Social Determinants of Preventive Testing and Adherence to Treatment for Osteoporosis

6

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6.1 Introduction

Commonly referred to as a ‘silent disease’, osteoporosis is primarily asymptomatic until a fracture occurs [1]. One in three women and one in five men aged 50 years and older will suffer an osteoporotic fracture [1–4]. Following a hip fracture, 10–20% of people will require long-term nursing care, and one in five people will die in the first 12-month post-hip fracture [5, 6]. Thus, the identification of osteoporosis prior to fracture and the provision of effective postfracture care are imperative. However, it is now established that disparities exist in screening, diagnosis and treatment of osteoporosis between sexes, social groups and ethnicities [7].

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6.2 Preventive Testing

Scanning of the axial skeleton by dual-energy X-ray absorptiometry (DXA) is currently the gold standard for determining measures of bone mineral density (BMD), which subsequently informs clinical decision-making regarding osteoporosis. Given the well-documented relationship between low socio-economic status (SES) and increased fracture [8], it could be expected that the largest benefit derived from DXA is for those of lower SES [9, 10]. This would result in an inverse association between SES and DXA [9–11]; however, this has not been observed. For instance, less uptake of DXA was observed in those of lower SES in Canada, where DXA scans for adults aged 70 years or older are fully subsidised [9] in a similar model of reimbursement to the Australian healthcare system. However, whilst some countries such as Australia may subsidise BMD testing, patients referred for densitometry may still be required to pay a gap fee. Furthermore, not all countries provide reimbursement for DXA tests or may only provide subsidisation after fracture [12]. In a study of 35,681 women (age 65–89 years) from the USA, a positive association between income and DXA utilisation was only observed for those pre-fracture [12]. In a best-evidence analysis and systematic review, it was reported that limited, but consistent, evidence existed for a positive association between DXA utilisation and income and education [10]. Clearly, out-of-pocket costs for DXA or osteoporosis therapies present a key barrier to access for individuals of lower SES.

Area of residence has been shown to play a role in the uptake of DXA, whereby women residing in urban areas are more likely to be referred for DXA than women in rural areas (RR 1.15, 95%CI 1.08–1.22), with stronger results observed for men (RR 1.46, 95%CI 1.17–1.81) [13]. However, the urban-rural disparity may not be surprising given that patients in rural areas are more likely to experience difficulties accessing services due to the concentration of DXA services in metropolitan areas, medical workforce shortage in rural areas and travel distances to specialist services, as has been reported for mammography [14, 15].

External factors influencing DXA utilisation, including cost and accessibility, interact with individual factors, such as health literacy and perceptions of fracture risk and treatment benefit. Combined, this creates inequity in the uptake of preventive testing between advantaged and disadvantaged populations: the latter group being most at risk of fracture. Health literacy, a term that describes the broad range of abilities and supports that an individual requires to manage health [16], has been identified as a potential mediator in the relationship between social disadvantage and poor health outcomes [17]. However, there exists a paucity of data concerning the role health literacy play in the relationship between social disadvantage and uptake of DXA scans. One Australian study found that among patients hospitalised for minimal trauma fracture, individuals who had previously undergone assessment for osteoporosis reported higher functional health literacy [18]. This suggests that patients with better functional health literacy, an aspect of health literacy related to reading and comprehending written health information [19], may be more likely to undergo a DXA scan. However, there are a broader range of health literacy abilities and supports beyond functional health literacy likely to play a role in the utilisation of DXA scans that have yet to be explored.

A relationship has been observed between higher functional health literacy and greater osteoporosis knowledge [20]. However, an exploratory study of the beliefs and perceptions of outpatients with osteoporosis found that even those with a good level of osteoporosis knowledge attributed their own fractures to factors such as falls and poor vision rather than bone fragility [21]. These patients may have adequate functional health literacy required to find and understand basic osteoporosis information but lack the more complex health literacy abilities necessary to apply this information to their own situation [19]. Those data indicated that many patients lacked awareness of anti-fracture treatments [21]: an unfortunate knowledge state, given that higher perceived benefit of anti-fracture treatment has been associated with increased treatment uptake and with increased uptake of DXA scans [22].

Higher levels of health literacy would enhance the ability of individuals to address their perceived or real barriers to undergoing a DXA scan [22]. For example, an individual requires health literacy abilities to understand the financial burden of undertaking a DXA scan. This may require navigating their region- or country-specific reimbursement system to understand if they are entitled to any reimbursement, how much of the cost would be reimbursed, how to seek reimbursement and how long the reimbursement process would take. However, given that lower SES is strongly associated with lower health literacy, the choice to avoid undergoing a DXA may be considered the preferred option.

Barriers to DXA uptake must also be considered in the context of ageing and multimorbidity. Older adults are more likely to have low health literacy compared to their younger counterparts [23–25]. This may relate to cognitive decline observed in older adults [26, 27] and/or the higher number of chronic conditions among older adults [28] placing additional burden on health literacy skills. Individuals managing multiple conditions are more likely to report lower health literacy [24, 25, 29]. Previous research has also identified low salience of osteoporosis among patients when compared with other long-term conditions [30]. It is possible older patients managing several chronic conditions with limited health literacy may not prioritise screening for an asymptomatic condition such as osteoporosis.

In addition to the patient level factors that influence uptake of DXA scans, healthcare providers play a crucial role in the utilisation of DXA scans not only in making the decision to refer but also adequately communicating the need for bone density assessment to their patient. Thus, the beliefs and perceptions of referrers are important in determining whether a patient receives a DXA scan. One study demonstrated increased likelihood of undergoing a DXA scan among patients of female healthcare providers [22]. A recent qualitative study found that over one third of patients with a fragility fracture described referrer barriers to DXA scan [31]. These included being told their bone density was normal based on their physical appearance or X-rays or being told their fracture was not a fragility fracture, despite an osteoporosis screening coordinator categorising it as such [31]. This suggests either a misunderstanding between the patient and healthcare provider regarding the need for a DXA scan or a lack of understanding among some GPs regarding osteoporosis assessment and characteristics of a fragility fracture. An earlier survey of GPs suggests that, despite the overwhelming majority recognising the importance of preventing osteoporosis, many felt they lacked the necessary tools to address the issue with patients [32]. In a qualitative exploratory study, GPs identified the perceived availability of DXA scans in the local area also influence their decision to refer [33], suggesting healthcare providers may be sensitive to the barriers faced by their patients in accessing healthcare.

6.3 Non-pharmacological Treatment

The first-line treatments for low BMD are non-pharmacological interventions, primarily vitamin D and/or calcium supplementation and physical activity.

Vitamin D is important for optimal calcium absorption and bone formation and assists in the regulation of calcium levels. The key source of vitamin D is ascertained from sunlight exposure of the skin: notably, exposure to ultraviolet B [UVB] light. Sun exposure should be outdoors, as UVB transmission is unlikely to occur through normal clear windows. Vitamin D deficiency may be more likely observed in older or housebound persons [including residents of aged-care facilities], individuals with naturally darker skin, those that avoid sun exposure such as persons whose bodies are covered for cultural or religious reasons, babies of mothers that are vitamin D deficient and those that are unable to absorb or process vitamin D [34].

Calcium plays an imperative role in normal growth and maintenance of bone and is a dynamic store of intra- and extracellular calcium pools [35]. Adequate dietary calcium intake is essential to achieve peak bone mass and to reduce age-related loss of bone [36]. Different life stages require different levels of dietary calcium intake, and recommendations for daily calcium intake vary between countries; however, the recommended daily consumption of calcium [from foods] can be achieved by consuming 3–5 serves daily of calcium-rich foods. In older community-based individuals and residents of aged-care facilities, reducing falls risk is imperative, with the end-goal being to reduce both falls and fractures. It is universally recommended that a combination of vitamin D and calcium supplementation be optimised in all residents of aged-care facilities [37]. However, previous research suggests that compared to other osteoporosis treatments, calcium and vitamin D supplementation have lower adherence rates among patients with osteoporosis [38]. Patients who discontinued calcium and vitamin D supplements were more likely to identify lack of motivation as the reason [38]. Fear of side effects was the most commonly cited reason for stopping other prescribed anti-fracture medications [38].

Age-specific requirements for the type, duration, intensity and regularity of physical activity have been proposed to maximise bone health [39]. The beneficial effect of selected exercise modalities on bone health ranges from those that are highly osteogenic [basketball/netball, impact aerobics, tennis, jumping], moderately osteogenic [running/jogging, hill walking, resistance training, stair climbing], low osteogenic [leisure walking, lawn bowls and yoga/Pilates], to non-osteogenic [swimming, cycling] [39]. Whilst leisure walking is not recommended as an adequate strategy for bone health, this activity nonetheless provides overall health and fitness benefits.

Greater health literacy and higher SES have been associated with an increased uptake of preventive health behaviours, including better diet quality [29, 40] and increased physical activity levels [24, 29, 40, 41]. It has previously been suggested health literacy may be important in meeting dietary calcium requirements [42]. However, there is a need for further research regarding the role of health literacy in preventive health behaviours directly related to bone health including dietary calcium intake, vitamin D levels and osteogenic activity.

6.4 Worldwide 'Care Gap' in Osteoporosis and Fracture Treatment

Despite it being well-documented that experiencing one fracture substantially increases the risk for a subsequent fracture, large-scale studies that have investigated healthcare systems demonstrate suboptimal postfracture care. For instance, national audits in Australia [43], Canada [44], Germany [45], Italy [46], Japan [47], Korea [48], the Netherlands [49], Switzerland [50], the UK [51] and the USA [52] reported the proportion of patients with fracture that were assessed for subsequent fracture risk ranged from 5 to 65%; similarly, the proportion of patients with new fractures who received appropriate osteoporosis treatment ranged from 7 to 60%. Whilst the postfracture care gap is a worldwide phenomenon, there are data to suggest that specific population subgroups are disproportionately affected compared to others. For instance, in a large Canadian study of 11,234 major osteoporotic fractures, it was observed that, postfracture, First Nations peoples were less likely to receive a BMD test (OR 0.1, 95%CI 0.0–0.05), osteoporosis-related pharmacotherapy (OR 0.05, 95%CI 0.3–0.7) or a diagnosis of osteoporosis (OR 0.5, 95%CI 0.3–0.7), compared to non-First Nations peoples [53]. The worldwide failure to effectively treat fractures has led to an unacceptable care gap for patients, leading to a predominantly avoidable risk of subsequent fracture and increased burden for healthcare systems [54].

6.5 Postfracture Care Pathways

Given the increased likelihood of subsequent fracture and the imperative to reduce the fracture care gap, there is now much worldwide attention focused towards secondary fracture prevention. One initiative has been the development of fracture care pathways, commonly referred to as 'clinical care pathways', 'models of care', 'integrated care pathways' or 'ortho-geriatric care models'. Care pathways aim to deliver evidence-based treatment plans for patients presenting to hospital [55]. As opposed to usual fracture care, care pathways encompass a multidisciplinary team approach to fracture care, which, more commonly than not, involves an orthopaedic surgeon and a geriatrician. The three key goals of postfracture care pathways are related to the identification and treatment of osteoporosis and fracture, specifically, identify, investigate and initiate [56].

Fracture care pathways are now being implemented internationally as they have been found to be cost-effective [57] and shown to reduce the health burdens of fractures when compared to usual care. Multiple systematic reviews have aimed to determine the effectiveness of care pathways compared to usual care on a variety of outcomes. A meta-analysis of nine studies demonstrated lower odds of deep venous thrombosis (odds ratio (OR) 0.33, 95%CI 0.14–0.75), pressure ulcer (OR 0.48, 95%CI 0.30–0.75), surgical site infection (OR 0.48, 95%CI, 0.25–0.89) and urinary tract infection (OR 0.71, 95%CI 0.52–0.98) in patients managed according to care pathways compared to those receiving usual care [58]. A meta-analysis of 15 randomised controlled trials [RCTs] showed that, compared to controls, more patients in the care pathway group regained the same level of basic activities of daily living (ADLs) (29.1–46.0%) and walking ability (56.3–68.9%) 12 months after hospital discharge compared to controls [59]. A subsequent review reported similar improvements in basic ADLs [standardised mean difference (SMD 0.32, 95%CI, 0.17–0.47)] and mobility (SMD 0.32, 95%CI, 0.12–0.52) compared with usual care [60]: reviews have also reported decreased refracture rates [61] and increased treatment initiation [61], but outcomes have varied in terms of length of hospital stay [62, 63] and long-term mortality [59, 62]. In addition to biomedically orientated measures, a recent meta-analysis demonstrated that, compared to usual care, care pathways following hip fracture achieve short- and long-term improvements in patient-reported outcomes such as quality of life and physical performance [64]. The overall positive findings of these reviews suggest care pathways contribute to better outcomes after fracture.

There exists a lack of data pertaining to the uptake and impact of care pathways according to the SES of patients; this is despite the well-documented influence of social determinants on osteoporosis and fracture risk. Given this paucity of data, there is no evidence, to date, to suggest how care pathways can overcome these inequalities; however, it could be speculated that at the service-level, the communication of these pathways to patients [65] would plausibly improve their uptake and adherence across the spectrum of SES.

6.6 Adherence to Osteoporosis Treatment and Management

Low adherence to a prescribed treatment regime is a worldwide phenomenon, described by the WHO as '…a worldwide problem of striking magnitude' [54, p. 7]. As for all chronic diseases, treatment adherence plays a critical role in effective management of osteoporosis and reduces the likelihood of subsequent fracture. Patient claims data indicate that less than 50% of patients are adherent to their osteoporotic medications [66]. The consequences of low adherence include poorer outcomes and increased healthcare costs [54]. The WHO, among others, has identified that social disadvantage decreases the likelihood of treatment adherence [54]. Data also suggest a correlation between social disadvantage and lower health literacy [67], which will influence unintentional non-adherence [related to forgetfulness, regimen complexity, physical problems] and intentional non-adherence [patient decision-making, perceived benefits] [68].

6.6.1 Patients

Several patient factors have been identified as potentially contributing to poor uptake, suboptimal adherence or discontinuation of pharmacological osteoporosis treatments. One's capacity to correctly identify osteoporosis status has previously been associated with greater uptake of anti-fracture medications [22]. Concerningly, it has been reported that 28–63% of individuals who have undergone a DXA scan are unable to correctly identify their osteoporosis status [69–71]. Another study of 3484 White and 1041 Black women from the USA who underwent DXA testing observed that White women were more likely to correctly identify their actual DXA results; these results were sustained after adjustment for income and health literacy [72]. It is apparent that adequate communication of DXA results and fracture risk is important in supporting medication uptake and adherence; however communication methods between practitioner and patient are imperative to reducing disparities in understanding health information [72]. Patient perceptions also play a role in determining effective pharmacological management of osteoporosis. Patients who perceive greater benefit to using anti-fracture medications are more likely to initiate treatment [22, 73]. Conversely, perceived side effects or fear of side effects has been identified as common motivations for discontinuing pharmacological treatment for osteoporosis [38].

Health literacy abilities may influence a number of these adherence-related, and, as previously discussed, social disadvantage and cultural diversity are strongly associated with lower health literacy. In order to manage a complex treatment plan, an individual requires a range of health literacy skills to self-manage their medications [74]. Obtaining and filling prescriptions, understanding medication instruction, organising often complex medication regimens and sustaining medication use whilst monitoring for adverse events require a broad range of health literacy abilities [74]. Patients need to be able to find and understand information regarding the risks and benefits of medications, access the necessary health services, communicate effectively with healthcare providers to participate in medication-related decision-making and have the knowledge and support to adhere to and monitor medication regimens over time.

Previous research suggests low health literacy is associated with poorer self-management and medication across a range of conditions [75, 76], though evidence for an association between health literacy and pharmacological management of osteoporosis is currently limited [77]. There is some evidence to suggest low functional health literacy is associated with poorer anti-fracture medication adherence [78, 79]. However, findings from studies utilising multidimensional health literacy assessments to investigate the influence of a broader range of health literacy abilities on anti-fracture medication adherence have demonstrated mixed results [20, 80]. This suggests that different aspects of health literacy may play different roles in anti-fracture medication uptake and adherence. Interventions to improve anti-fracture medication uptake and adherence among populations with low health literacy should consider the specific health literacy needs of these populations. In addition, mass media has been shown to play a key role in refocusing the conceptualisation of osteoporosis to influence treatment adherence [65].

6.6.2 Healthcare Providers

Regardless of reasons for non-adherence, it is imperative that patients be supported rather than blamed [54]. It is here that practitioners can instigate change in patient attitudes, beliefs and behaviours that are integral to management of osteoporosis. However, physician attitudes, beliefs and knowledge are equally important to the multifaceted issue of postfracture care gap, and practitioner-patient interactions in terms of health communications play a key role in treatment adherence [65]. Adherence is a dynamic process, and as the number of comorbidities increases, so too does the complexity of treatment regimes and the potential for medication-related harms [81]. As identified above, an individual requires a range of abilities to manage a medication plan [74]; however, there is evidence to suggest healthcare providers can support self-management in patients with low health literacy.

Interventions that tailor medication-related information for older adults with osteoporosis have demonstrated relative improvement in medication adherence [82] and have received positive responses from patients and healthcare providers [83]. However, beyond tailoring information, interventions that specifically target health literacy to improve pharmacological management of osteoporosis have been lacking. Health literacy may also be an important factor to consider when prescribing an anti-fracture medication. As previously identified, older adults are more likely to be managing multiple comorbidities and therefore more complex medication regimens. The higher number of comorbidities has demonstrated an inverse relationship with anti-fracture medication use in older adults [84]. Reducing the complexity of medication regimens may be an appropriate mechanism for improving adherence among patients with low health literacy. For instance, in a study of 432 Korean women with a previous low-trauma fracture, low functional health literacy was associated with poorer adherence to weekly oral bisphosphonates but not bisphosphonates delivered intravenously every 3 months [79]. Efforts in the clinical setting to reduce complexity of medication regimens may increase the capacity of individuals to self-manage their osteoporosis with greater effectiveness.

6.7 Health Policy

As discussed earlier, the provision of reimbursement or subsidisation of healthcare services supports greater utilisation by those in greatest need, including those of lower SES. An increasing focus is now being directed towards SES as important to public health research, in order to inform future health policy and disease intervention or prevention [85]. In other areas, there is evidence that socially disadvantaged groups have benefited from reduced health inequalities due to targeted policies addressing tobacco control [86] and cardiovascular health [87]. Unless the mechanisms underlying and overarching the relationship between SES and poorer health are better understood, we are limited in our ability to intervene effectively to decrease the disproportionate burden of disease in disadvantaged groups. There have been few specific attempts at reducing social inequality in bone health. This requires major promotion of DXA utilisation and osteoporosis therapy to patients and practitioners within Australia's health system and, potentially, revisiting current health policies to examine their focus and implementation.

Where disparities do not exist in subsidisation for DXA scans, there should, in theory, be no difference in referral practices. However, international data examining social inequality, health policy and bone health suggest otherwise. For example, in 1997, Manitoba Health in Canada mandated the creation of a Bone Density Program Committee to develop, implement and oversee a strategic plan for bone densitometry within their province. This plan, which had led to transformational change in testing within the Manitoba healthcare system, includes tracking the utilisation of bone densitometry across different social groups and assessing the impact of this on patient management and outcomes such as fracture [88]. Other examples of the need to promote diagnostic imaging within different SES groups include angiography in Canada [89], as well as general radiology, vascular, computed tomography, MRI and general and obstetric ultrasound [11], CT and MRI in Sweden [90], and mammography in Finland [91] and Guam [92]. One of the major current challenges to health research and policy is to gain a better understanding of the level of equity in the uptake of DXA testing and adherence to osteoporosis medications and treatment plans.

It has been argued that health literacy is a policy choice [93–95], a political choice [93, 94, 96] and indeed a challenge to both [93, 94, 96]. Health policy cannot be considered a niche topic nor applicable only at the individual level; rather it requires an approach that is whole-of-government, whole-of-society and intersectoral for good governance [93, 96]. National action plans to improve health literacy have been developed in various countries [97–100], with the common theme of identifying and removing health literacy-related barriers to healthcare, raising awareness, providing new tools, testing interventions and designing responsive organisations. It is imperative, however, that interventions are codesigned with patients [65], as this will align content of the intervention to the health beliefs that influence non-adherence [65]. Political health literacy will facilitate a health literate, inclusive and sustainable society, '…where no one is left behind' [95, p. 6].

6.8 Conclusion

Disparities between social and ethnic groups exist in screening, diagnosis and treatment of osteoporosis. Various patient- and practitioner-specific factors influence low uptake of testing and poor adherence, many of which relate to health literacy, the quality of patient-practitioner communications and salience of osteoporosis.

To influence the availability of equitable healthcare options and to increase the uptake of services and adherence to treatment plans, health policy must strategically act on health literacy: this requires an approach that is whole-of-government, whole-of-society and intersectoral for good governance.

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