



An investigation into the foot health of Aboriginal and Torres Strait Islander peoples: a literature review

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Acknowledgement: I would like to acknowledge the traditional owners of all the many Aboriginal and Torres Strait Islander nations that make the great continent of Australia. I would like to pay my respects to the Aboriginal and Torres Strait Islander elders past and present, also the young community members, as the next generation of leaders and representatives.

Disclaimer: In some instances in this paper I will be using the term 'Aboriginal' to describe both Aboriginal and Torres Strait Islander peoples. This is due to word restrictions, and no disrespect is intended to any individual or group.

Abstract

Objective: The object of this paper is to review the literature on risk markers, risk factors, and chronic conditions in relation to foot health in the Aboriginal population.

Methods: Basic literature review, databases searched – Cochrane, EMBASE, CINAHL, PubMed, MEDLINE, and EBSCOhost and references from articles, and not limited by date or language. This search yielded 214 articles, abstracts of these articles were read to identify articles which were directly relevant to the topic, and this strategy provided a total of 55 articles.

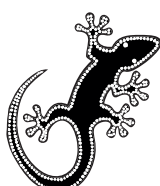
Results: Risk markers like age and gender were shown to significantly contribute to poor health and foot health outcomes. Risk factors like obesity and smoking were also shown to be associated with many chronic diseases and poor foot health. Footwear can contribute to poor foot health, for example high heeled shoes have been associated with foot pain, calluses and corns.

Conclusions: The search and review revealed that there has been limited research into risk markers or risk factors for Aboriginal foot health. This review found that risk markers and risk factors for poor foot health outcomes are high and current foot health is poor and under researched.

Implications: The information gained from this study will assist in identifying potential targets for intervention and research to improve foot health in Aboriginal communities.

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Introduction

There are approximately 548,000 Aboriginal people, representing 2.5% of the Australian population. Of those, 172,000 live in NSW, comprising 32% of the total Aboriginal population and the highest number of any state or territory [1]. Aboriginal people suffer with a high prevalence of chronic conditions which accounts for approximately 60% of the premature morbidity and mortality occurring in this population [2]. A number of these chronic conditions including diabetes, neuropathy of various causes and peripheral vascular disease (PVD) are prevalent within Aboriginal communities, and have been shown to be associated with foot pathology [3-5]. The little data available on foot health in the Aboriginal population indicates that generally it is poor and the rates of ulceration, infection and amputation are continuing to increase [6, 7]. Often the only option to resolve these wounds is to amputate above the infected area. With many more amputations being conducted on the Aboriginal population [8]. However, despite evidence of high prevalence of serious foot complications in the Aboriginal community, no research has thoroughly investigated the nature and mechanism of the foot problems affecting Aboriginal communities.

Risk markers for Aboriginal health: Age

Age has been associated with many diseases and chronic conditions which are risk factors for poor foot health [9-11]. The ageing process has also been associated directly with impaired foot function which may predispose to poor foot health. Longitudinal research (n=343) has found that age is associated with the development of foot pathology, with the odds of developing a foot pathology increasing by a factor of 1.069 for every year over 65 years [5]. Older age has also been associated with poor foot health, like calluses and corns, likely due to reduced flexibility and durability of ageing skin [12]. In summary, the literature shows that age is associated with many diseases and chronic conditions associated with poor foot health outcomes but this has not been investigated in the Aboriginal population.

Risk marker for Aboriginal health: Resident Area

An extremely important aspect of Aboriginal health is the different foot health and other health services in different residential areas. Approximately 34% of all Aboriginal people live in cities (233,100 people), and 22% (147,700) of Aboriginal people live in inner regional centres, with 21% (146,100) living in outer regional areas, compared with 71%, 18% and 9% respectively of non-Aboriginal Australians [13]. The greatest difference in residence between Aboriginal and other Australians is remote and very remote, with

approximately 7 times more Aboriginal people living in remote and 26 times more living in very remote areas [13]. Location of residence makes a difference to life expectancy at birth for Aboriginal people. Aboriginal men living in cities and inner regional areas live 11.9 years less than non-Aboriginal men, but for Aboriginal women the greatest difference compared with non-Aboriginal women was for those living in remote and very remote areas, living 10.2 years less [14]. Although area of residence has been investigated for some areas of health and life expectancy for Aboriginal people the implications for foot health have not been investigated.

Risk markers for Aboriginal health: Gender

Gender has been associated with many diseases and chronic conditions which are risk factors in Aboriginal health, and which may be associated with changed foot function and poor foot health. Males develop diabetic neuropathic degeneration approximately 4 years earlier than females, putting men at greater risk for poor foot health [15]. In the total Australian population, males were nearly twice as likely as females to have diseases of the arteries, arterioles and capillaries [16]. Some studies have found non-Aboriginal women have a greater prevalence of diabetes than non-Aboriginal men [17, 18]. The prevalence of obesity as indicated by waist circumference was higher in women (34.1%) than in men (26.8%) [19]. Gender is associated with many of the risk factors and chronic conditions, impacting on foot health, potentially predisposing specific genders to poor foot health outcomes, making gender an important risk marker.

Risk factors for Aboriginal health: Obesity

A study found overweight and obesity results (n=11,247), measured by waist circumference was 39% overweight and 20.8% obese, with BMI the results were 30.5% and 25.5% respectively [19]. Waist circumference was reported to be the most appropriate measure, but with either measure, 56-60% of the Australian population tested were overweight or obese [19]. Recent data suggests that obesity is more prevalent in the Aboriginal community than in other Australians. Recent large studies with Aboriginal volunteers (n=10,434) have shown that Aboriginal females have higher waist circumference, waist-hip ratio, waist-height ratio and waist-weight ratio than non-Aboriginal women [19]. Aboriginal men had higher weight-height ratio and waist-weight ratio compared with non-Aboriginal men (n=10,434) [19]. The proportion of obese Aboriginal women was significantly higher than that of non-Aboriginal women and obesity rates for Aboriginal men are higher than non-Aboriginal men, with the exception of 45-54 years cohort [20]. Obesity has been associated with many chronic conditions including diabetes and PVD which are to be investigated in this

literature review [21-23]. Being overweight or obese has been shown to have a negative impact on foot health, especially due to the associated increase in foot pressure and resulting longitudinal arch collapse [24]. Obesity (BMI >30) has been linked to chronic plantar heel pain, and with a flattening of the medial longitudinal arch in an Indian population, using the Arch Index as a measure of flatfeet [25]. The literature establishes that obesity is highly prevalent in the Australian population and it is higher for some Aboriginal populations.

Risk factors for Aboriginal health: Smoking

Smoking tobacco in the Aboriginal population is reported to be 45% compared with 22% for non-Aboriginal Australians [26]. Smoking is a risk factor for chronic conditions [27] and poor foot health [28]. In the general population tobacco smoking is linked to poor healing, research has showed that nicotine was related to non-healing of gastric ulcers in rats [29], possibly as a result of smoking-related reductions in epidermal growth factor (EGF) [30] which may be the same mechanism that prevents healing in human dermal tissue. Cigarette smoking has also been associated with reduced blood circulation, by impairing endothelium-dependent dilatation of vessels [31, 32]. Reduced peripheral blood flow, including impaired blood flow to the foot, will put smokers at risk of poor foot health. The literature shows that smoking is a risk factor for chronic conditions and poor foot health for all Australians, but maybe more serious for the Aboriginal population due to far great smoking rates.

Risk factors for Aboriginal health: Footwear

Footwear can contribute to poor foot health, for example high heeled shoes have been associated with foot pain, calluses and corns [33]. Other studies have also shown wearing shoes is not necessarily related to good foot health. A survey of skeletally mature individuals in India (n=1864) found that those wearing shoes had a higher prevalence of flatfeet [25], especially those that started wearing shoes before they turned 6 years of age [25, 34]. Shoes that provide support and cushioning can reduce poor foot health, trauma and falls [35, 36]. Wearing of appropriately fitting closed toed shoes can promote foot health in populations at risk of developing foot problems. Podiatrists recommend wearing of such shoes for all diabetics (especially those with peripheral neuropathy), to prevent small traumas that may go unnoticed and become infected and or non-healing. A large unpublished study in South Australia (n=1092) using Aboriginal Health Workers to collect observational data on Aboriginal feet, found that 65% of males and 80% of women with diabetes were wearing slip on shoes, thus potentially putting their foot health at risk [37]. While

the wearing of closed toed shoes is advocated, it is important that the shoes fit appropriately. The lack of appropriately fitting closed toed shoes was found to impact on foot health, with 71% of 913 Aboriginal participants wearing closed toed ill-fitting shoes having calluses and corns [37]. The results of Jones (2001) are supported by early studies showing that people without shoes experienced less pain than those wearing shoes in India, China and Kenya [38]. Therefore, although there is evidence for the foot health benefits of wearing shoes, it could be argued that poorly fitting shoes may be worse than slip-on shoes or no shoes.

Chronic conditions related to foot health in the Aboriginal population: Diabetes

There are many important chronic conditions in Aboriginal health that need to be investigated, but diabetes is directly and indirectly related to foot health and other related chronic conditions. Diabetes is a worldwide epidemic and especially prevalent in Western countries. The prevalence of diabetes in Australia (2013) was 4.6% and affected more males than females [39]. In comparison, the prevalence of diabetes in the Aboriginal population is 11% of all adults [2], which is an increase from 8% in 2012-2013 [40]. The prevalence of diabetes in the Aboriginal population is 7% in cities and about 12% in very remote regions, which has increased from 6% and 8% in 2001-2012 [40]. Diabetes Australia (2007) states Aboriginal adolescents are 6 times more likely to have type 2 diabetes than non-Aboriginal and it is believed that for every person diagnosed there is one undiagnosed [41]. Aboriginal men are less likely to have diabetes with only 7% compared to 10% of Aboriginal females [40], which is in contrast with the non-Aboriginal population. In addition about 18% of over 25 year old Aboriginal people have diabetes, and this increases with age, with 39% of over 55s having diabetes [40].

The burden of disease with diabetes in the Aboriginal population occurred 5.1 times that for non-Aboriginal Australians [42]. Diabetes also accounted for 8.9% of the total burden of disease for Aboriginal peoples, and females carried most of the burden [42]. The disability-adjusted life year (DALY) for the total burden for Aboriginal people with diabetes was 8,498 [42]. Diabetes is the second leading cause of death of Aboriginal people, accounting for 7.6% of all deaths, which was 6 times higher than for non-Aboriginal Australians [43]. Diabetes has been found to be a risk factor for other chronic conditions, including PVD and neuropathy [28]. It has also been demonstrated to significantly increase the risk of foot pathology with increasing age, with a 90 year old person with diabetes having an approximately eight-fold increased risk of developing a foot problem compared with a non-Aboriginal person of the same age [5]. A study by Jones (2001) found that in a South Australian Aboriginal population, those with diabetes were

twice as likely to have calluses and corns as those without diabetes [37].

In a random sample of the Australian population, (n=11, 247), Tapp et al. (2003) found that 13.1% of those with diabetes had peripheral neuropathy, 13.9% had PVD and 19.6% were at risk of developing a foot ulceration [28]. Diabetes has also been found to modify muscle through oxidation of proteins. Markers of oxidative stress (protein carbonyls) were compared in soleus and plantaris muscles of non-diabetic and diabetic rats, and higher plasma glucose concentrations were associated with greater oxidative stress [44]. Human tissue also was found to have a link between higher glucose levels and increased glycation of proteins. Glycation of connective tissue proteins induces structural changes in tendons and muscle, increased density of collagen fibrils, decreased fibrillar diameter and abnormal fibril morphology which leads to decreased stretch and elasticity [3, 45, 46] and may contribute to decreased joint ROM and poor foot health outcomes. Duffin et al. (1999) compared foot joints of 302 adolescents with diabetes and 51 non-diabetic controls and found double the prevalence of hammer and claw toe, in the diabetic group, indicating that the changes in the foot are associated with foot pathology [47]. Spencer et al. (1985) found that 50% of patients with diabetes present with some foot deformity [48] linking diabetic foot changes directly with poor foot health outcomes. A study found 68% of 92 diabetic patients had structural pathology in the foot and this put patients at risk of ulceration and amputation [49]. Diabetes increases the risk of ulceration and amputation, with diabetics being 15 times more likely to have an amputation. Diabetic patients that have an amputation will have an increased chance of having a subsequent amputation on the other foot within 2-3 years, and in 2004-5 there were 3,400 amputations in Australia [41]. The relationship with diabetes and foot health in the Australian Aboriginal population has not been established, which is a gap in the literature.

Chronic conditions related to foot health in the Aboriginal population: Neuropathy

Peripheral neuropathy refers to loss of nerve function in the foot, occurring more frequently in people with diabetes and those who smoke [50]. The loss of nerve function in the foot has been found to be a risk factor for foot functional changes and poor foot health, especially amputation [3, 4]. Jones (2001) showed that 18% of 94 Aboriginal people with diabetes had peripheral neuropathy in the foot as tested with a 10g monofilament [37]. The Jones study may have underestimated neurological function loss, as recent research recommends use of a 6g monofilament for nerve function testing [51]. Using a 10g monofilament will give some false positive results because participants with some neurological loss will be able to feel the 10g monofilament. Case studies have shown an association

between neurological degeneration and increased risk of foot functional change and poor foot health, due to loss of sensory function of muscle and joints [52]. Peripheral neuropathy causes loss of sensation and those individuals without pain will continue their activities, increasing the chance injury and poor foot health.

Chronic conditions related to foot health in the Aboriginal population: PVD

Risk factors for PVD include diabetes, smoking and age, [28, 37, 53], which have been identified as important variables to foot health in this literature review. The proportion of the Australian population reported as having disease of the arteries, arterioles and capillaries was 1.2%, although Jones (2001) reported a prevalence of 9.4% of Aboriginal people that volunteered to participate in a study [37]. It is likely that PVD often goes undiagnosed, usually secondary to diabetes or smoking. PVD has been associated with poor foot health, including amputation [28, 53]. PVD is reportedly very high in the Aboriginal population, with an estimated prevalence of 12%, which is 10 times that for the non-Aboriginal population [16]. Literature shows that PVD can be associated with poor foot health and risk factors for PVD are high in the Aboriginal population. The very high rates of PVD in the Aboriginal population increases the likelihood of poor foot health outcomes.

Foot health in the Aboriginal population

There are a limited number of studies investigating foot health in Aboriginal communities, but with the high occurrence of risk factors and chronic conditions it is hypothesised that foot health will be poor. A clinical audit at the Alice Springs Hospital found that Aboriginal people accounted for 89% of foot complications and 91% of separations for diabetic foot [6], yet Aboriginal people comprise only 38% of the population in Alice Springs [1]. The incidence of diabetic foot complications in Aboriginal people increased nearly 3 fold from 98/100,000 to 285/100,000 people from 1992 to 1997 [6]. Half of Aboriginal people with infected diabetic foot wounds were found to be infected with methicillin-resistant *Staphylococcus aureus* (MRSA) [7]. Often the only option to resolve these wounds is to amputate above the infected area. Consequently, 59% of major amputations in Alice Springs were conducted on Aboriginal people and they accounted for half of all infection cases (n=51) [6]. Only 2% of non-Aboriginal people admitted to hospital with diabetes had amputations in Northern Territory from 1993-1996 [54] and study on admission data in Alice Springs Hospital showed 7% of Aboriginal people (n=165) with diabetes admitted from 1984-1986 with bacterial infection, had amputations, [55]. Although no direct comparisons can be

made between these studies, it could be used to demonstrate the different amputation outcomes between non-Aboriginal and Aboriginal people.

Conclusion

The literature showed high prevalence of serious foot complications in the Aboriginal community, and no research has thoroughly investigated the nature and mechanism of the foot problems affecting Aboriginal communities. Risk markers like age and gender were shown to be associated with many risk factors and chronic conditions associated with poor foot health outcomes but has not been investigated in the Aboriginal population. Residence has been investigated for many areas of health in the Aboriginal population, but the implications for foot health have not been investigated. Obesity is highly prevalent in the Australian population and it is higher for many Aboriginal cohorts. The literature established it is also associated with poor foot health outcomes but had not been investigated in the Aboriginal community. Smoking is a risk factor for chronic conditions and poor foot health, and the prevalence is extremely high in the Aboriginal population, which increases risk of foot complications. Aboriginal people have been shown to wear a lot of open shoes, and those that were wearing closed shoes perhaps were not an appropriate fit, putting the community at risk of foot complications. The rate of diabetes in the Aboriginal population is extremely high, and has been associated with all aspects of foot health. It is also a risk factor for other foot related chronic conditions (neuropathy and PVD), and directly related to ulceration, infection and amputation. The Aboriginal population is at risk of foot complications, but there is very limited research on foot health. There needs to be research specifically investigating risk markers, risk factors, relevant chronic conditions, foot biomechanics, and poor foot health outcomes.

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