medications (supplied, advised, or prescribed), referrals for pathology or diagnostic imaging, referrals to other health professionals and any procedures provided by the GP during the clinical encounter. Pharmaceutical data were coded using the Coding Atlas of Pharmaceutical Substances (CAPS) [18] which maps to the Anatomical Therapeutic Chemical Classification System [19]. All other data (including problems managed, non-pharmaceutical treatments, referrals and investigations) were coded using the Australian GP interface terminology known as ICPC-2 PLUS [20] by the BEACH research team, with automated classification to the International Classification of Primary Care, Version 2 (ICPC-2)[21]. ICPC-2 is a member of the World Health Organization Family of International Classifications[21] and is mapped to the International Classification of Disease, Version 10 (ICD-10).[22]

Ethical approvals for ongoing BEACH dataset research purposes were provided by the Human Research Ethics Committee of the University of Sydney (Ref: 2012/130) and (from 2000 to 2010) the Ethics Committee of the Australian Institute of Health and Welfare. GPs provided implied informed consent to collect unidentified data about patients through return of information. Patients (or their parents or guardians) provided informed oral consent to the GP for their de-identified data to be included in the dataset.

Participants and data elements

We initially identified all GP encounters for children and adolescents aged 0-18 years recorded from April 2000 until March 2016 within the dataset. We selected ICPC-2 PLUS terms that primarily related to problems specifically affecting the foot and ankle, but also included conditions that manifest below the knee (such as restless leg syndrome), dermatological conditions (such as tinea pedis), and congenital lower limb conditions (such as pes planus or genu valgum) through a previously reported expert consensus process (Supplementary dataset 1).[12]

Statistical analysis

The BEACH dataset forms a single-stage cluster sample study design. The GP is the sampling unit, and the GP-patient encounter is the unit of inference. We used Survey procedures in SAS v9.4 to adjust for this cluster in all analyses. We initially extracted data from all encounters where the patient was

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3 aged 18 years or less. We then extrapolated the rate of management per encounter recorded in
4 BEACH to the number of annual Medicare Benefits Scheduled GP items of services claimed for
5 children to calculate the total number of foot/ankle/leg problems in children managed that year. We
6 then divided this figure by the number of children in the population (Australian Bureau of Statistics
7 population statistics)[23] to calculate the rate per child in the population. We calculated the rate of
8 foot, ankle or leg problems managed per 100 encounters for children aged 0-18 years (with the age
9 groups <1, 1-4, 5-9, 10-14 and 15-18 years) and analysed this by both GP and patient characteristics.
10 Patient encounters were then grouped into comparable age clusters. Due to the low numbers of foot,
11 ankle and leg problems managed at encounters, the <1 and 1-4 years ages were combined so that
12 our final age groups were: 0-4, 5-9, 10-14, and 15-18 years. The most common types of foot, ankle
13 and leg problems were examined and reported per 100,000 encounters for all ages, and for each age
14 group. We also examined how these foot, ankle and leg problems were managed by GPs. Significant
15 differences were determined through non-overlapping 95% confidence intervals (95% CI). This
16 provided a conservative estimate of significance compared with the traditional alpha of <0.05.[24]

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18 We used multivariate logistic regression to determine the GP and patient characteristics
19 independently associated with a foot, ankle and leg problem being managed at an encounter. All GP
20 and patient characteristics were included in the model.
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38 *Patient and public involvement*

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40 Patients and the public were not involved in the development of the research question, design or
41 conduct of the study.
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48 **Results**

49 *GP management rate for foot, ankle, and leg problems*

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53 Between April 2000 and March 2016, 15,472 GPs recorded 229,137 encounters meeting the
54 extraction criteria (children aged 0-18 years), of which 4,694 were related to foot, ankle or leg
55 problems. The foot, ankle, and leg problems were managed at a rate of 2.05 (95% CI 1.99 to 2.11) per
56 100 GP encounters with children. There was a significant increase in the rate of foot, ankle and leg
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3 problems managed per 100 children in the population, from 6.1 (95% CI: 5.3-6.8) in 2005-06 to 9.0
4 (95% CI: 7.9-10.1) in 2015-16 (Figure 1).
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7 *GP and child characteristics associated with management of foot, ankle, or leg problems*
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10 The highest rate of management was 4.64 (per 100 encounters) in the 10-14 years age group, the
11 lowest was infants <1 year (0.44) (Table 1). After adjustment, male patients were 30% more likely to
12 have a foot, ankle, or leg problem managed than their female peers at an encounter. Children in age
13 groups 1-4, 5-9, 10-14 and 15-18 years were all more likely to receive care for foot ankle and leg
14 conditions than children aged <1 year. Those aged 10-14 years were 10.2 times more likely than those
15 aged <1 year. Those most disadvantaged were 8% more likely than those who were most advantaged.
16 Male GPs were 13% more likely to provide care for a foot leg or ankle condition than female GPs. GPs
17 aged <45 years were 13% more likely than those aged >55 years. Concession card status, being from
18 a non-English speaking background, Indigenous status, practice location or GP country of training did
19 not have a significant effect on whether a foot, ankle, and leg condition was managed.
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Table 1. Child and GP specific management rate of foot/ankle/leg problems per 100 encounters, 2010-16.

Patient characteristics	Sample size (n=229,137)	Number of problems managed (n = 4694)	Distribution (%) (95% CI) of problems managed by patient and GP characteristics	Characteristic specific rate of problems per 100 encounters	Adjusted odds ratios of a problem being managed at encounter (95% CIs)
Sex (<i>missing</i>)	(1,734)	(38)			p = <0.001
Male	111,448	2490	53.48 (53.5-53.5)	2.23 (2.1-2.3)	1.304 (1.215-1.399)
Female	115,955	2166	46.52 (46.5-46.5)	1.77 (1.8-1.9)	Reference group
Age (<i>missing</i>)		-			p < 0.001
<1 year	30,722	134	2.85 (2.9-2.9)	0.44 (0.4-0.5)	Reference group
1-4 years	68,704	543	11.57 (11.6-11.6)	0.79 (0.7-0.9)	1.746 (1.413-2.157)
5-9 years	45,333	772	16.45 (16.4-16.5)	1.70 (1.6-1.8)	3.776 (3.073-4.640)
10-14 years	39,310	1824	38.86 (38.9-38.9)	4.64 (4.4-4.9)	10.244 (8.412-12.475)
15-18 years	45,068	1421	30.27 (30.3-30.3)	3.15 (3.0-3.3)	7.067 (5.787-8.629)
Socioeconomic level (<i>missing</i>)	(5859)	(122)			p = 0.0498
Most disadvantaged	82,797	1825	39.92 (39.9-39.9)	2.20 (2.1-3.8)	1.080 (1.000-1.166)
Most advantaged	140,481	2747	60.08 (60.1-60.1)	1.96 (1.9-2.0)	Reference group
Health care card (<i>missing</i>)	(19,844)	(410)			p = 0.1716
Health care card	61,166	1293	30.18 (29.9- 30.2)	2.00 (2.0-2.2)	1.092 (1.047-1.138)
No health care card	148,127	2991	69.82 (69.1-69.8)	2.02 (1.9-2.1)	Reference group
Language background (<i>missing</i>)	(24,052)	(502)			p = 0.1477
Non-English speaking	16,009	273	6.51 (6.5-6.5)	1.71 (1.5-1.9)	Reference group
English speaking	189,076	3919	93.49 (93.5-93.5)	2.07 (2.0-2.1)	1.124 (1.051-1.201)
Indigenous status (<i>missing</i>)	(339,873)	(841)			p = 0.9918
Indigenous	5,924	121	3.14 (3.1-3.1)	2.0 (1.7-2.4)	0.999 (0.812-1.229)
Non-Indigenous	183,340	3732	96.86 (96.9-96.9)	2.04 (2.0-2.1)	Reference group
GP sex (<i>missing</i>)	(0)	(0)			p = 0.0013
Male	135,116	2999	63.89 (63.9-63.9)	2.13 (2.1-2.3)	1.131 (1.049-1.218)
Female	94,021	1695	36.10 (36.1-36.1)	1.80 (1.7-1.9)	Reference group
GP age (<i>missing</i>)	(1319)	(21)			p = 0.0076
<45 years	82,041	1660	32.61 (32.6-32.6)	2.02 (1.9-2.1)	1.13 (1.033-1.237)
45-54 years	76,784	1524	31.86 (31.9-31.9)	1.98 (1.9-2.1)	1.027 (0.939-1.123)
55+ years	68,993	1489	35.52 (35.5-35.5)	2.16 (2.0-2.2)	Reference group
Practice location (<i>missing</i>)	(234)	(2)			p = 0.1379
Major cities	166,932	3264	69.57 (69.6-69.6)	1.95 (1.9-2.0)	1.007 (0.0894-1.133)
Inner regional	39,571	928	19.78 (19.8-19.8)	2.36 (2.2-2.5)	1.078 (0.948-1.226)
Outer regional / remote	22,400	500	10.7 (10.7-10.7)	2.25 (2.0-2.5)	Reference group
Country of graduation (<i>missing</i>)	(536)	(8)			p = 0.7471
Australian graduate	157,881	3203	68.35 (68.3-68.4)	2.10 (2.0-2.2)	1.054 (1.010-1.100)
Overseas graduate	70,720	1483	31.65 (31.6-31.7)	2.03 (2.0-2.1)	Reference group
Year					p = 0.0222
					1.010 (1.001-1.018)
Total	229,137		100.0%	2.05 (2.0-2.1)	

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3 *Rate of specific foot, ankle, and leg problems*
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6 Table 2 presents the child- and GP-specific management rate for the most common foot, ankle, and
7 leg problem groups and specific conditions. The most frequently managed problem groupings were
8 injuries (755.9 per 100,000 encounters), followed by infections (458.2) and dermatological conditions
9 (299.4). The most frequent specific conditions were ankle sprains (310.3 per 100,000 encounters),
10 ingrown toenails (272.3) or infected ingrown toenails (135.6), tinea or fungal skin infections (184.6),
11 injuries to the foot/feet (76.4) and foot/feet pain (69.4). In general, management rates for problem
12 groups and specific conditions increased with age until the 10 to 14 years age group, and then
13 reduced in the 15-18 years group, except for the congenital problem groupings.
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Table 2. Management rate of foot/ankle/leg problem groups per 100,000 child encounters, 2000-16.

Specific foot/ankle/leg problem group	N=229,137	Rate per 100,000 encounters (95% CIs) for all ages
Injury	1732	755.9 (718.0-793.8)
Ankle sprain	711	310.3 (286.3-334.2)
Injury foot/feet	175	76.4 (64.9-87.8)
Injury ankle	138	60.2 (49.9-70.6)
Fracture metatarsal	138	60.2 (49.5-70.9)
Fracture ankle	103	45.0 (36.2-53.7)
Fracture toe	93	40.6 (32.4-48.8)
Foot/feet sprain	72	31.4 (24.1-38.8)
Infection	1050	458.2 (429.5-487.0)
Tinea/fungal skin infection	423	184.6 (166.5-202.8)
Infected ingrown toenail	313	136.6 (120.8-152.4)
Onychomycosis/fungus nail	179	78.1 (66.4-89.9)
Cellulitis of the leg	83	36.2 (28.0-44.4)
Dermatological	686	299.4 (276.0-322.7)
Ingrown toenail	624	272.3 (250.0-294.6)
Corns/callosities	60	26.2 (19.5-32.9)
Unspecified pain	404	176.3 (158.7-193.9)
Pain foot/feet	159	69.4 (58.5-80.2)
Pain leg	127	55.4 (45.6-65.2)
Pain ankle	90	39.3 (31.1-47.5)
Congenital	354	154.5 (135.7-173.3)
Pes planus (flat foot)	135	58.9 (45.1-72.7)
Musculoskeletal	194	84.7 (72.4-96.9)
Plantar fasciitis	64	27.9 (21.0-34.9)
Calcaneal apophysitis (Sever's)	52	22.7 (16.3-29.1)
Non-specific foot/ankle/leg problem	105	45.8 (36.8-54.8)
Management of foot/ankle/leg	42	18.3 (12.8-23.9)
Venous/swelling	34	14.8 (9.9-19.8)
Ischaemia	30	13.1 (8.4-17.8)
Ulceration	27	11.8 (7.3-16.2)
Venous/varicose leg ulcer	21	9.2 (5.2-13.1)
Leg ulcer	19	8.3 (4.6-12.0)
Foot ulcer	6	2.6 (0.5-4.7)
Neuropathy	20	8.7 (4.9-12.5)
Cramps	15	6.5 (3.2-9.9)
Amputation	1	0.4 (0.0-1.3)

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3 Table 3 outlines the management rate for foot, ankle, and leg problem groupings and specific
4 conditions according to age group. The top three most frequently managed problem groupings were
5 similar for all four age groups, with some exceptions in the younger age groups. Injuries (677.2 to
6 1835.7 per 100,000 encounters), infection (386.0 to 905.62), and dermatological conditions (101.5
7 to 877.6) were typically the top three in the older age groups (5 to 9 years, 10 to 14 years, and 15 to
8 19 years), although unspecified pain was the third most common problem group in those aged 5-9
9 years (247.1). For the youngest age group (0 to 4 years), the top three problem groupings were
10 congenital (195.1), infection (191.1) and injury (142.8).
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19 The top three specific conditions were also similar for the older age groups (10-14 and 15-18 years)
20 with ankle sprains (594.7 to 594.7), ingrown toenails (525.9 to 824.2) and infected ingrown toenails
21 (308.4 to 371.4) being the top three in all those age groups. However, for the 0 to 4 years age group,
22 the top three specific conditions were tinea or fungal skin infections (117.0), onychomycosis/fungal
23 nail (56.2), and injuries to the foot/feet (38.2), while in the 5 to 9 years group, they were ankle sprains
24 (308.8), tinea or fungal skin infections (209.7) and leg pain (92.6).
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Table 3. Management rate of paediatric foot/ankle/leg problem groups per 100,000 encounters, 2000-16 for age groupings

Specific foot, ankle, and leg problem group	0-4 years n= 99426	Rate per 100,000 encounters (95% CIs) 0-4 years	5-9 years n=45333	Rate per 100,000 encounters (95% CIs) 5-9 years	10-14 years n=39310	Rate per 100,000 encounters (95% CIs) 10-14 years	15-18 years n=45068	Rate per 100,000 encounters (95% CIs) 15-18 years
Injury	142	142.8 (118.4-167.3)	307	677.2 (600.3-754.1)	772	1836.7 (1693.3-1980.0)	561	1244.8 (1138.4-1351.2)
Ankle sprain	31	31.2 (19.9-42.5)	140	308.8 (256.3-361.4)	272	691.9 (605.5-778.0)	268	594.7 (521.9-667.4)
Injury foot/feet	38	38.2 (25.5-51.0)	31	68.4 (44.4-92.4)	66	167.9 (127.2-208.3)	40	88.8 (61.3-116.2)
Injury ankle	7	7.0 (1.8-12.3)	18	39.7 (21.4-58.0)	57	145.0 (105.5-184.5)	56	124.3 (91.2-157.3)
Fracture metatarsal	12	12.1 (5.2-18.9)	12	26.5 (11.5-41.4)	93	236.6 (184.4-288.4)	21	46.6 (25.8-67.4)
Fracture ankle	5	5.0 (0.6-9.4)	20	44.1 (24.8-63.4)	43	109.3 (76.8-142.0)	35	77.7 (52.0-103.3)
Fracture toe	3	3.0 (0.0-6.4)	13	28.7 (13.1-44.3)	46	117.0 (83.3-150.7)	31	68.8 (44.6-93.0)
Foot/feet sprain	6	6.0 (1.2-10.9)	23	50.7 (30.0-71.4)	30	76.3 (48.2-104.5)	13	28.9 (13.2-44.5)
Infection	190	191.1 (164.6-218.6)	175	386.0 (325.9-446.1)	356	905.62 (810.1-1000.8)	329	730.0 (649.7-810.3)
Tinea/fungal skin infection	117	117 (95.9-139.4)	95	209.7 (166.3-252.8)	114	290.0 (236.9-343.4)	97	215.2 (172.6-257.9)
Onychomycosis/fungus nail	56	56.2 (41.1-71.6)	39	86.0 (59.1-113.0)	34	86.5 (57.5-115.5)	50	110.9 (80.3-141.6)
Infected ingrown toenail	10	10.1 (3.8-16.3)	18	39.7 (21.4-58.0)	146	371.4 (310.4-432.5)	139	308.4 (254.6-362.3)
Cellulitis of the leg	14	14.1 (6.2-22.0)	20	44.1 (23.9-64.4)	28	71.2 (42.2-100.3)	21	46.6 (26.7-66.5)
Dermatological	33	33.2 (21.9-44.4)	46	101.5 (72.2-130.7)	345	877.6 (781.1-973.7)	262	581.3 (508.9-653.7)
Ingrown toenail	30	30.2 (19.4-41.0)	33	72.8 (48.0-97.6)	324	824.2 (731.1-917.1)	237	525.9 (457.5- 594.3)
Corns/callosities	2	2.0 (0.0-4.8)	13	28.7 (13.1-44.3)	21	53.4 (30.6-76.3)	24	53.3 (31.1-75.4)
Unspecified pain	57	57.3 (42.2-72.4)	112	247.1 (199.9-294.2)	143	363.8 (304.4-423.4)	92	204.1 (161.3-247.0)
Pain foot/feet	15	15.1 (7.0-23.2)	39	86.0 (59.1-113.0)	66	167.9 (127.2-208.3)	39	86.5-59.4-113.7)
Pain leg	36	36.2 (24.4-48.0)	42	92.6 (63.4-121.9)	24	61.1 (36.7-85.5)	25	55.5 (32.9-78.0)
Pain ankle	4	4.0 (0.1-8.0)	22	48.5 (28.3-68.8)	37	94.1 (63.9-124.4)	27	59.9 (37.3-82.5)
Congenital	194	195.1 (167.4-222.9)	56	123.5 (90.1-157.0)	80	203.5 (147.8-259.3)	24	53.3 (27.2-79.3)
Pes planus (flat foot)	34	34.2 (22.4-46.0)	32	70.6 (45.4-95.8)	54	137.4 (87.6-187.1)	15	33.3 (10.7-55.9)
Musculoskeletal	11	11.0 (4.5-17.6)	41	90.4 (62.8-118.1)	92	234.0 (183.4-284.2)	50	110.9 (80.3-141.6)
Plantar fasciitis	2	2.0 (0.0-4.8)	15	33.1 (16.4-49.8)	35	89.0 (58.8-119.3)	12	26.6 (11.6-41.7)
Calcaneal apophysitis (Sever's)	-	-	18	39.7 (21.4-58.0)	32	81.4 (52.4-110.4)	2	4.4 (0.0-10.6)
Non-specific foot/ankle/leg problem	34	34.2 (22.4-46.0)	18	39.7 (21.3-58.0)	32	81.4 (53.3-109.6)	21	46.6 (25.8-67.4)
Management of foot/ankle/leg	3	3.0 (0.0-6.4)	2	4.4 (0.0-10.5)	16	40.7 (20.8-60.6)	21	46.6 (26.7-66.5)
Venous/swelling	6	6.0 (1.2-10.9)	5	11.0 (1.4-20.7)	11	28.0 (11.5-44.5)	12	26.6 (11.6-41.7)
Ischaemia	1	1.0 (0.0-3.0)	1	2.2 (0.0-6.5)	8	20.4 (6.3-34.4)	20	44.4 (25.0-63.8)
Ulceration	1	1.00 (0.0-3.0)	6	13.2 (2.6-23.8)	12	30.5 (13.3-47.8)	8	17.8 (5.5-30.0)
Leg ulcer	1	1.0 (0.0-3.0)	3	6.6 (0.0-14.1)	9	22.9 (7.9-37.8)	6	13.3 (2.7-24.0)
Venous/varicose leg ulcer	1	1.0 (0.0-3.0)	4	8.8 (0.18-17.5)	9	22.9 (7.9-37.8)	7	15.5 (4.0-27.0)

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2	Foot ulcer	-	-	2	4.4 (0.0-10.5)	3	7.6 (0.0-15.3)	1	2.2 (0.0-6.6)
3	Neuropathy	1	1.0 (0.0-3.0)	1	2.2 (0.0-6.5)	4	10.2 (0.2-20.1)	14	31.1 (14.8-47.3)
4	Cramps	3	3.0 (0.0-6.4)	2	4.4 (0.0-10.5)	3	7.6 (0.0-15.3)	7	25.5 (4.0-27.0)
5	Amputation	1	6.0 (1.2-10.9)	-	-	-	-	-	-

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Foot, ankle, and leg management strategies

Table 4 reports the most frequently used management strategies by GPs for foot, ankle, and leg problems. The top three most frequent action groupings were provision of medication (47.0 per 100 problems), counselling, advice, or education (25.4) and imaging (25.2). The most specific actions were referral for x-ray (22.7), prescription of antibiotics for systemic use (17.6), and prescription of analgesics (7.9).

Table 4. Management actions used by GPs for paediatric foot/ankle/leg problems, 2000-2016.

Management action	n	Rate per 100 problems (95% CIs)
Medication (any)	2205	47.0 (45.2-48.8)
<i>Antibiotics for systemic use</i>	824	17.6 (16.4-18.7)
Cephalexin	480	10.2 (9.2-11.1)
Flucloxacillin	104	2.2 (1.8-2.7)
Dicloxacillin	58	1.2 (0.9-1.6)
<i>Analgesics</i>	370	7.9 (7.6-8.6)
Non-opioid analgesics	311	6.6 (5.9-7.4)
Paracetamol	277	5.9 (5.2-6.6)
Opioid analgesics	59	1.3 (0.9-1.6)
Codeine/paracetamol	55	1.2 (0.9-1.5)
Oxycodone	4	0.1 (0.0-0.2)
Tramadol	3	0.1 (0.0-0.1)
<i>Anti-inflammatory and antirheumatic products</i>	228	4.9 (4.2-5.5)
Ibuprofen	163	3.5 (2.9-4.0)
Meloxicam	11	0.3 (0.1-0.4)
Diclofenac (oral)	26	0.6 (0.3-0.8)
Diclofenac (topical)	35	0.8 (0.5-1.0)
<i>Antifungals for dermatological use</i>	354	7.5 (6.7-8.3)
Terbinafine (oral)	27	0.6 (0.4-0.8)
Terbinafine (topical)	67	1.4 (1.1-1.8)
Clotrimazole	117	2.5 (2.0-2.9)
<i>Corticosteroids for dermatological use</i>	120	2.6 (2.1-3.0)
Hydrocortisone	16	0.3 (0.2-0.5)
Procedures	997	21.2 (19.9-22.6)
Imaging	1185	25.2 (23.8-26.7)
Ultrasound	75	1.6 (1.2-2.0)
Xray	1064	22.7 (21.3-24.0)
Pathology	272	5.8 (4.6-7.0)
Full blood count	38	0.8 (0.5-1.1)
C-reactive protein	13	0.3 (0.1-0.4)
Nail scraping/culture	19	0.4 (0.2-0.6)
Skin swab/culture	16	0.3 (0.2-0.5)
Fungal scraping/culture	41	0.9 (0.6-1.1)
Counselling/advice/education	1192	25.4 (24.0-26.8)
Referral	749	16.0 (14.8-17.1)
Podiatrist	182	3.9 (3.3-4.5)
Orthopaedic surgeon	158	3.4 (2.8-3.9)
General surgeon	65	1.4 (1.0-1.7)
Physiotherapist	167	3.5 (3.0-4.1)

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3 Table 5 outlines the management strategies used according to age group. The top three most
4 frequent management strategies were similar for the 5 to 9 years and 10 to 14 years age groups,
5 although both the 0 to 4 years and 15 to 18 years exhibited different management patterns. For the
6 5 to 9 years and 10 to 14 years groups, the top three management strategies included medication
7 prescription or advice (43.3 and 45.3 per 100 problems), imaging referral (27.2 and 30.7) and
8 counselling, advice or education (25.8 and 27.7). In the 0 to 4 years group, the top three management
9 strategies were medication prescription or advice (38.2), referral to another health professional
10 (23.2) and counselling, advice, or education (21.2), whereas in the 15-18 years age group, it was
11 medication prescription or advice (55.3), procedures, 24.4) and imaging referral (24.3). The top
12 specific management strategies were similar for the 5 to 9 years and 10-14 years age groups. These
13 were referrals for x-rays (24.6 to 28.4 per 100 problems), prescription of antibiotics for systemic use
14 (11.1 to 20.4) and analgesics (7.7 to 9.5). The 0 to 4 age group top management strategies were
15 referral for x-ray (15.2), antifungals for dermatological use (12.7) and prescriptions of antibiotics for
16 systemic use (9.0), whereas, in the 15 to 18 years age group, the top three were prescription of
17 antibiotics for systemic use (21.1), referral for x-ray (20.6) and analgesia (9.1).
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Table 5. Management actions used by GPs for paediatric foot/ankle/leg problems, 2000-2016 for age groupings

Management action	0-4 years n=677	Rate per 100 problems (95% CIs) for 0-4 years	5-9 years n=772	Rate per 100 problems (95% CIs) for 5-9 years	10-14 years n=1824	Rate per 100 problems (95% CIs) for 10-14 years	15-18 years n=1421	Rate per 100 problems (95% CIs) or 15-18 years
Medication (any)	259	38.2 (34.0-42.5)	334	43.3 (39.0-47.5)	826	45.3 (42.5-48.1)	786	55.3 (52.0-58.6)
<i>Antibiotics for systemic use</i>	61	9.0 (6.8-11.2)	86	11.1 (8.9-13.4)	373	20.4 (18.5-22.4)	304	21.4 (19.2-23.6)
Cephalexin	36	5.3 (3.6-7.0)	45	5.8 (4.2-7.5)	216	11.8 (10.2-13.3)	183	12.9 (11.1-14.7)
Flucloxacillin	6	0.9 (0.2-1.6)	14	1.8 (0.9-2.8)	48	2.6 (1.3-3.4)	36	2.5 (1.7-3.4)
Dicloxacillin	-	-	-	-	30	1.6 (1.0-2.2)	28	2.0 (1.2-2.7)
<i>Analgesics</i>	27	4.0 (2.5-5.5)	73	9.5 (7.3-11.6)	140	7.7 (6.4-9.0)	130	9.1 (7.6-10.7)
Non-opioid analgesics	26	3.8 (2.4-5.3)	71	9.2 (7.0-11.4)	123	6.7 (5.8-7.9)	91	6.4 (5.1-7.7)
Paracetamol	22	3.2 (1.9-4.6)	62	8.0 (6.1-10.0)	114	6.3 (5.4-7.4)	79	5.6 (4.3-6.8)
Opioid analgesics	1	0.1 (0.0-0.4)	2	0.3 (0.0-0.6)	17	0.9 (0.0-1.4)	39	2.7 (1.9-3.6)
Codeine/paracetamol	3	0.4 (0.00-0.9)	1	0.1 (0.0-0.4)	16	0.9 (0.7-1.3)	35	2.5 (1.6-3.3)
Oxycodone	-	-	1	0.1 (0.0-0.4)	1	0.1 (0.0-0.2)	2	0.1 (0.0-0.3)
Tramadol	-	-	-	-	1	0.1 (0.0-0.2)	2	0.1 (0.0-0.3)
<i>Anti-inflammatory and antirheumatic products</i>	10	1.5 (0.6-2.4)	32	4.1 (2.7-5.6)	86	4.7 (3.5-5.7)	100	7.0 (5.7-8.4)
Ibuprofen	6	0.9 (0.2-1.6)	31	4.0 (2.6-5.4)	69	3.8 (2.6-4.7)	57	4.0 (3.0-5.0)
Meloxicam	1	0.1 (0.0-0.4)	-	-	2	-	8	0.6 (0.2-1.0)
Diclofenac (oral)	1	0.1 (0.0-0.4)	-	-	10	0.5 (0.0-0.9)	15	1.1 (0.5-1.6)
Diclofenac (topical)	2	0.3 (0.0-0.7)	5	0.6 (0.1-1.2)	15	0.8 (0.0-1.2)	13	0.9 (0.4-1.4)
<i>Antifungals for dermatological use</i>	86	12.7 (10.2-15.3)	73	9.5 (7.3-11.6)	97	5.3 (4.4-6.4)	98	6.9 (5.5-8.3)
Terbinafine (oral)	5	0.7 (0.1-1.4)	5	0.6 (0.1-1.2)	10	0.5 (0.0-0.9)	7	0.5 (0.1-0.9)
Terbinafine (topical)	6	0.9 (0.2-1.6)	19	2.5 (1.4-3.6)	19	1.0 (0.3-1.5)	23	1.6 (1.0-2.3)
Clotrimazole	42	6.2 (4.4-8.0)	21	2.7 (1.6-3.9)	31	1.6 (1.0-2.3)	8	1.6 (1.0-2.3)
<i>Corticosteroids for dermatological use</i>	38	5.6 (3.8-7.4)	30	3.8 (2.5-5.3)	26	1.4 (0.9-2.0)	26	1.8 (1.1-2.6)
Hydrocortisone	9	1.3 (0.5-2.2)	4	0.5 (0.01-1.0)	2	-	1	0.1 (0.0-0.2)
Procedures	60	8.9 (1.2-6.4)	138	17.9 (14.8-20.9)	452	24.8 (22.5-27.1)	347	24.4 (21.8-27.0)
Imaging	107	15.8 (12.8-18.8)	236	30.7 (27.8-34.3)	496	27.2 (24.9-29.5)	346	24.3 (21.9-26.8)
Ultrasound	4	0.6 (0.01-1.2)	10	1.3 (0.5-2.1)	33	1.8 (1.1-2.4)	25	2.0 (1.2-2.7)
Xray	103	15.2 (12.3-18.2)	219	28.4 (24.8-31.9)	449	24.6 (19.0-26.8)	293	20.6 (18.6-22.8)
Pathology	41	6.1 (2.8-9.3)	61	7.9 (4.4-11.4)	86	4.7 (3.0-6.5)	84	5.9 (3.8-8.0)
Full blood count	6	0.8 (0.4-1.6)	13	1.0 (0.8-2.6)	10	0.5 (0.0-0.9)	9	0.6 (0.2-1.0)
C-reactive protein	4	0.6 (0.01-1.2)	3	0.4 (0.0-0.8)	3	0.2 (0.0-0.4)	3	0.2 (0.0-0.4)
Nail scraping/culture	2	0.3 (0.1-0.7)	3	0.4 (0.0-0.8)	4	0.2 (0.0-0.4)	10	0.2 (0.3-0.4)

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2	Skin swab/culture	1	0.1 (0.0-0.4)	1	0.1 (0.0-0.4)	11	0.6 (0.0-1.0)	3	0.1 (0-0.5)
3	Fungal scraping/culture	8	1.2 (0.4-2.0)	8	1.0 (0.3-1.8)	16	0.9 (0.0-1.3)	9	0.6 (0.2-1.0)
4	Counselling/advice/education	179	21.2 (19.9-22.6)	214	27.7 (24.4-31.1)	471	25.8 (23.6-28.0)	328	23.1 (20.7-25.4)
5	Referral	157	23.2 (19.8-26.6)	112	14.5 (11.9-17.2)	277	15.2 (13.4-16.9)	203	14.3 (12.4-16.2)
6	Podiatrist	18	2.7 (1.3-4.1)	39	5.1 (3.5-6.6)	85	4.7 (3.7-3.1)	40	2.8 (2.0-3.7)
7	Orthopaedic surgeon	51	7.5 (5.5-9.5)	23	3.0 (1.8-4.2)	44	2.4 (1.7-3.1)	40	2.8 (1.9-3.7)
8	General surgeon	1	0.1 (0.0-0.4)	3	0.2 (0.0-0.8)	32	1.8 (1.1-2.4)	29	2.0 (1.3-2.8)
9	Physiotherapist	26	3.8 (2.4-5.3)	21	2.7 (1.5-3.9)	61	3.3 (2.0-4.2)	59	4.2 (3.1-5.2)

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Discussion

This study was one of the first to investigate the national management of children's foot, ankle, and leg conditions by GPs. Findings suggest Australian GPs commonly manage children's lower limb problems, and more frequently in males and older children. Injury, infection, and dermatological conditions presented most frequently to GPs across all ages and medications were the most frequently used management strategy. The frequency of specific problems managed, and the management strategies used, varied across the different age groupings, such as differing rates of congenital problems, or differing prescription or advice of medications. GPs also commonly provided counselling, advice and education for all ages, an appropriate management strategy for concerned parents, and a common first stage management strategy for many benign congenital, or undefined foot, ankle, or leg problems or while undergoing further testing to refine diagnosis.

Children from more disadvantaged socioeconomic areas had a significantly higher GP management rate of foot, leg and ankle conditions than their peers in more advantaged areas. This presentation is consistent with other studies on children's healthcare in countries with socialised medicine, and reflects a complex interaction between health literacy of parents or the knowledge or financial ability for parents to seek health care information or alternate care providers without a GP recommendation, such as seeing a podiatrist or physiotherapist for their children's foot, ankle or leg concerns.[25, 26]

Foot, ankle, and leg problems differed across age groupings and in general, increased with age. The presentations patterns extracted from this dataset related to foot, ankle, or leg concerns potentially reflect the different key skeletal and developmental stages. Younger children presented more with congenital lower limb concerns, while older children presented with more dermatological (e.g., tinea or ingrown toenails) or injury (e.g., ankle sprain) concerns. These presentation patterns align with key gross motor or developmental stages and may also align with the different health professional referral patterns. For example, there were higher numbers of congenital foot problems in younger children, and more frequent referrals to orthopaedic surgeons than in older age groups. In contrast, injuries were more common in older children, who were referred more often to podiatrists and physiotherapists. These patterns may reflect the more emergent nature of ensuring right timed surgical care at key osseous stages versus providing rehabilitation during injury recovery or individualised skin or nail care advice.

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3 Injury was the primary problem managed in all ages. This may be due to different mechanisms of
4 injuries occurring across childhood such as those occurring in the playground, or during social or
5 organised sport.[27-30] Despite how injuries may have occurred, common management strategies
6 extracted from this dataset included frequent medical imaging. Ultrasound and x-rays were the most
7 common imaging methods, with fewer ordered than frequency of injury presentations. This suggests
8 conservative and judicious imaging referrals, and potential use of injury imaging referral guidelines,
9 such as the Ottawa Ankle Rules.[31]
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12 Antibiotic stewardship and pain management medication strategies elicited from this dataset also
13 mirror prescribing guidelines established for general practice relating to childhood presentations
14 involving the lower limb for the timeframe data were extracted.[32] For example, at the time of data
15 collection, cephalexin was commonly prescribed in a suspension for children to treat mild skin
16 infections (e.g., cellulitis) while narrow spectrum antibiotics such as flucloxacillin and dicloxacillin
17 were the recommended antibiotics for infected skin relating to infected ingrown toenail
18 presentations.[32] Similarly, the use of non-opioid pain medications exceeded opioid prescriptions,
19 consistent with recommended actions for pain management practices.[32] We did not undertake
20 direct comparisons between the problem managed and corresponding management strategy during
21 this analysis; however, these patterns suggest that medication management practices align with best
22 practice clinical guidelines.
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26 Contrary to this, it was surprising to see fewer musculoskeletal conditions recorded within the
27 dataset, despite epidemiological studies finding that 12% of children report or seek care for leg or
28 foot pain relating to specific musculoskeletal conditions.[33] The low frequency rates we observed
29 within this dataset may be related to several factors. The most likely reason is how these problems
30 were recorded by the GP. Underpinning how problems were recorded may be limited knowledge
31 about less common foot, ankle or leg conditions, lower presentation rates of foot, ankle or leg
32 conditions to GPs compared with hospital outpatients, the single point data collection used in the
33 BEACH dataset that captures a problem as a symptom with as yet unknown diagnosis (e.g., waiting
34 test results for confirmation) and relevant management guidelines of the time.
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38 The low frequency of musculoskeletal concerns recorded within this dataset may also reflect
39 different health literacy in parents and its association with not seeking care from GPs, or
40 misdiagnosis. One potential example of this was the frequency of plantar fasciitis diagnoses recorded
41 across younger ages (33.1 per 100,000 in the 5-9 year group and 89.0 per 100,000 in the 10 to 14
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3 year group). Plantar fasciitis is rarely reported in contemporary paediatric orthopaedic literature, and
4 if diagnosed on ultrasound, associated with being an older and highly athletic adolescent than the
5 ages in this dataset.[34] Heel pain in older children is more likely to be calcaneal apophysitis. This
6 diagnosis was recorded as 39.1 per 100,000 encounters in 5-9 year grouping and 81.4 in 10-14 year
7 grouping, and at a less frequent rate than plantar fasciitis in the 10-14 year age grouping, despite this
8 being the age when foot apophyseal injuries are most prevalent.[3] Other conditions also resulting
9 in childhood plantar heel pain include inflammatory disease, infection (including osteomyelitis) or
10 post-viral joint pain, all presenting more commonly than plantar fasciitis in younger age
11 groupings.[35] Management strategies of these heel pain conditions differ significantly, making it
12 imperative for timely and accurate diagnosis to minimise health care wastage, and prevent
13 development of chronic pain.[36]

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16 Recently there has been a global call to action on improving primary care diagnosis and assessment
17 of musculoskeletal conditions in childhood to minimise misdiagnosis and reduce the development of
18 disability and chronic pain.[37] Simple assessments and screening tools have been implemented to
19 support general practice, such as the paediatric Gait, Legs and Spine (p-GALS) screen,[38] and free
20 online generic health professionals training to improve paediatric musculoskeletal condition
21 diagnoses.[39] These resources have been developed in acknowledgement of limited exposure to
22 paediatric musculoskeletal conditions during medical training,[40] less common presentations in
23 childhood compared to other childhood complaints such as ear infections or upper respiratory tract
24 infection leading to low confidence in diagnostic skills of musculoskeletal conditions,[41] knowledge
25 deficits of the types of common paediatric musculoskeletal presentations,[42] and serious long term
26 consequences of some musculoskeletal conditions missed or misdiagnosed.[37] Our findings of GPs
27 reporting unspecified pain or conditions known to be more prevalent in adults than children suggests
28 that Australian GPs may require additional support to diagnose and manage musculoskeletal
29 conditions in childhood. Future research may include development of guidelines and supporting
30 models of care for children's foot, ankle, or leg problems to determine if these improve health
31 outcomes, reduce the progressive nature of many musculoskeletal conditions and pain syndromes
32 and if these are cost-effective.

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35 This study is the first to our knowledge, to examine the full spectrum of childhood foot, ankle, or leg
36 presentations in primary care and how these are managed. The data extracted from a large and
37 representative sample of Australian GPs provides an extensive snapshot of practice to guide future

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3 directions for education, guideline development and models of care for childhood foot, ankle, or leg
4 conditions. A limitation of this study is the historical nature of the data, and that education, practice
5 and models of care may have evolved between the 2016 end date of BEACH and data analysis. Known
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7 paediatric model of care and referral changes in some Australian state and territories occurred in late
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9 2015,[43] which may have resulted in improved management of conditions through several
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11 guidelines, recommended assessments and when to refer to orthopaedic surgeons for several
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13 specific musculoskeletal conditions. The way in which conditions were recorded by the GP, then
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15 coded and classified, presents a broad representation of the conditions, as ICPC-2 PLUS and ICPC-2
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17 do not contain sufficient specificity to capture severity. Even in ICD-10[22] for example, the code for
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19 congenital pes planus combines benign, and often asymptomatic paediatric flexible flat foot with
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21 other types of flat foot. We acknowledge that asymptomatic flat foot rarely requires treatment and
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23 is often managed by providing reassurance to families. However, the ICD-10 inclusion also captures
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25 the rigid flat foot, which is commonly symptomatic, or flat foot due to spasticity, both requiring
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27 conservative or surgical management by allied health or medical specialists. As a result of the
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29 methodology, this paper did not allow for detailed analysis of care trajectories and outcomes. Also,
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31 the single point in time data collection method means that the diagnosis may have changed with
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33 results of tests or following specialist referral. Regardless, this dataset of encounters and
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35 management strategies provides a robust baseline on which future guidelines and implementation
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37 studies can measure the outcomes of practice change over time.

41 Conclusion

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43 Childhood foot, ankle and leg conditions are a common reason parents bring their children to a GP in
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45 Australia. Frequencies of presentations vary according to developmental stage with potential under
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47 reporting of musculoskeletal conditions. Future studies should consider how to support GPs in
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49 managing childhood musculoskeletal conditions to minimise disability and development of chronic
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51 pain. These actions have the potential to reduce long term burden of disease.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

The data that support the findings of this study are available from BEACH, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of BEACH.

Author Contributions

CW and PL conceived this study with authors HBM, JG and CH contributing to data extraction plan. CH undertook data extraction and analysis; CW developed the first draft of the manuscript with all authors providing critical review. All authors approved the final draft for submission

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23 *Competing interest's statement:*

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25 The authors declare no competing interests.
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3 **Figure 1.** The management rate of children's foot, ankle and leg problems managed by Australian GPs
4 between April 2000 and March 2016 (aged 0-18 years). Blue line represents problems per 100
5 encounters, orange line represents problems per 100 children (Error bars = 95% CI).
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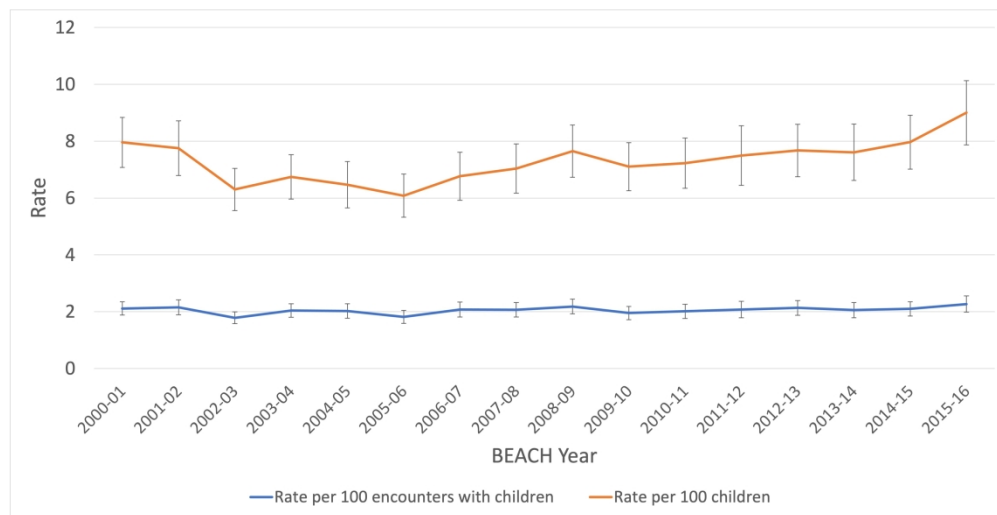


Figure 1. The management rate of children’s foot, ankle and leg problems managed by Australian GPs between April 2000 and March 2016 (aged 0-18 years). Blue line represents problems per 100 encounters, orange line represents problems per 100 children (Error bars = 95% CI).

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Supplementary dataset 1: ICPC2-Plus codes related to foot, ankle, and lower leg conditions.

ICPC-2 Plus code	Label	Category
A29030	Problem;foot/feet;diabetes	Non-specific foot/ankle/lower leg disorder
A31033	Exam;foot/feet	Management
A66020	Referral;podiatrist/chiroprapist	Management
A67028	Referral;foot clinic	Management
K07001	Oedema;ankle/foot/feet	Venous / swelling
K07002	Swollen;ankle	Venous / swelling
K07003	Dropsy	Venous / swelling
K07004	Swollen;foot/feet	Venous / swelling
K07005	Swollen;ankle;non-traumatic	Venous / swelling
K07008	Oedema;dependent	Venous / swelling
K07009	Oedema;leg	Venous / swelling
K07010	Swollen;leg	Venous / swelling
K07013	Oedema;peripheral	Venous / swelling
K07014	Oedema;ankle	Venous / swelling
K07014	Oedema;ankles	Venous / swelling
K07015	Oedema;feet	Venous / swelling
K07015	Oedema;feet	Venous / swelling
K92001	Disease;Buerger's	Ischaemia
K92002	Disease;Raynauds	Ischaemia
K92003	Disease;peripheral vascular	Ischaemia
K92004	Gangrene	Ischaemia
K92006	Ischaemia;limb (gangrene)	Ischaemia
K92010	Raynauds phenomenon	Ischaemia
K92016	Vasospasm;peripheral	Ischaemia
K92017	Claudication;intermittent	Ischaemia
K92031	Disease;small vessel	Ischaemia
K95001	Eczema;varicose	Venous / swelling
K95002	Stasis;venous	Venous / swelling
K95004	Insufficiency;venous	Venous / swelling
K95005	Varicose veins;inflamed;leg	Venous / swelling
K95006	Varicose veins;leg	Venous / swelling
K95007	Dermatitis;stasis	Venous / swelling
K95008	Rupture;varicose vein	Venous / swelling
L14005	Pain;musculoskeletal;leg	Unspecified pain
L14006	Pain;leg	Unspecified pain
L14008	Cramp(s);nocturnal/night	Cramps
L14010	Sympt/complaint;leg	Non-specific foot/ankle/lower leg disorder
L14014	Cramp(s);leg	Cramps
L14016	Cramp(s);calf	Cramps
L16001	Pain;ankle	Unspecified pain
L16002	Pain;musculoskeletal;ankle	Unspecified pain
L16004	Sympt/complaint;ankle	Non-specific foot/ankle/lower leg disorder
L16005	Unstable;ankle	Musculoskeletal

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3	L16006	Stiffness;ankle	Non-specific foot/ankle/lower leg disorder
4	L17001	Pain;foot/feet	Unspecified pain
5	L17002	Pain;musculoskeletal;foot/feet	Unspecified pain
6	L17003	Pain;toe(s)	Unspecified pain
7	L17004	Pain;musculoskeletal;toe(s)	Unspecified pain
8	L17007	Sympt/complaint;foot/feet	Non-specific foot/ankle/lower leg disorder
9	L17008	Sympt/complaint;toe(s)	Non-specific foot/ankle/lower leg disorder
10	L17011	Metatarsalgia	Non-specific foot/ankle/lower leg disorder
11	L17012	Pain;heel	Unspecified pain
12	L17013	Cramp(s);foot/feet	Cramps
13	L17014	Stiffness;toe(s)	Non-specific foot/ankle/lower leg disorder
14	L17015	Swelling;toe(s)	Non-specific foot/ankle/lower leg disorder
15	L40003	Arthroscopy;ankle	Management
16	L40005	Arthroscopy;foot/feet	Management
17	L41026	X-ray;foot/feet	Management
18	L41027	X-ray;ankle	Management
19	L41037	X-ray;toe(s)	Management
20	L41038	X-ray;heel	Management
21	L41039	X-ray;tibia/fibula	Management
22	L41066	X-ray;leg lower	Management
23	L41068	X-ray;metatarsal	Management
24	L41071	Ultrasound;ankle	Management
25	L41076	Ultrasound;foot/toe(s)	Management
26	L41094	CT scan;foot/feet	Management
27	L41095	CT scan;ankle	Management
28	L41114	MRI;ankle	Management
29	L41115	MRI;foot/feet	Management
30	L45006	Advice/education;footwear	Management
31	L52009	Amputation;non-traumatic	Amputation
32	L52012	Amputation;below knee	Amputation
33	L52013	Amputation;above knee	Amputation
34	L52016	Amputation;foot	Amputation
35	L52019	Amputation;toe(s)	Amputation
36	L54002	Adjusting;orthopaedic shoes	Management
37	L54023	Fitting (of);brace;leg	Management
38	L54025	Fitting (of);orthopaedic shoe	Management
39	L54029	Reconstruction;ankle	Management
40	L54032	Reconstruction;foot/feet	Management
41	L54032	Reconstruction;foot/feet	Management
42	L54039	Adjusting;brace;leg	Management
43	L54051	Treat;fract/disloc;ankle	Management
44	L54058	Treat;fract/disloc;fibula	Management
45	L54066	Treat;fract/disloc;metatarsal	Management
46	L54082	Treat;fract/disloc;tibia	Management
47	L54083	Treat;fract/disloc;toe(s)	Management
48	L54092	Replace;joint;ankle	Management
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L73001	Fracture;fibula	Injury
L73002	Fracture;ankle	Injury
L73003	Fracture;Potts	Injury
L73004	Fracture;tibia	Injury
L73005	Fracture;malleolus;medial	Injury
L73006	Fracture;malleolus;lateral	Injury
L73007	Fracture;malleolus	Injury
L73009	Fracture;tibia and fibula	Injury
L74002	Fracture;foot/feet	Injury
L74005	Fracture;metatarsal(s)	Injury
L74007	Fracture;tarsal(s)	Injury
L74010	Fracture;toe(s)	Injury
L74012	Fracture;calcaneus	Injury
L77001	Sprain;ankle	Injury
L77002	Strain;ankle	Injury
L79014	Sprain;foot/feet	Injury
L79018	Strain;foot/feet	Injury
L79036	Shin splints	Musculoskeletal
L80004	Dislocation;foot/feet	Injury
L80012	Dislocation;ankle	Injury
L80023	Dislocation;toe(s)	Injury
L81019	Injury;toe	Injury
L81022	Injury;ankle	Injury
L81025	Injury;foot/feet	Injury
L81030	Haemarthrosis;ankle	Injury
L82003	Clubfoot	Congenital
L82005	Bowlegged;congenital	Congenital
L82008	Knock-knee;congenital	Congenital
L82009	Pigeon toed	Congenital
L82014	Talipes	Congenital
L82016	Feet turned in	Congenital
L82017	Genu valgum;congenital	Congenital
L82025	Deformity;foot;congenital	Congenital
L82029	Hemimelia	Congenital
L82032	Feet turned out	Congenital
L82033	Deformity;ankle;congenital	Congenital
L87017	Calcaneal spur	Musculoskeletal
L87024	Fasciitis;plantar	Musculoskeletal
L87029	Bursitis;heel	Musculoskeletal
L91016	Arthritis;ankle	Musculoskeletal
L91017	Osteoarthritis;ankle	Musculoskeletal
L91018	Arthritis;foot/feet	Musculoskeletal
L91019	Osteoarthritis;foot/feet	Musculoskeletal
L91021	Osteoarthritis;toe(s)	Musculoskeletal
L91023	Arthritis;toe(s)	Musculoskeletal
L94014	Severs disease	Musculoskeletal

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L98001	Bunion	Musculoskeletal
L98002	Clubfoot;acquired	Musculoskeletal
L98003	Bowlegged	Congenital
L98004	Pes planus (flat foot)	Congenital
L98006	Hammer toe	Musculoskeletal
L98007	Hallux;valgus	Musculoskeletal
L98008	Hallux;rigidus	Musculoskeletal
L98011	Pes cavus (claw foot)	Congenital
L98013	Genu valgum;knock knee	Congenital
L98015	Deformity;limb;acquired	Musculoskeletal
L98017	Deformity;foot;acquired	Musculoskeletal
L98018	Deformity;ankle;acquired	Musculoskeletal
L99105	Arthropathy;Charcot	Neuropathy
N04001	Restless legs syndrome	Neuropathy
N05001	Burning;sensation;extremities	Neuropathy
N05005	Tingling;feet/toes	Neuropathy
N05006	Paraesthesia	Neuropathy
N06022	Numbness;toe(s)	Neuropathy
N06023	Numbness;foot	Neuropathy
N06024	Numbness;leg	Neuropathy
N18002	Footdrop	Neuropathy
N94012	Neuropathy; diabetic	Neuropathy
N94016	Mononeuritis;legs	Neuropathy
N94018	Neuritis;peripheral	Neuropathy
S09005	Infection;toe(s)	Infection
S09010	Abscess;toe(s)	Infection
S09011	Cellulitis;toe(s)	Infection
S11019	Infection;ingrown toenail	Infection
S20001	Corns	Dermatological
S20002	Callosities	Dermatological
S21021	Sympt/complaint;skin;heel	Dermatological
S46002	Consult;podiatrist	Management
S52022	Resection;ingrown toenail(s)	Management
S52026	Removal;toenail(s)	Management
S59002	Podiatry	Management
S74001	Athletes foot	Infection
S74004	Infection;fungus;nail(s)	Infection
S74005	Infection;fungus;skin	Infection
S74006	Mycosis;skin	Infection
S74009	Tinea	Infection
S74015	Onychomycosis	Infection
S74018	Tinea pedis	Infection
S74025	Mycetoma	Infection
S76009	Pitted keratolysis	Infection
S76015	Cellulitis;leg	Infection
S76016	Cellulitis;foot/feet	Infection

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3	S94002	Ingrown;toenail(s)	Dermatological
4	S97004	Ulcer;varicose	Ulceration
5	S97008	Ulcer;leg	Ulceration
6	S97012	Ulcer;foot	Ulceration
7	S97013	Ulcer;diabetic	Ulceration
8	S97014	Ulcer;venous	Ulceration
9	S97016	Ulcer;toe(s)	Ulceration
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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	3-4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	6
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	6-7
Study size	10	Explain how the study size was arrived at	N/A
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7
		(b) Describe any methods used to examine subgroups and interactions	7
		(c) Explain how missing data were addressed	7
	7	(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	7
		(e) Describe any sensitivity analyses	N/A

Continued on next page

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-9
		(b) Indicate number of participants with missing data for each variable of interest	N/A
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	N/A
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	N/A
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	8-9
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9
		(b) Report category boundaries when continuous variables were categorized	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9-18
Discussion			
Key results	18	Summarise key results with reference to study objectives	19
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	22
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	20-21
Generalisability	21	Discuss the generalisability (external validity) of the study results	20
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	N/A

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.