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REVIEW

The burden of rheumatologic disease in Aboriginal and Torres Strait Islander Australians

Jason Sines,[1] Ken Cai,[1,2] Belinda Cashman,[3] Penelope Abbott,[4] Ayse Zengin,[5] Nicholas Manolios[1,2] and Peter K. K. Wong[1,2,6]

[1]Department of Rheumatology, Westmead Hospital, [2]Westmead Clinical School, Faculty of Medicine and Health Sciences, The University of Sydney, [3]Aboriginal Health Unit, Western Sydney Local Health District, [4]Department of General Medicine, School of Medicine, Western Sydney University, and [6]Rural Medical School, Coffs Harbour, Faculty of Medicine, University of New South Wales, Sydney, New South Wales, and [5]Department of Medicine, School of Clinical Sciences at Monash Health, Monash University, Melbourne, Victoria, Australia

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Correspondence
Peter K. K. Wong, Department of Rheumatology, Clinical Sciences Building, Room 2016, Block A & B Westmead Hospital, Cnr Hawkesbury Road and Darcy Road, Sydney, NSW 2145, Australia.
Email: peter.wong2@health.nsw.gov.au

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Abstract

The objective of this article is to summarise the current knowledge regarding the prevalence of six rheumatological conditions in indigenous Australians – rheumatoid arthritis (RA), osteoarthritis (OA), osteoporosis (OSP), systemic lupus erythematosus (SLE), gout and musculoskeletal (MSK) pain. Online medical literature databases were searched for 'indigenous', 'Aboriginal' and 'Torres Strait Islander', as well as the names of the six conditions. Other included search terms were 'crystal', 'urate', 'arthritis' and 'arthropathy'. No limitations were placed on publication data or language. Forty-five articles examining the prevalence of the six conditions were identified. Based on the published literature, SLE appears to have a higher prevalence, while RA appears to have a lower prevalence in indigenous Australians compared to the non-indigenous community. MSK pain is prevalent, has a significant impact on indigenous people and is perceived as an important area of need. There is a paucity of data regarding these conditions in indigenous Australians. This may be impacted by the uncertainty of case ascertainment by self-report, differences in disease phenotypes and prevalence between the metropolitan compared to the rural or remote indigenous population, and difficulty with access to healthcare. Further studies in conjunction with local indigenous communities are needed to accurately determine the burden of rheumatological disease in the indigenous population. This will assist with resource and workforce planning to deliver culturally appropriate interventions. Strategies for future clinical work and research include the development and dissemination of culturally safe rheumatology resources, rheumatology training of Aboriginal Health Workers and wider integration of rheumatology clinics into community-controlled Aboriginal Health Services.

Introduction

Rheumatologic diseases, such as osteoarthritis (OA), rheumatoid arthritis (RA), osteoporosis (OSP), systemic lupus erythematosus (SLE) and gout, are major public health issues. As the fourth most costly group of diseases in Australia, it accounts for 9% of total national healthcare expenditures.[1] In 2015, almost seven million (28%) Australians had a musculoskeletal condition,[2] and the estimated healthcare cost of arthritis was AU$ 4.7 billion.[3]

Aboriginal and Torres Strait Islanders (respectfully termed 'indigenous Australians' from here on) represented 3.3% of the Australian population in 2021.[4] Most indigenous Australians live in regional areas (44%), followed by major cities (38%) and remote areas (18%) (termed by the Australian Bureau of Statistics as 'ABS Indigenous Region').[5] Life expectancy is estimated to be 71.6 years and 75.6 years for indigenous men and women, respectively, compared to 80.2 and 83.4 years for non-indigenous men and women born between 2015 and 2017.[6] This represents a shorter life expectancy of 8.6

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and 7.8 years for indigenous men and women, respectively, compared to their non-indigenous counterparts.

Indigenous Australians suffer a higher burden of economic, social and health disadvantage for a range of reasons, in particular marginalisation and the generational effects of colonisation.[7] In particular, the latter has resulted in indigenous distrust of medical services and other governmental organisations. In 2014, approximately two-thirds of indigenous Australians had at least one chronic health condition.[8] Compared to the non-indigenous population, indigenous Australians have a higher prevalence of type 2 diabetes across all age groups, with a fourfold increased diabetes-related mortality rate,[9] a higher burden of end-stage kidney disease, which occurs at an earlier age,[10] and a higher prevalence of vascular disease, with associated increased cardiovascular mortality.[11]

Although further research on the impact of rheumatic conditions in indigenous Australians has been recommended,[12–14] there is a paucity of published data. There are also conflicting reports on the prevalence of these conditions in indigenous communities. The aim of this narrative review was to explore the current knowledge regarding the prevalence of rheumatological conditions in indigenous Australians, namely OA, RA, OSP, SLE, gout and musculoskeletal (MSK) pain. The burden of other autoimmune rheumatic diseases in the indigenous Australian population was recently reviewed.[15]

Methods

A search of medical literature databases and an indigenous-specific online index was performed with the assistance of a medical librarian. The medical databases accessed were Medline (1946 to May 2022), EMBASE (1974 to May 2022) and the indigenous-specific online index 'Lit. Search' through the Lowitja Institute (a community-controlled health research organisation). Keywords and Medical Subject Headings (MeSH) for terms related to indigenous Australians and arthritis were selected. Search terms for indigenous Australians were 'indigenous', 'Aboriginal', 'Torres Strait Islander' as well as 'Australia', and the names of each state and territory were used. The rheumatological conditions selected for review based on likely prevalence and economic importance were RA, SLE, OA, OSP, gout and MSK pain. In addition to the names of the conditions, other included search terms were 'crystal', 'urate', 'arthritis' and 'arthropathy'. The complete search strategy is provided in Appendix 1. The names of the rheumatological conditions were the only search terms used for the Lowitja Institute's index. There were no restrictions based on language or publication date. Duplicate results were only included once. Twenty-one published reports about disease prevalence across the five conditions and 24 reports regarding MSK pain were identified. The review team included indigenous authors (JS and BC), and experts in primary care (PA), OSP (AZ) and rheumatology (NM, KC and PKKW).

Results

Table 1 summarises the studies included in this narrative review regarding RA, SLE, OA, OSP and gout.

Rheumatoid arthritis

RA is the most common chronic inflammatory arthritis, affecting 1% of the general population.[16] Only three publications reporting the prevalence of RA in indigenous Australians were identified from the literature search. One report of skeletal remains in 1928 described the dorsal ankylosis of two vertebrae with irregular osteophytes and attributed these changes to RA, although it is more likely to be due to diffuse idiopathic skeletal hyperostosis, which was also described in 1995.[17,18] A study of 288 indigenous Australians living in Far North Queensland in 1965 reported only one young woman with definite, erosive deformities consistent with RA.[19] Seropositivity was not reported. Despite the absence of clinical arthritis, a relatively high proportion (6–12.7%) of the collected 268 sera samples tested positive for rheumatoid factor. This could have been accounted for by a non-specific rise in gammaglobulins in 28% of serum samples, which may have yielded a false positive result.[19]

In 1998, a case series of seven indigenous Australians from Northern Australia with rheumatoid factor-positive clinical RA was reported.[20] In 2001–2002, a Community Oriented Program for the Control of Rheumatic Diseases (COPCORD) survey was performed in Yarrabah, Queensland.[21] The COPCORD methodology was developed by the World Health Organisation and the International League of Associations for Rheumatology in 1981 for data collection on rheumatic diseases in rural areas of developing countries. Local healthcare workers were trained in survey administration and undertook door-to-door household surveys. Approximately 80% ($n = 847$) of the estimated 1077 inhabitants were surveyed. Two hundred eighty-one reported rheumatic symptoms, and 263 were examined by a rheumatologist. No cases of RA were reported.

The National Aboriginal and Torres Strait Islander Health Survey (NATSIHS) was conducted in 2004–2005. Households with more than one indigenous member were randomly selected from the Australian Census and approached for the self-reported survey, including households in remote communities. The survey was performed on 10 349 indigenous people. There was a 2.5% prevalence of self-reported RA in indigenous Australians

Table 1 Studies included stratified by disease

Rheumatic condition	First author	Study years	Data source	Criteria	Geographic location of indigenous population	Parameter	Indigenous prevalence estimate	Comparison population	Comparison population prevalence estimate
Rheumatoid arthritis	Douglas *et al*.	1965	Clinic visit and physician survey	Indigenous Australians aged >20 years	Aurukun, QLD Weipa, QLD		0.4%		
	Roberts-Thomas *et al*.	1998	Case series	Indigenous Australians with rheumatoid arthritis	Australia-wide		7 patients		
	Cunningham	2004–2005	Self-report of doctor-diagnosed RA (NATSIHS)	Indigenous Australians aged >18	Australia-wide		2.7%	Non-indigenous Australians aged >18	1.9%
	Grosman *et al*.	2016–2020	Clinic audit	Indigenous Australians aged >18 years	Inala, QLD		23/105		
Gout	Emmerson *et al*.	1964–1965	Clinic visit and physician survey	Indigenous Australians	Mitchell River, QLD Aurukun, QLD Weipa, QLD		0		
	Chin and Segasothy	1999	Case series	Indigenous Australians	Central Australia, NT		6 patients		
	Chan and Segasothy	2001–2004	Case series	Indigenous Australians	Central Australia, NT		7 patients		
	Minaur *et al*.	2001–2002	COPCORD	Aged >15 years	Yarrabah, QLD		3.8%		
	Lee and Roberts	2001–2010	ICD codes and medical file review	Indigenous Australians admitted to hospital with gout as a secondary diagnosis	Townsville, QLD		21.6%	Indigenous Australians admitted to hospital without gout as a secondary diagnosis	12.9%
	Angell *et al*.	2017	Medicare data linkage	Indigenous Australians at high risk of cardiovascular disease	NSW, QLD, VIC, NT		17.0%	Non-indigenous Australians at high risk of cardiovascular disease	23.0%
	Grosman *et al*.	2016–2020	Clinic audit	Indigenous Australians aged >18 years	Inala, QLD		12/105		
Osteoarthritis	Douglas *et al*.	1965	Clinic visit and physician survey	Indigenous Australians aged >20	Aurukun, QLD Weipa, QLD		7% (multiple joints) and 5% (knee) 14% (knee)		
	Minaur *et al*.	2001–2002	COPCORD	Indigenous Australians aged >15 years	Yarrabah, QLD		18%		

Table 1 *Continued*

Rheumatic condition	First author	Study years	Data source	Criteria	Geographic location of indigenous population	Parameter	Indigenous prevalence estimate	Comparison population	Comparison population prevalence estimate
	Cunningham	2004–2005	Self-report of doctor-diagnosed OA (NATSIHS)	Indigenous Australians aged >18	Australia-wide		6.4%	Non-indigenous Australians aged >18	5.7%
	Grosman *et al*.	2016–2020	Clinic audit	Indigenous Australians aged >18 years	Inala, QLD		22/105		
Osteoporosis	Macintosh and Pearson	1997–2000	Hospital records	Indigenous Australians admitted with fracture of neck of femur	Cairns, QLD	Hip fracture rate	30/10 000 (female) person-years 13/10 000 (male) person-years	Non-indigenous Australians admitted with fracture of neck of femur	30/10 000 (female) person-years 5/100 000 (male) person-years
	Wong *et al*.	1999–2009	Hospital records	Indigenous Australians admitted to hospital aged >40 with hip fracture	Western Australia	Hip fracture rate	273/100 000 person-years	Non-indigenous Australians admitted to hospital aged >40 with hip fracture	148.8/100 000 person-years
	Raja *et al*.	2003	BMD measurement through DEXA	Non-diabetic, urban-dwelling, adult indigenous women	Sydney, NSW		No significant difference in bone mineral density	Non-diabetic, urban-dwelling, adult non-Indigenous woman	
	Lukaszyk *et al*.	2003–2012	Population-based retrospective cohort data linkage	Indigenous Australians admitted for a fall-related injury	New South Wales	Proportion of hospitalisation for fall-related fractures	49%	Non-indigenous Australians admitted for a fall-related injury	60.2%
	Australian Institute of Health and Welfare	2005–2007	National Hospital Morbidity Database		NSW, VIC, QLD, SA, WA, NT	Ratio of number of cases observed to the number of cases expected for osteoporotic hip fracture	1.26 (female) 2.01 (male)		
	Lai and Waldron	2005–2010	Hospital records	Indigenous Australians aged >45 years admitted with surgery for minimal trauma hip fracture	Perth, WA		16.6%		

Table 1 *Continued*

Rheumatic condition	First author	Study years	Data source	Criteria	Geographic location of indigenous population	Parameter	Indigenous prevalence estimate	Comparison population	Comparison population prevalence estimate
	Maple-Brown *et al*.	2008–2010	BMD measurement through DEXA	Indigenous people aged >16 years without chronic kidney disease	Top End, Central Australia, remote Western Australia, Far North Queensland		*Z*-scores shifted to right of zero for both male and female indigenous Australians		
Systemic lupus erythematosus (SLE)	Anstey *et al*.	1984–1990	Hospital records	Indigenous patients with a diagnosis of SLE	Top End, NT		1:1900 (52/100 000)	Europe New Zealand USA	1:3750 1:6750 1:3300
	Grennan *et al*.	1993–1994	Physician and health service reports	Indigenous patients with a diagnosis of SLE	Indigenous population of Cairns, QLD		1:1120	Indigenous population of Sydney, NSW	1:7466
	Segasothy *et al*.	1990–1999	Hospital records	Patients with a diagnosis of SLE	Indigenous patients with SLE in Central Australia, NT		1:1360	Non-indigenous patients with SLE in Central Australia, NT	1:5170
	Bossingham	1996–1998	Physician, hospital and primary healthcare records	Patients with a diagnosis of SLE	Indigenous patients with SLE in Far North Queensland		1:1007	All patients with SLE in Far North Queensland	1:2207
	Subramani *et al*.	1999–2016	Medical records	Patients with a diagnosis of SLE	Indigenous patients with SLE in Central Australia, NT		1:601	Non-indigenous patients with SLE in Central Australia, NT	1:4051
	Grosman *et al*.	2016–2020	Clinic audit	Indigenous Australians aged >18 years	Inala, QLD		5/105		

BMD, bone mineral density; COPCORD, Community Oriented Programme for the Control of Rheumatic Diseases; DEXA, dual-energy x-ray absorptiometry; NATSIHS, National Aboriginal and Torres Strait Islander Health Survey.

compared to 1.9% in non-indigenous people from the concurrent National Health Survey.[22] However, there are no published data on accuracy of self-reported arthritis in indigenous Australians. There may therefore be uncertainty regarding case ascertainment. However, a recent review of an urban rheumatology clinic located in an Indigenous Health Service (The Southern Queensland Centre of Excellence in Aboriginal and Torres Strait Islander Primary Health Care; CoE) in southern Queensland reported a significant number of indigenous patients with RA ($n = 26$, of whom 17 were seropositive).[23]

The relative scarcity of RA in indigenous Australians can partly be explained by genetic factors. The shared rheumatoid epitope, a motif of five amino acids on the Major Histocompatibility Complex class II molecule, which increases RA risk, is present in 85% of non-indigenous patients with RA. However, the RA-associated haplotypes of DRBI*0401 and DRBI*0404 haplotypes are uncommon in indigenous Australians.[24]

Gout

The prevalence of gout is estimated to be between 1.5% and 6.8% in the general population.[25,26] Gout in indigenous Australians was first reported in 1965.[27] Joint symptoms, clinical examination and hand radiographs were performed, and serum samples were collected from 392 indigenous Australians from three communities in Far North Queensland. Serum urate levels were compared to the largest contemporary group of stored serum urate samples from the US state of Michigan. Serum urate levels were measured using the same method (spectrophotometric uricase method).

The mean serum urate concentration was higher in indigenous Australians compared to the Caucasian control group at all ages. In men, the mean serum urate concentration was 0.31 mmol/L in the Caucasian control group compared to 0.35 mmol/L in the combined Mitchell River and Weipa indigenous group and 0.36 mmol/L in the Aurukun indigenous group. In women, the mean serum urate concentration was 0.25 mmol/ in the Caucasian control group, 0.29 mmol/L in the Mitchell River and Weipa indigenous group and 0.28 mmol/L in the Aurukun indigenous group. Despite the relative hyperuricaemia, there was no reported gout in the indigenous Australians in this study.[27]

The seminal study assessing gout prevalence in indigenous Australians was the COPCORD survey performed in 2001–2002 (see Rheumatoid arthritis section for details).[21] Gout was diagnosed in 32 people, indicating a 3.8% prevalence of gout in this population of indigenous Australians living in Yarrabah, Far North Queensland.

A case series of six indigenous Australians from Central Australia with monoarthritis and hyperuricaemia attributed to gout was reported in 2000.[28] This series included the first reported case of aspirate-proven gout in an indigenous Australian. The other patients did not undergo arthrocentesis, so gout was not definitively confirmed. Another seven cases of aspirate-proven gout in indigenous Australians (including the first case in an indigenous woman) were reported in 2004.[29]

In 2012, a 10-year review of hospital admissions in Townsville, Queensland complicated by gout was undertaken and compared to a control group of patients with matched admission diagnoses.[30] Indigenous Australians were over-represented in the cohort with in-hospital gout – 18.8% Aboriginal and 5.2% Torres Strait Islanders, compared to 11.0% and 1.9%, respectively, in the patient population that did not have an in-hospital gout flare, suggesting a higher susceptibility to in-hospital gout flares for indigenous Australians.

The *Kanyini Guidelines Adherence with the Polypill (GAP)* was a pragmatic, randomised controlled trial of a cardiovascular poly-pill conducted in indigenous and non-indigenous patients at high risk of cardiovascular disease.[31,32] Various cardiovascular risk factors and associated conditions, including gout, were captured in this study. Compared to a 24% gout prevalence in non-indigenous Australians, the prevalence of gout in indigenous Australians in this study was 16%. Subgroup analysis revealed a lower prevalence of gout in indigenous Australians living in remote areas (12%) compared to urban counterparts (23%) – which was similar to the non-indigenous rate. This relatively high prevalence could be explained by study cohort enrichment for cardiovascular disease. Many patients suffering from metabolic syndrome had established cardiovascular or cerebrovascular disease – both of which are frequently associated with gout. A similar gout prevalence was found in a New Zealand population with type 2 diabetes.[33]

Gout was initially reported to be uncommon in indigenous Australians,[27] then progressed to two case series[28,29] and culminated in a reported prevalence of 3.8% in 2003. These papers challenge the previous widely held belief in gout's absence in indigenous Australians.[21] Although a high serum urate may have been beneficial in maintaining blood pressure in times of famine,[21] the adoption of a Western diet/lifestyle may have precipitated gout in indigenous Australians after 1965, as obesity and alcohol intake were rare in Emmerson's initial study.[34]

Systemic lupus erythematosus

Five studies have explored the prevalence of SLE in indigenous Australians (Table 1). In 1993, a study examined hospital records of indigenous patients with SLE at

Katherine and Darwin in the Northern Territory.[35] The prevalence of SLE was 1:1900, higher than contemporary estimates for the United States (1:3300), Europe (1:3750) and New Zealand (1:6750). Another study compared the rate of SLE in the indigenous populations of Far North Queensland and metropolitan Sydney.[36] A prevalence of 1:1120 was reported in the Queensland population, while a lower prevalence, comparable to the rate in a non-indigenous population, was reported in Sydney (1:7466). A similar prevalence of 1:1360 for the indigenous population of Central Australia was reported and compared to a local non-indigenous SLE prevalence of 1:5170.[37] The indigenous prevalence of SLE in Far North Queensland was similar to other indigenous populations (1:1007), and the overall Far North Queensland SLE prevalence (indigenous and non-indigenous population) was 1:2207.[38] A study of lupus nephritis in Central Australia reported a similar prevalence of 1:4051 for the non-indigenous inhabitants, but a higher prevalence of 1:601 for indigenous residents.[39] In Central Australia, between 1999 and 2016, medical record review in Alice Springs Hospital found 31 of the 39 SLE patients were indigenous, and 17 of the 18 patients with biopsy-proven lupus nephritis were indigenous. In the CoE rheumatology service in southern Queensland, five patients had a diagnosis of SLE.[23]

Several studies have confirmed a higher prevalence of SLE in indigenous Australians.[35–39] The difference in SLE prevalence between the two indigenous populations (Far North Queensland and Sydney) could be explained by genetic and environmental factors. Although a higher rate of C4A null alleles resulting in an increased risk of SLE was suggested, this was not supported by later studies.[37] The mechanism for this remains uncertain, but environmental factors, such as exposure to ultraviolet light and variable rates of bacterial infection, may be implicated.[40]

Osteoarthritis

The reported prevalence of knee OA in indigenous Australians varies from 5% to 18%.[21,41] A review of skeletal remains of Aboriginal people from several sites across Australia reported the incidence of OA changes in the knee and elbow between 1.0% and 20.4% and was influenced by gender and anatomical and geographical site.[18] Vertebral OA changes have also been described, but the incidence by age and sex was not reported.[18] The COPCORD survey undertaken at Yarrabah diagnosed OA in 47 people with a point prevalence of 5.5%.[21] The NATSIHS conducted in 2004–2005 included questions focusing on OA and RA and reported the national, self-reported prevalence of doctor-diagnosed OA at 6.4% for indigenous Australians. This was higher than the prevalence of 5.7% in the general non-indigenous Australian population reported in the concurrent National Health Survey. Indigenous Australians also had a higher prevalence of self-reported arthritis across all socio-economic categories.[22] Despite a comparable rate of OA, indigenous Australians had a lower rate of joint replacements.[42] In a metropolitan rheumatology clinic, 22 (24%) indigenous patients had a diagnosis of OA – although the anatomic site was not specified.[23]

The slightly higher prevalence of OA in indigenous Australians could be due to obesity – which is a strong risk factor for OA.[3,43] Other chronic conditions, such as diabetes, cardiovascular disease and chronic kidney disease, which disproportionately affect indigenous Australians, share risk factor profiles with OA, and their co-existence could also explain a higher prevalence of OA.[14]

Osteoporosis

Only two studies compared the areal bone mineral density (aBMD) of indigenous and non-indigenous Australians. A small study of 16 Aboriginal women and 16 non-indigenous women in Sydney found no significant difference in aBMD by dual-energy X-ray absorptiometry (DXA).[44] Another study measured hip and spine aBMD in 166 indigenous Australians living in remote regions of the Northern Territory, Western Australia and Far North Queensland and compared this to non-indigenous adults matched for age, sex and body mass index.[45] Femoral neck aBMD was higher in indigenous participants after adjustment and remained higher in indigenous men, even after the addition of lean mass to the model.

Despite this, there are varying reports of osteoporotic fracture rates. Two studies have supported a higher rate of osteoporotic fractures in indigenous people,[46,47] while one found a lower rate.[48] A review of hospital admissions for neck of femur (NOF) fractures between 1997 and 2000 from Cairns, Queensland[46] found the proportion of indigenous NOF admissions was 6%, while the indigenous population comprised 12% of the hospital's catchment area. There was a similar age-adjusted fracture rate in indigenous and non-indigenous women (30 per 100 000 person-years for both), but the fracture rate for indigenous men was higher (13 per 100 000 person-years) than in non-indigenous men (5 per 100 000 person-years). All 15 of the fractured NOFs in indigenous people were sustained following low trauma, that is, trauma following a fall from a standing height. No information was provided on the degree of trauma associated with fractures in the non-indigenous group.

A review of hospital hip fracture data over a 10-year period in Western Australia between 1999 and 2009 also reported a higher age-adjusted hip fracture rate (273 per 100 000 person-years, $n = 201$ fractures) for indigenous

Australians compared to non-indigenous Australians (148.8 per 100 000 person-years, $n = 11\ 643$).[47] This study also reported an average annual increase in age-standardised fracture rate of 7.2% for indigenous adults over this decade, while the rate in non-indigenous people fell by an average of 3.4% per year. The Australian Institute of Health and Welfare (AIHW) reported a slightly higher self-reported prevalence of OSP in indigenous (3.9%) compared to non-indigenous Australians (3.3%).[49]

A study of people aged over 50 years admitted to New South Wales hospitals between 2003 and 2012 found a smaller proportion (49%) of indigenous people admitted with a fall-related injury had a fracture compared to non-indigenous counterparts (60.2%, $P < 0.001$), including fall-related hip fractures (10% vs 18%, respectively, $P < 0.001$).[48]

Thus, there are conflicting data regarding whether indigenous Australians have a higher fracture risk than non-indigenous Australians. One study reported a lower fracture rate than non-indigenous Australians,[48] while two reported a higher fracture rate in indigenous Australians.[47,49] As the mean age for indigenous people with a NOF fracture was higher, some have suggested a higher baseline aBMD in indigenous people may result in osteoporotic fractures occurring later in life.[46] A higher rate of obesity in indigenous Australians might be associated with increased aBMD and cushioning of the hip from impact during a fall, or indigenous people living to older ages are amongst the healthiest of their populations and therefore less susceptible to age-related conditions, such as osteoporotic fractures.[48] It is worth noting that AIHW prevalence data are based on self-reporting, and the accuracy of self-report for medical conditions in indigenous Australians is uncertain. Despite a higher mean aBMD, it is unclear whether indigenous Australians sustain minimal trauma fractures at a higher rate than non-indigenous Australians.

Musculoskeletal pain

Twenty-four studies, of which two were systematic reviews, were identified examining MSK pain in indigenous Australians. Of these, only nine were primary sources regarding MSK pain and three were qualitative interviews (Table 2). One publication was a pilot project regarding the training of Aboriginal Health Workers in chiropractic approaches to MSK pain,[50] four studies developed or examined pain assessment tools,[51–53] three publications reported outcomes from the same initial qualitative survey,[54–56] three were open letters outlining previous clinical experience or research about MSK pain in indigenous patients,[57–59] and one was a protocol for a scoping review.[60] Early reviews of conditions affecting indigenous Australians included MSK pain (rheumatism) and described traditional therapies, including the topical application of subcutaneous emu oil and fumigation with smoke from eucalyptus leaves.[17,61]

A community survey from remote Central Australia found more than one-third ($n = 23/55$) of the surveyed community members reported long-term low back pain in the absence of public pain/illness behaviours. Despite this, there were no clinic presentations for back pain recorded over the 1 month survey duration. The authors suggested there were cultural expectations regarding tolerance and suppression of pain behaviours.[62] Another survey of 189 community members aged between 15 and 80 years from a rural Aboriginal community in NSW found a high proportion (95%) of chronic MSK pain, with low back, neck and shoulders being the commonest sites.[63] A small case–control study ($n = 16$) found muscular pain in eight indigenous Australians who were deficient in serum 25-cholecalciferol (the eight patients with MSK pain had a mean serum 25-cholecalciferol level of 40.88 mmol/L, and the mean serum 25-cholecalciferol level in the controls was 58.25 mmol/L). The authors suggested that indigenous Australians may be more susceptible to the muscular symptoms of vitamin D deficiency.[64] A cross-sectional sample of 363 indigenous Australians aged older than 45 years living in the Kimberley region in Western Australia yielded a self-reported pain prevalence of 55% ($n = 199/363$), and persistent pain was reported in 18% of the study sample ($n = 67/363$). Women and people with poor mobility or hearing were more likely to report pain.[65] A qualitative study employing a ‘yarning’ framework found negative beliefs about lower back pain and a perception of a poor prognosis was common in indigenous Australians living in rural and remote Western Australia.[55] Indigenous Australians with conditions associated with chronic pain, including OA and low back pain living in regional and remote Queensland, were reluctant to disclose pain to health professionals for a variety of reasons, including a cultural preference for stoicism, communication difficulties with healthcare professionals and previous experiences of perceived discriminatory attitudes from healthcare professionals.[66]

Culturally appropriate low back pain information for indigenous Australians living in rural Western Australia was developed with the ‘My back on track, my future’ (MBOT) program.[67] Five short audio-visual scenarios about lower back pain were developed to incorporate evidence-based lower back pain recommendations, overseen by a local Aboriginal steering committee and filmed using Aboriginal actors. Twenty Aboriginal adults were involved in a qualitative randomised crossover design comparing the MBOT resource to an evidence-based written resource (the

Table 2 Studies on musculoskeletal pain

Author (reference number)	Study years	Data source	Criteria	Geographic location of indigenous population	Parameter	Prevalence/conclusions	Notes
Honeyman *et al.*[45]	1988	Community survey	Indigenous adults aged >18 years	Central Australia	Long-term lower back pain	23/55 (41.8%)	
Vindigni *et al.*[57]	2001–2002	Community survey	Indigenous adults aged >18 years	Kempsey, NSW	Lower back pain in previous 7 days	72/189 (39.6%)	
Benson *et al.*[58]	2005	Case–control study	Indigenous adults with muscle pain	Adelaide, SA	Serum 25-hydroxyvitamin D deficiency	8/8 (100%)	
LoGiudice *et al.*[59]	2004–2006	Cross-sectional community survey	Indigenous adults aged >45 years	Kimberley region, WA	Pain	199/363 (54.8%)	
Lin *et al.*[50]	2007–2010	Interviews using ‘clinical yarning’ methodology	Indigenous adults with chronic lower back pain	Rural and remote WA (community names not supplied)	Impact of chronic lower back pain	32 interviews	
Strong *et al.*[60]	Not supplied	Qualitative interviews using focus groups	Indigenous adults living with an associated pain condition	South-east QLD	Experience of healthcare communication regarding pain	40 interviews	Pain conditions explored included (unspecified) arthritis, orthopaedic injuries, back pain, coronary artery disease
Alejandro Gonzalez-Chica *et al.*[1]	2013–2018	Medicare data regarding 1 501 267 GP presentations	Adult patients presenting to a GP with chronic back pain, gout, osteoporosis, spondyloarthropathies, rheumatoid arthritis, chronic pain	550 general practices across Australia	Prevalence of MSK condition GP presentations	22.9% of Indigenous Australians had MSK presentations vs 17.6% non-indigenous	Similar rate of chronic pain presentations (58.2% vs 56.9%)
Bernardes *et al.*[63]	2020	Qualitative interviews using focus groups	Indigenous adults attending a public chronic pain service	Queensland	Experience of managing pain	13 patients	Acknowledgement of historical and cultural factors was important Stigma or fear of differing treatment
			Aboriginal and Torres Strait Islander Hospital Liaison Officers (ATSIHLO)		Experience of ATSIHLOs in supporting patients with chronic pain	8 ATISHLOs	Difficulty with standard pain measures Importance of non-verbal communication

Back Book). Most ($n = 13/20$, 65%) participants preferred the MBOT resource and found the inclusion of Aboriginal actors relatable and the language understandable and appreciated the visual format of the resource.[67]

A study of more than 1.5 million general practitioner (GP) presentations for arthritis, chronic back pain, gout, OSP spondyloarthropathies, RA and chronic pain between 2010 and 2016 reported Aboriginal people had a higher prevalence of MSK disease (22.9% vs 17.6%). However, the proportion of consultations for current chronic pain was similar between Aboriginal and non-Aboriginal people for the same MSK condition (58.2% vs 56.9%), suggesting that Aboriginal people were not more likely to develop (or present to a GP for) chronic pain.[1] A metropolitan rheumatology clinic found that 39% of indigenous patients ($n = 36$) had mechanical MSK pain.[23]

A systematic review of MSK pain in indigenous Australians analysed 14 quantitative studies and four qualitative studies. Using the Mixed Methods Appraisal Tool, eight quantitative and three qualitative studies were rated as 'high' methodological quality, one quantitative and one qualitative were rated 'medium', and five quantitative studies were rated 'low' quality. The authors found that MSK pain had a significant impact on Aboriginal people and that Aboriginal people had a predominantly negative experience of healthcare interactions. The authors concluded there was preliminary evidence of an increased burden of MSK pain in indigenous Australians with disparities in prevalence and access to care.[13]

Most MSK pain data in Aboriginal people are derived from small study cohorts using predominantly qualitative study methods.[68] However, three pain assessment tools, the Brief Pain Inventory Short Form, the McGill Pain Questionnaire and the Numerical Rating Scale, were not able to fully capture the pain experience of 13 Aboriginal people living in South Australia – possibly because the Aboriginal perspective of pain is a bio-psycho-social-spiritual one.[52] Aboriginal Health Liaison Officers may be a key component in establishing collaborative relationships between clinicians and Aboriginal people with chronic pain as they can act as advocates, assist with tailoring culturally sensitive communication and deliver culturally relevant information to Aboriginal people and communities.[69]

Discussion

Of the rheumatological conditions reviewed, based on the published literature, SLE appears to have a higher prevalence, while RA appears to have a lower prevalence in indigenous Australians compared to the non-indigenous community. However, the paucity of published data with uncertainty of case ascertainment by self-report makes it difficult to draw firm conclusions. It is hoped that highlighting this will prompt efforts to address this gap in knowledge. A major issue may be the difference in disease phenotype and prevalence between the metropolitan compared to the rural or remote indigenous population. Access to healthcare for the indigenous population may also affect case ascertainment. The collective indigenous experience of racism, discrimination, stress and a legacy of dispossession[22] is a prominent, current and potent contributor to both rheumatological and broader disease. Powerful social and cultural determinants of disease are clearly impacting disease burden. Furthermore, the personal impact of disease on indigenous people is often substantial as treatment may not be readily available where they reside and may require referral to a major tertiary centre with separation from family, community and country. As these factors constitute a crucial part of indigenous identity and well-being, indigenous people may decline hospitalisation or transfer to metropolitan referral centres – thus compromising health outcomes.

Strategies to investigate rheumatological disease in indigenous people were explored in several studies and have been incorporated into several published study protocols.[23,70–72] The development of culturally appropriate resources providing information about rheumatological and musculoskeletal conditions for Aboriginal people, development and training of Rheumatology Aboriginal Health Workers and wider integration of rheumatology clinics into Aboriginal Community Controlled Health Services are possible strategies to improve the provision of care to this population. Indigenous communities have requested self-determination and opportunities to oversee and administer policies directly affecting them.[73–77] This needs to be considered prior to implementation of any such programs. The importance of obtaining the consent and collaboration of the local target community is crucial as there is vast diversity across indigenous communities.

More recent studies appropriately recognise and embrace principles of cultural sensitivity, indigenous oversight and engagement and authorship by indigenous researchers. Recently, study protocols have been published focusing on the development of community-led and culturally appropriate resources for rheumatologic diseases.[71,72] Consultation by rheumatology healthcare providers and departments with Aboriginal Community-Controlled Health Organisations and indigenous stakeholders is crucial. This is exemplified by the 'Staying Moving, Staying Strong' project, which will explore rheumatology health information needs and preferences of indigenous Australians with arthritis and has led to the production of clinical practice guidelines and culturally appropriate resources which have been endorsed by Arthritis Australia[71,78] The qualitative analysis of indigenous Australian experiences of a rheumatology service in a metropolitan hospital in NSW is being explored in order to incorporate the indigenous perspective in rheumatology strategy and models of care.[70] The Study of Indigenous Muscle and Bone Ageing protocol aims to assess the prevalence of OSP in indigenous Australians through a prospective observational study and was co-designed with the indigenous community.[72]

Although there is uncertain prevalence of rheumatologic disease in indigenous Australians, it appears several of the conditions reviewed may occur at a comparable or higher rate than non-indigenous Australians, excluding perhaps RA. It is therefore crucial that methodologically rigorous, long-term, larger studies be undertaken to accurately determine the burden of rheumatological disease in the indigenous population. Such studies should involve indigenous co-design and indigenous investigators, especially Aboriginal Health Workers. Such trained healthcare professionals are crucial for establishing collaborative relationships between clinicians/researchers and Aboriginal communities, assisting in advocacy and tailoring development and delivery of culturally sensitive communication regarding rheumatological disease to Aboriginal people and communities.

Conclusion

A robust understanding of disease burden will then allow an accurate determination of what culturally appropriate resources need to be directed to address these chronic conditions in the target population. Undertreated rheumatological conditions have wide-reaching consequences for cultural participation, well-being and the ability to self-manage other chronic conditions.[14] Equity of access requires us to attend to this as a matter of urgency.

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Appendix S1: Supporting Information.