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The role of deprivation and quality of care on healthy ageing in older people with musculoskeletal pain: a prospective study

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Table of Contents

Chapter 1: Introduction

Chapter 2: Methods

Chapter 3: Results

Chapter 4: Discussion

Index of Tables

Context

This thesis was undertaken as part of an NIHR Academic Clinical Fellowships Programme. Programmes are for 4 years of which 75% is clinical and 25% academic. The academic proportion began in August 2012, ending in August 2014. The majority of this thesis was completed during private time after August 2014.

The author (G Rhys) was not involved in designing the questionnaire used in the North Staffordshire Osteoarthritis Project (NorStOP), nor the Healthy Ageing Index (HAI), the English Index of Multiple Deprivation (IMD) 2004, the GP Patient Survey 2007/08 (GPPS) or Quality and Outcomes Framework 2005/06 (QOF) respectively. The author was responsible for the selection of relevant data to answer the research question.

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Abstract

Background: Musculoskeletal pain is common in older adults and is associated with a decrease in the Healthy Ageing Index (HAI) (a validated composite ageing measure). Deprivation measures were not included in the HAI. The literature advocates including measures of deprivation in ageing models and a literature review illustrated the need to investigate the relationship between deprivation {individual level deprivation (ILD), area level deprivation (ALD), access to care (ATC) and quality of care (QOC)} and healthy ageing in older people with musculoskeletal pain.

Methods: 2949 adults from six general practices aged ≥50 years with complete questionnaires at baseline, 3 and 6 years were analysed. Subject HAI scores (higher scores indicated healthier ageing) were calculated. The questionnaire provided ILD data. ALD was measured using the Index of Multiple Deprivation, ATC by GP Patient Survey and QOC by Quality Outcomes Framework data. Aims: determine whether HAI scores differ by levels of deprivation and establish if associations exist between pain and healthy ageing, and if they are moderated by deprivation at baseline and across 6 years.

Results: HAI scores were lower (and associations noted after adjustment for confounders) with greater deprivation across ILD, ALD, ATC and QOC variables at baseline and over 6 years. There were significant interactions between widespread pain and; ILD, ALD, ATC and QOC variables at baseline and ILD and ALD variables over 6 years, translating to significant reductions in healthy ageing.

Conclusion: Healthy ageing decreases with pain and deprivation (ILD, ALD, ATC & QOC), demonstrating need to; reduce pains causes, improve treatment, reduce inequality and assess interventions. Deprivation variables should be included in ageing models. Assessing whether unaccounted exposures explain poorer ageing amongst particular practice subjects is warranted. Qualitative approaches could investigate reasons for generally lower HAI scores from service users experiencing greater

deprivation.

List of abbreviations

ATC Access to care

ALD Area level deprivation

GPPS General Practice Patient Survey 2008

HAI Healthy Ageing Index

ILD Individual level deprivation

Medical Outcomes Short Form – 12 (MOS SF-12)

NHS National Health Service

NSAIDs non-steroidal anti-inflammatory drugs

QOC Quality of care

SES Socioeconomic Status

SOC Selective Optimization with Compensation model

The English Index of Multiple Deprivation 2004 (IMD)

UK United Kingdom

WHO World Health Organisation

WP Widespread Pain

1. Introduction

This chapter introduces and defines pain, then highlights the challenges posed by musculoskeletal pain in older people. Subsequently, the concepts of ageing well and healthy ageing are defined. The wealth of ageing research necessitated a brief but representative coverage of the literature. This includes discussion of the three schools of thought regarding ageing well, namely the expansion of morbidity, the compression of morbidity and dynamic equilibrium hypotheses, as well as the three healthy ageing models, the biomedical, psychosocial and lay models. These works provide the platform for the definition of healthy ageing used in this thesis. Thereafter, the literature describing the impact of deprivation, quality of care and access to care upon healthy ageing is discussed. Lastly, the research rationale and objectives are discussed.

1.1. Pain

Pain is universal and essential for survival, but a prevalent and expensive problem (Turk & Melzack, 2011). A World Health Organisation survey of primary care patients between 18 and 65 years old in 15 countries reported that 22% of patients reported pain present for 6 months or longer that required either medical attention or medication, or that interfered significantly with daily activities (Gureje, 1998). Furthermore, the economic burden of back pain alone in the United Kingdom was estimated in 1998 to be £1632 million (direct care costs), with the cost of informal care and associated production loss totalling £10668 million (Maniadakis & Gray, 2000). However, despite pain being a common symptom (Gureje, 1998) prompting many patients to seek medical attention (Turk & Melzack, 2011), with far reaching economic consequences (Maniadakis & Gray, 2000; Turk & Melzack, 2011), the majority of older adults experiencing pain do not seek the advice of a health care professional (Thomas, Dunn *et al.,* 2007), potentially leading to unnecessary morbidity.

1.1.1. Pain defined

The International Association for the Study of Pain (IASP) defines pain as *'an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage'* (Merskey & Bogduk, 1994). Melzack's pain neuromatrix (Melzack, 1999) proposes that pain is produced in the central nervous system (CNS - brain and spinal cord) in response to stimuli from the body and or environment. This emphasises that the CNS produces pain, not tissue damage. Generally, there is no way to distinguish this experience from that due to tissue damage when taking a subjective report. The IASP definition avoids tying pain to the stimulus (Merskey & Bogduk, 2012). An individual's personal history, psychological state and physical pathology will all influence a patient's response to "how much does it hurt?" (Turk & Melzack, 2011). Increasing awareness that the link between underlying pathology and pain reporting is variable (Croft *et al.,* 2010) {a common exemplar being that pain is not always associated with advanced radiographic degeneration in the joint concerned (Neogi, Felson *et al.,* 2009)} and that prolonged, poorly controlled pain leads to stress, depression (Moore & Jorsh, 2007) and inability to work, led to pain being viewed as a disease in itself, rather than a consequence of it (Turk & Melzack, 2011).

Furthermore, the realisation that individual factors, sociocultural and healthcare systems all influence perceived pain intensity, response to treatment, disability, and quality of life informed a move away from addressing pain by medication alone (Turk & Melzack, 2011).

Pain can be described by aetiology, chronology (acute, intermittent, chronic) and location (e.g. specific regional pain sites and widespread pain). Subsequently, reported pain prevalence in the literature varies by pain classification and the studies methodologies and sampling (Thomas, Dunn *et al.,* 2007).

1.1.2. Pain in older adults

Pain is common amongst older people (Gauthier & Gagliese, 2011). Four week pain prevalence (any pain) was around 55% in a Canadian study of adults aged 70 or more (Scudds & Østbye, 2001), with an annual pain prevalence of 72% in a Swedish population 77 years and over (Brattberg, Parker *et al.,* 1996). The presence of acute pain remains roughly equivalent across the lifespan, though different pain conditions account for the incidence and prevalence of pain in different age groups (Scudds & Østbye, 2001). However, chronic pain increases with age until at least the seventh decade, with some research suggesting a plateau or small reduction in pain complaints beyond the seventh decade (Brattberg *et al.,* 1997; Helme & Gibson, 2001). Whilst chronic pain is common amongst older adults it is important to remember that it is not a normal part of ageing and physical or psychopathology is always involved (Harkins *et* *al.,* 1994). The majority of chronic pain experienced by older adults is musculoskeletal in origin (Dieppe, 2013). This thesis will examine musculoskeletal pain.

1.1.3. Musculoskeletal pain in older adults

1.1.3.1. Aetiology of musculoskeletal pain in older adults

Musculoskeletal pain can be caused by; soft tissue regional pain syndromes (e.g., back pain and neck pain), generalised soft tissue pain syndromes (e.g., fibromyalgia), osteoarthritis, osteoporosis, inflammatory arthritis (e.g., rheumatoid arthritis and gout), generalised inflammatory conditions (e.g., polymyalgia rheumatica and connective tissue diseases) and malignancy (Walker-Bone, 2007).

1.1.3.2. Prevalence of musculoskeletal pain in older adults

Musculoskeletal pain is common at all ages and increases with age (Badley & Tennant, 1992) before plateauing around age 70 (Urwin *et al.,* 1998). A UK study of adults aged 55 or more reported a four-week musculoskeletal pain prevalence of 66% *(figure 1 appendix)* (Thomas, Peat, Harris *et al.,* 2004a), whilst annual musculoskeletal pain prevalence in a French population 65 years and over was 71.5% (Brochet, Michel *et al.,* 1998). Urwin *et al.,* (1998) report that the prevalence of pain in different body areas increased up to the age of 65 and then plateaued. In women the number of joint sites affected by pain increased with age up to the age of 74. In men however, the number of joints affected was very similar after the age of 45. Only 34% of those who reported pain experienced pain in one site. The most common overlaps were back and knee pain, neck and shoulder pain, and back and hip pain. Furthermore, they noted that some regional pain types (e.g., back pain) decline in prevalence with age, whereas others increase (e.g., knee pain) (Urwin *et al.,* 1998), supported by Elliott, Smith & Penny *et al.,* (1999) prevalence data on back pain by age cohort *(figure 2 appendix)*. Women generally report higher rates of pain in all sites and for all age groups (Urwin *et al.,* 1998; Thomas *et al.,* 2004a).

Most musculoskeletal pain is short lived and does not require medical care. However, chronic musculoskeletal pain (pain persisting for more than 3 months) is a common {prevalence between 10 and 34% (Thomas, Peat, Harris *et al*., 2004a; Bowsher, Rigge *et al.,* 1991; Brochet, Michel *et al.,* 1998)}, persistent problem (Helme *et al.,* 2001), with relatively high incidence and low recovery rates (Elliott, Smith *et al.,* 2002). Almost thirty percent of those aged over 75 are in chronic pain due to arthritis alone (Elliott, Smith *et al.,* 1999). Additionally, the severity of joint symptoms, the prevalence of associated disability (Walker-Bone, 2007) and the degree of interference with normal activities (Thomas, Wilkie *et al.,* 2004) all rise markedly with age *(figure 3 appendix)*.

1.1.4. The impact and burden of musculoskeletal pain and pain

The consequences of pain are various, substantial and far-reaching. The incidence and prevalence of pain interfering with life (defined as pain interfering with normal activities) rises sharply with age (Thomas, Mottram *et al.,* 2007; Thomas *et al.,* 2004a). Pre-existing pain complaints, anxiety, depression, smoking, obesity and age are linked with interfering pain in older people (Peters *et al.,* 2005; Jordan *et al.,* 2008; Shi *et al.,* 2010), as are social factors such as inadequate income, neighbourhood deprivation and lower education (Jordan *et al.,* 2008; Shi *et al.,* 2010; Dorner *et al.,* 2011). In a stepwise logistic regression model adjusted for; age, gender, diseases, number of painful body sites and intensity of pain, Dorner *et al., (2011)* reported that people with lower socioeconomic status reported greater disability with pain.

Pain can cause psychological distress, cognitive impairment (Lee, Pendleton *et al.,* 2010), physical disability, social withdrawal, reduced sexual function (Tajar, O'Neill *et al.,* 2011), falls (Blyth, Cumming *et al.,* 2007), self-neglect and suicidality (Juurlink, Herrmann *et al.,* 2004). Those with regional and widespread pain are at increased risk of cancer death (McBeth, Symmons *et al.,* 2009) and new onset of chronic widespread pain is associated with poor mental and physical Health Related Quality of Life (Nicholl, Macfarlane *et al.,* 2009).

Older age, comorbid conditions, poor cognitive functioning and poor self-rated health increase the risk of disability in older adults with pain (Lin, Chen *et al.,* 2010; van Dijk, Veenhof *et al.,* 2010). Such limitations impact upon all aspects of life, including employment, recreation and leisure leading to reduced quality of life, increased morbidity and mortality, as well as increased health expenditure (both personal and societal) and reduced individual earnings and consequently national productivity. One UK study noted that the median monthly spend on complementary medicines by adults aged 55 or more with knee osteoarthritis alone was £5 (range £0.66 to £150), with the more affluent spending significantly more (Jordan *et al.,* 2004). Clearly, those with more limited means are restricted in their potential responses to pain.

Given the continued and projected growth of the aged population {increased life expectancy due to improvements in health and a decrease in the birth rate is leading to a progressive ageing of society (Silverstein, 2008)} pain and its impact on the functioning and health requirements of older adults will become a greater concern (Badley & Crotty, 1995). The aging population is likely to result in a disproportionate increase in the number of people with chronic disabling disorders, occurring against a background of a decreasing or static number of young adults, with consequences for meeting health care and community support needs (Shi *et al.,* 2010). Therefore, pain has a significant and growing public health impact.

1.1.5. Challenges of an ageing population to health and social care services

1.1.5.1. Projected health and social care deficiencies

The House of Lords Select Committee concluded that the UK is "woefully underprepared" for the challenges of an ageing population, commenting that "longer lives can be a great benefit, but there has been a collective failure to address the implications and without urgent action this great boon could turn into a series of miserable crises" (Lords Select Committee, 2013). The 'Ready for Ageing?' report comments that there will be 51% more people aged 65 and over in England in 2030 compared to 2010 {Office for National Statistics data}. The number of people with arthritis in the UK is projected to increase by 50% by 2030 {compared to 2010} (Lords Select Committee, 2013). Given the projected disease burdens, the number of people with a moderate or severe need for social care is expected to increase by 90% (Lords Select Committee, 2013). The NHS will have to deal with large increases in demand and costs of health and social care. The report concludes that current quality of healthcare for older people is unacceptable, and older people should be concerned about future quality of care (Lords Select Committee, 2013).

The Nuffield Trust estimates that given the current healthcare system, the NHS in England will experience a funding shortfall of £54 billion by 2021/22 if NHS funding remains constant in real terms, if no productivity gains are made, and if current patterns of hospital utilisation by people with chronic conditions continue (Nuffield Trust, 2012). Given that the total budget for the English NHS in 2010/11 was £107 billion (Nuffield Trust, 2012) this is a crisis. Additionally, public expenditure on social care and continuing healthcare for older people will need to rise to £12.7 billion in real terms by 2022 (an increase of 37% from £9.3 billion in 2010) (Nuffield Trust & London School of Economics, 2012).

People need to work longer to fund the care needed by an older population {the UK has to increase the number of people aged 50 or more in employment by over 1 million by 2050 to maintain the current ratio of non-workers to workers (Okunribido & Wynn, 2010)}. However, the UK Labour Force Survey estimates that musculoskeletal disorders account for 41% of all work related illnesses (Health and Safety Executive, 2006), and the total UK cost of musculoskeletal disorders is estimated at £5.7 billion annually (Nicholson *et al.,* 2006). Furthermore, the commonest condition resulting in people receiving DLA (Disability living allowance or DLA is a UK benefit for people who are disabled, having personal care needs, mobility needs or both and who claim before their 65th birthday) is 'arthritis' *(figure 4 appendix)* (Department for Work and Pensions, 2007). As older workers become more prevalent in the workplace *(figure 5)* given the ageing population this problem is likely to get worse (Hotopp, 2007). It is accepted that changes in physical abilities that are encountered with ageing are influenced by genetics and lifestyle as well as the environment in which individuals work and live (Buchman, Boyle *et al.,* 2007; Kenny, Yardley *et al.,* 2008). However, there is growing concern that as people age, their increased lifespan may not be matched by increased healthy years (Ebrahim, 1999). Interventions to promote healthier ageing and subsequently greater functional capacity and ability to work are vital to prevent decreased output (Silverstein, 2008).

Clearly, the UK is not prepared for the ageing population (Lords Select Committee, 2013) and NHS funding will not satisfy demand (Nuffield Trust & London School of Economics, 2012). Greater tax revenues generated by longer working lives are essential to meeting healthcare costs, but the prevalence of musculoskeletal pain in older age and its associated disability will generate high attrition amongst older workers, undermining this (Hotopp, 2007). Greater understanding of factors impacting upon, and interventions to promote healthier ageing in those with musculoskeletal pain, and subsequently greater functional capacity and ability to work are essential to maintain the current levels of social and healthcare provision in older age (Silverstein, 2008).

1.1.5.2. Health service shortfalls

Worryingly, the pain literature reinforces the claim made by the House of Lords Select Committee that “the local delivery of health and social care does not serve older people well: services operate independently of each other and are peppered with negative incentives” (Lords Select Committee, 2013). Older people are at risk of inadequate treatment (Gauthier & Gagliese, 2011; Lovheim, Sandman *et al.,* 2006). Some patients believe that pain is a normal part of ageing, with no possible treatment (Martin, Williams *et al.,* 2005), others do not want to complain (Gauthier & Gagliese, 2011), and age related barriers to the use of analgesics also affect the reporting of symptoms (Ross, Carswell *et al.,* 2001). These factors limit opportunities to receive care and alleviate morbidity.

Nevertheless, 20% of adults consult their General Practitioner (GP) each year with a musculoskeletal problem and older patients attend their GP more regularly with musculoskeletal problems (RCGP Birmingham Research Unit, 2006) *(figure 6 & 7 appendix).* General practices are unlikely to meet the growing demand generated by changing demographics without additional resources.

1.1.5.3. Solutions to the health and social care shortfall

The high prevalence of pain in older persons, the impact and disability it causes, as well as the existence of modifiable risk factors makes identifying approaches to prevention a public health priority (Thomas *et al.,* 2007). If services are not proactive, these patients may experience poorer outcomes (Cho, Kim *et al.,* 2012), contributing to "a series of miserable crises" (Lords Select Committee, 2013). Clearly, interventions to promote ageing well with pain are needed, but the causes of unhealthy ageing with various diseases are not fully understood. Aetiological research is required, which can direct the development of preventive health and social programmes (Ebrahim, 1999) to satisfy the challenges of providing effective management to optimise function and quality of life for older adults with pain (Gauthier & Gagliese, 2011). Discovering why older adults with pain do not seek care should be a priority, likewise reducing barriers to accessing care, which is known to be effective and engenders healthier ageing, is essential (Gauthier & Gagliese, 2011). Determining if individuals who are more deprived, receive poorer care or have poorer access suffer worse outcomes (less healthy ageing) would direct the assessment of potential interventions.

1.2. Ageing well

'There is substantial heterogeneity in the extent of physiological, psychological, and functional capacity among individuals of the same chronological age' (Busse & Maddox, 1985). Longer life expectancy, medical advances, rising health and social care costs and greater expectations for life in old age fuels interest in how to age well. Ageing is a multi-factorial process characterised by the progressive loss of function accompanied by increasing morbidity and decreasing fertility with advancing age (Kirkwood & Austad, 2000). The increased human life expectancy in the developed world during the twentieth century (the 'epidemiological transition') occurred as degenerative diseases; especially cancers and circulatory diseases replaced infectious

disease as the leading cause of death (Howe, 2006). The European population is ageing rapidly; with the highest median age in the world, and the proportion of people aged 65 and older is projected to increase from 14% in 2010 to 25% in 2050. Europeans are living longer, however, the likelihood of good health and wellbeing in older age varies within and between countries (WHO, 2014). For some, old age confers a high risk of social isolation, poverty, and limited access to affordable, high-quality health and social care services. Public health policies should ensure that the benefits of longer life extend to everyone regardless of where they live or the socioeconomic group they belong to (WHO, 2014). Promoting health throughout the life course necessitates reversing the growing inequalities in old age, strengthening health systems to satisfy the changing needs of an ageing population and expanding the evidence base for health and social care policies for older people. The WHO advocates supportive, adapted social environments and ensuring older people have access to high-quality, tailor-made, well-coordinated health and social services, thereby supporting maximum health and functional capacity throughout their lives (Rechel *et al.,* 2009). However, consensus regarding the definition or measurement of successful ageing is lacking. There is also controversy regarding the development of morbidity in the ageing population. This hinders the development and coordination of services to maximise the maintenance of health for individuals and inhibits targeting interventions at those with the greatest need.

1.2.1. Morbidity hypotheses

Predicting the effect of increasing life expectancy on the period of disability (morbidity) at the end of life is dependant on the causal factors driving the trend (Howe, 2006). Three alternative explanations for increasing life expectancy (due to postponed death from disease) are discussed in the literature, namely, the expansion of morbidity, compression of morbidity and dynamic equilibrium hypotheses.

1.2.1.1. Expansion of morbidity

Gruenberg (1977) claimed that reduced mortality from chronic disease would coincide with increased disease prevalence. He postulated that decreased mortality would arise from increased survival of people with health problems, rather than lower disease incidence rates, resulting in more disease in the population, coined 'the failure of success'. Gruenberg postulated that the degenerative diseases pathologies were so closely related to ageing (thought of as symptoms of ageing) that they would not be amenable to medical interventions.

The assumption that all degenerative diseases would not be amenable to intervention was flawed. There are numerous examples of effective primary and secondary prevention, to prevent and slow the progression of disease and disability (e.g., atrial fibrillation confers a fivefold risk of stroke (Department of Health, 2010), anticoagulation reduces stroke risk by 68% (Sacco *et al.,* 1997)). Also there are clear discrepancies between and within countries in later life morbidity and mortality (WHO, 2014). The best explanation for this is the role of environmental factors (Howe, 2006) in the aetiology of chronic disease. Consequently, the argument that there is an inevitable and unchangeable fact about the timing of disease processes in the lifespan is undermined. However, morbidity can expand at the end of life, despite the incidence of age related disease changing and people being healthier for longer, if life expectancy increases faster than healthy life expectancy (disability free life expectancy) (Howe, 2006).

1.2.1.2. Compression of morbidity

Fries (1980) 'compression of morbidity' theory proposed that increased life expectancy would be accompanied by a shortened length of morbid life, believing that the same influences leading to reduced mortality would also lead to a lower incidence and higher age of onset of chronic disease. Because Fries believed that life expectancy had a limiting biological maximum, he concluded that the time with disease would be compressed into a shorter period at the end of life (Fries, 2001). Fries theory was based on observed delays in the onset of chronic disease and associated disability as well as US data suggesting a reduction in the rate of increase in life expectancy. However, Howe (2006) illustrates that the stagnation in life expectancy observed in the US during the 1970's is not sufficient to conclude that this is due to reaching a limiting biological maximum. In fact life expectancy continued to rise (Doblhammer & Kytir, 2001). Secondly, trends in morbidity and mortality suggest a higher prevalence of numerous individual diseases, as well as an increase in the number of comorbid diseases (Crimmins & Saito, 2000; Crimmins & Beltran-Sanchez, 2010). Crimmins and Beltran-Sanchez (2010) suggest that little has been done to eliminate or delay disease, adding that while “substantial strides have been made in dealing with the consequences of disease” evidence supports an “expansion in life with disability and mobility functioning loss”. Similar to the expansion of morbidity theory, if the compression of morbidity theory is taken to entail a compression of mortality, it fails to explain trends in population health (Howe, 2006).

However, compression of morbidity could occur without any discernible compression of mortality if healthy life expectancy increased faster than life expectancy (e.g. if primary prevention strategies were effective and generated a significant delay in the onset of disabling disease in later life). In effect, if healthier lifestyles and the social changes that support such lifestyles could postpone the onset of age-associated diseases, then the compression of morbidity becomes plausible. Subsequent US data supports this. The National Long-Term Care Survey and the National Health Interview Survey illustrate the compression of morbidity in the United States at the population level (Fries, 2003).

In summary, the expansion of morbidity hypothesis explains increasing life expectancy (subsequent to reduced mortality rates) by a delay in the progression from severe disease to death secondary to life-sustaining medical technologies. The compression of morbidity hypothesis also concentrates on one stage in the progression of chronic disease, namely the delay in appearance or onset, and is reliant upon the effectiveness of primary prevention for its plausibility (Howe, 2006).

1.2.1.3. Dynamic equilibrium

Manton (1982) believed that changes in the severity and progression of chronic disease would match changes in mortality, so that disease progression would be stopped at an early stage, cumulating in more disease in the population, but disease with reduced consequences, namely reduced disability and death. Essentially, people with chronic degenerative disease live longer because the rate of progression of their disease slows (possibly due to medical advances offering improved secondary prevention, but also due to underlying health improvement). If this, rather than postponement of onset or the postponement of death for those with severe disease is the main driving force behind increasing life expectancy at old ages, then the increasing life expectancy will lead to an increase in overall prevalence (due mostly to increases in prevalence of mild/less disabling disease states) and largely stable rates of severe disease (Howe, 2006).

Although the three theories are often taken as exclusive alternatives, and have underpinned numerous research on ageing trends (Crimmins *et al.,* 2011) the causal factors highlighted are not. The hypotheses are exclusive in that they site different causal pathways as the main reason for increased life expectancy (or postponement of death). These being either improved primary prevention leading to delayed onset, improved secondary prevention leading to delayed progression of disease, or increased survival with severe disease subsequent to better tertiary prevention (Howe, 2006). It seems probable that all of these factors operate together, the balance of these factors determining outcomes for health in older populations.

Crucially, Howe (2006) queries the impact of non-fatal degenerative disease, such as musculoskeletal pain. As an increasing proportion of older persons survive into older age without suffering potentially fatal degenerative disease (e.g., cardiovascular disease, cerebrovascular disease or cancer), whether or not the population experiences a compression of morbidity will be dependent upon their risk for non-fatal disabling degenerative disease. If such diseases are not as easy to prevent, delay or ameliorate there could be an increase in ill health and disability.

Interestingly, in different populations Howe concludes that the pattern observed is a temporal one, with an increase in the survival rates of sick persons initially leading to an initial expansion of morbidity, subsequently improved control of the progression of chronic diseases leads to dynamic equilibrium between the fall of mortality and the increase in disability, then improved health status and health behaviors' in new cohorts of older people leads to some compression of morbidity, but the eventual emergence of very old and frail populations leads to a new expansion of morbidity (with differing weighting of these scenarios by location and disease) (Howe, 2006). Howe surmised that total life expectancy in the UK appears to be increasing faster than both the expectation of life in good health or the expectation of life without limiting longstanding illness, in line with the Lords Select Committee conclusion (2013).

1.2.1.4. Implications of the morbidity debate

The evidence reveals a steady increase in life expectancy at birth, and populations of nearly all developed countries are ageing as a result of lower fertility, low immigration and longer lives. However, whether increases in life expectancy are accompanied by a postponement of functional limitations and disability remains unclear (Christensen *et al.,* 2009).

Crimmins & Beltrán-Sánchez (2011) argue that little has been done to eliminate or delay disease or the physiological changes that are linked to age. Furthermore, Crimmins & Saito (2000) report that the proportion of the population with multiple diseases and the number of comorbid diseases in older individuals has increased, leading to longer periods of life with disease and diminished mobility and functioning (Crimmins & Beltrán-Sánchez, 2011).

Others conclude that the evidence suggests that ageing processes are modifiable and that some people are living longer without severe disability (Christensen *et al.,* 2009). Notably, there is evidence that improved treatment (secondary prevention) for arthritis has led to a reduction in late life disability prevalence (Freedman *et al.,* 2007), supporting Manton's dynamic equilibrium model. However, little to date has addressed any 'primary prevention' strategies towards musculoskeletal pain providing evidence of delayed onset and later disability with disease.

Clearly, the monetary and societal costs of maintaining and providing for a population of longer lived individuals is concerning, even if the length of disabled life remains the same, the length of life needing treatment for disease means lifetime health costs will increase (Crimmins & Beltrán-Sánchez, 2011). We need to know what it means to age well, or how to measure healthy ageing. This is important to save health and social care resources, to improve patients' quality of life, and allow society to benefit from the input of older adults.

1.3. Healthy ageing

The WHO defines health as *'a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity'* (World Health Organisation, 2014).

There are many definitions of healthy ageing (Rogers, 1995). The term is often used interchangeably with active ageing (Bowling, 2008; WHO, 2002), successful ageing (Bowling & Dieppe, 2005; Rowe & Khan, 1997), positive ageing (Kendig & Browning, 1997), optimal ageing (Brummel-Smith, 2007) and productive ageing (Kerschner & Pegues, 1998). However, the definitions vary, and should not be used interchangeably.

'Success' is an ambiguous concept, especially concerning ageing. Unsurprisingly, no single model or definition of healthy ageing is accepted. However, there is general acceptance that healthy ageing involves more than merely physical or functional health (Renehan *et al.,* 2012). The WHO define active ageing as *'the process of optimising opportunities for health, participation and security in order to enhance quality of life as people age allowing people to realise their potential for physical, social and mental well-being throughout the life course'* (WHO, 2002). Active is defined as continuing participation in society, retaining the social, mental and physical health to allow this, with the maintenance of dignity, self efficacy, human rights and the provision of age friendly physical environments facilitating autonomy and independence (WHO, 2002).

1.3.1. Development of the healthy ageing concept

‘Successful ageing’ arose in the social gerontology literature, providing a conceptual framework to describe ideal ageing outcomes. The changing definitions of ‘successful ageing’ reflect changes in the prevailing theories regarding the social and psychological aspects of aging.

“Successful ageing” is often attributed to Havighurst (1961) who spoke of ‘adding life to years’, essentially helping people enjoy life and derive life satisfaction. He questioned ‘what are the conditions of individuals and social life under which the individual older person gets a maximum of satisfaction and happiness?’. Crucially, he argued that ‘the modern American society is rich enough in material goods to provide the material of successful living to all ages and segments of its population’. Whether or not the ‘material of successful living’ was equitably distributed amongst the population generated vast research.

Competing theories regarding ageing at the time were the Activity Theory and the Disengagement Theory. The Disengagement Theory described successful ageing as the acceptance and the desire for a process of disengagement from active life in older age (Cumming & Henry, 1961). In contrast the Activity Theory (posed by Havighurst in response to the disengagement theory) defined successful ageing as the maintenance for as long as possible of the activities and attitudes of middle age, purporting that older adults were happiest when they stayed active and maintained social interactions (Havighurst, 1961).

Cumming and Henry's Disengagement Theory proposed that people gradually withdrew or disengaged from social roles in response to reduced capabilities, interest and societal disincentives to participation. In this model, the successfully ageing person happily retired from work or family life, contentedly pursuing solitary or passive activities whilst preparing for death. Though this theory seems antiquated, it was more plausible in a time of shorter life expectancy, earlier onset of disability, physically demanding work roles, obligatory retirement and few organised activities for older adults. Crucially, what was typical or common among older people may have shaped perception of what was optimal or possible. Both theories are now discredited, the activity theory being branded as too narrow with implied advocacy of a particular lifestyle (Bearon, 1996).

If inequalities in health and economics hinder the ability of older people to engage in activities as per the activist theory of healthy ageing, this could lead to disengagement and poorer ageing.

A third theory of ageing, termed Continuity Theory, proposed that older adults make adaptive choices in an attempt to preserve and maintain existing internal and external structures. They accomplish objectives by using strategies tied to past experiences (thereby carrying forwards the habits, preferences, lifestyles and relationships from midlife into late life) (Atchley, 1989). Clearly, if such habits are influenced by environmental opportunities or influences, and such strategies are more or less advantageous to ageing they will impact upon healthy ageing. Broadly speaking current successful ageing concepts are described using biomedical, psychosocial, or lay perspectives, or a combination of these approaches (Bowling, Dieppe 2005).

1.3.2. Biomedical theories of healthy ageing

Successful ageing is defined mostly in terms of maximising life expectancy and minimising the physical and mental deterioration and consequent disability associated with ageing. Such approaches focus on the absence of chronic disease or risk factors for disease, good health, as well as good independent physical functioning, performance, mobility and cognition. A well-known example is the MacArthur longitudinal study of successful ageing of community dwelling US adults (Seeman *et al.,* 1994).

1.3.2.1. Rowe and Kahn's model of successful ageing

Rowe and Kahn (1987) argued that research on successful ageing should focus on people with better than average physiological and psychological characteristics in later life, 'successful agers' as opposed to average or 'usual agers'. They commented that within the category of normal ageing, a distinction could be made between usual ageing, in which extrinsic factors heighten the effects of ageing alone, and successful ageing, in which extrinsic factors play a neutral or positive role.

They acknowledged the importance of differentiating pathological changes from those due to chronological ageing. However, they argued that the division of people into diseased and normal states posed three problems. Firstly it implies that a non-diseased state is normal, secondly it assumes the non-diseased group has no risk of disease or disability and thirdly it neglects the substantial heterogeneity within age groups (Rowe

& Kahn, 1987), a view endorsed by Bowling and Dieppe (2005).

Rowe and Kahn (1987) proposed that many age associated declines were the consequence of accumulated modifiable environmental risk factors (e.g., diet, exercise) that are extrinsic to aging itself. Their subsequent multidimensional model of successful ageing consists of low probability of disease and related disability (including the absence of risk factors), and high cognitive and physical functional capacity and active engagement in life (including maintenance of interpersonal relations and productive activities) (Rowe & Kahn, 1997). Their approach challenged the view that ageing involves inevitable decline, rather, proposing that age related functional loss is the consequence of modifiable extrinsic factors. Their model remains influential and widely used (Bowling, 2007).

Bowling and Dieppe (2005) highlight a failing of Rowe and Kahn's model in that a disease free older age is unrealistic for most. Additionally, when comparing elderly peoples own report of successful ageing, fewer than a fifth met the Rowe and Kahn criteria for successful ageing (Strawbridge *et al.,* 2002). Such criticism spawned other theories such as Optimal aging, characterized by the capacity to function across many domains, physical, functional, cognitive, emotional, social, and spiritual, to one's satisfaction and in spite of one's medical conditions (Brummel-Smith, 2007). Research on the risks associated with usual aging and strategies to modify them should help elucidate how a transition from usual to successful aging can be facilitated.

1.3.3. Psychosocial models of healthy ageing

In contrast to the biomedical models emphasis on the absence of disease and maintenance of physical and mental functioning as key constituents of healthy ageing, the psychosocial models cite life satisfaction, social participation and functioning, psychological resources and personal growth (Bowling & Dieppe, 2005). Satisfaction with an individuals past and present life is a commonly proposed definition of successful ageing (Havighurst, 1963). Subsequent refinement included the addition of continued social functioning, including positive interactions or relationships with others, social integration, and reciprocal participation in society (Havighurst *et al.,* 1968). Psychological resources proposed for successful ageing include a positive outlook and self worth, self efficacy and control over life, autonomy and independence, as well as coping and adaptive strategies despite changing circumstances (Baltes & Baltes, 1990). In contrast to the biomedical approaches absence of disease or maintenance of physical functioning, the psychosocial approach to successful aging is an interactive process, with growth, learning and change over the life course allowing past experiences to be used to meet future challenges (Riffs, 1989).

1.3.3.1. Baltes & Baltes selective optimisation with compensation theory

Baltes' (1990) Selective Optimization with Compensation (SOC) is a psychosocial lifespan model. Ageing is described as a changing balance between gains and losses and successful ageing a process of adaptation by way of selection, optimisation and compensation strategies. The authors state that people engage these components throughout their lifetime, however, the dynamics of this adaptive process are unique in older age because of declines in biological, mental and social reserves, and loss of function.

Selection refers to reducing or transforming the number of life domains in order to concentrate on or sustain the most valued life activities. Optimisation refers to engaging in behaviour to optimise the resources that facilitate success in these selected life domains. Compensation alludes to the use of alternative means such as mnemonics or technology to compensate for losses and reach one's goals (Baltes & Baltes, 1990).

The SOC model takes account of individual trajectories, attempting to take account of the heterogeneity within ageing. Baltes and Baltes (1990) note that the way such strategies are realised depends on the personal and societal circumstances individuals face as they age. Furthermore, they argue that SOC strategies may enable individuals to contribute to their own successful aging (Baltes & Baltes, 1990).

Early social health research described associations between social processes and health. Subsequent research has refined the conceptualisation and assessment of social constructs. Researchers now view psychosocial processes as multidimensional constructs, and attempts to delineate the underlying mechanisms responsible for the associations between various psychosocial factors and physiological processes that may lead to unhealthy ageing are on-going (Uchino *et al.,* 1996).

1.3.4. Lay views of successful ageing

Older people's views of what successful ageing is include mental, psychological and social health, functioning and resources, life satisfaction, sense of purpose, financial security, learning new things, accomplishments, physical appearance, productivity, contribution to life, sense of humour and spirituality (Phelan *et al.,* 2004; Bowling & Dieppe, 2005). Bowling and Dieppe's (2005) claim that the lay constituents of healthy ageing are not adequately captured by the theoretical models previously described is compelling.

Theoretical definitions variously include life expectancy, satisfaction and wellbeing; mental and psychological health, cognitive functioning, personal growth; physical health and functioning; psychological characteristics and resources; social, community and leisure activities, integration and participation. However, lay definitions also cite accomplishments, enjoyment of diet, financial security, neighbourhood, physical appearance, productivity and contribution to life, sense of humour and spirituality (Bowling & Dieppe, 2005).

Growing support exists in the literature for more incorporation of layperson perspectives in successful ageing models, thereby capturing "the diversity of life trajectories and routes to ageing successfully" (Bassett *et al.,* 2007; Bowling & Dieppe, 2005). Notably, in one study 50% of older adults rated themselves as ageing successfully whilst only 19% met an operational definition of the criteria proposed by Rowe & Kahn (Strawbridge *et al.,* 2002). Also, a national, random population based survey of perceptions of successful ageing among 854 people aged 50 or more living at home in Britain revealed that 75% rated themselves as ageing well. The most common definitions given by the respondents included aspects of health, psychology, social roles and activities, finances, social relationships and neighbourhood (Bowling & Dieppe, 2005). Rowe & Kahn (1987) and Baltes & Baltes (1990) models' poorly address such aspects.

1.3.5. Conceptual challenges to healthy ageing models

Consensus regarding the terminology, definition and measurement of healthy ageing is lacking (Depp *et al.,* 2010; Bowling & Dieppe, 2005). The ageing models discussed illustrate the evolution of the healthy ageing concept. The single school perspectives, namely biomedical approaches (e.g., Rowe & Kahn, 1987) and psychosocial theories emphasizing life satisfaction or adaptation (e.g., Baltes & Baltes, 1990) struggle to deal with the multidimensionality of healthy ageing. The models neglect the influence of broader social structures including allocation of resources and opportunities, cultural contexts, as well as societal norms and behavioural expectations (Riley, 1998; Ryff & Singer, 2009). However, they illustrate the models conceptual evolution with success or failure viewed on a continuum rather than more simplistic binary assessments. Subsequently, theories espousing environmental or cultural elements (e.g., Riley, 1998) and lay views of successful ageing (Phelan *et al.,* 2004) broadened the conceptualisation. Layperson definitions of successful ageing demonstrate that older individuals view ageing as multidimensional (Phelan *et al.,* 2004; Bowling & Dieppe, 2005), consequently the broader definitions of successful or healthy ageing have relevance for elderly people themselves (Bowling & Dieppe, 2005). The lay elements are poorly captured by Rowe & Kahn and Baltes & Baltes models' (Depp *et al.,* 2010; Bowling, 2007; Bowling & Dieppe, 2005).

Bearon's comment that as the older population becomes increasingly diverse the concept of successful ageing might become more difficult to define without expanding the number of models (Bearon, 1996) illustrates the challenge of conceptualising healthy ageing. However, the literature suggests additions to current models to improve their conceptualisation of ageing (Depp *et al.,* 2010; Bowling & Dieppe, 2005), but the role and impact of such variables remains poorly understood and unquantified.

Riley (1998) commented that Rowe and Kahn's model focused mainly on individual factors, overlooking the influence of surrounding structural or contextual factors. This is interesting given that this thesis will look at deprivation, access and quality of care. Riley's Structural Lag Theory asserts that changes in lives and social structures are fundamentally interdependent; therefore success is reliant on the availability of structural opportunities or interventions in society. Such opportunities lag behind the added years of life experienced by many older adults (Riley *et al.,* 1994). Consequently, poorer environments (greater deprivation or poorer quality of care) would be expected to lead to inequalities in health outcomes with ageing.

In summary, biomedical models emphasise the absence of disease and maintenance of physical and mental functioning, the psychosocial models focus on life satisfaction and social participation, whereas lay models emphasise accomplishments and contributions to life. Models combining these three approaches are more effective at predicting poor outcomes than one-dimensional approaches that were proposed to evaluate independence in older adults (Bowling & Iliffe, 2006). The main constituents of the various approaches are health, psychological factors, social roles and activities, finances, social relationships and neighbourhood factors (Bowling & Dieppe, 2005). Healthy ageing can broadly be described as functional independence, involving preservation of biomedical, physical and psychosocial health enabling cognitive, physical and mental wellbeing, social participation and improved quality of life (Bowling, Dieppe 2005, McLaughlin, Connell *et al.,* 2010). This contrasts with successful ageing, which conceptualises ageing as involving adaptation to the changing balance between gains and losses over the life course. Successful ageing is perceived as the attainment of valued goals, the minimisation of loss and maximisation of gains through the linked processes of selective compensation and optimisation (Godfrey, 2000). Yet the terms are often used indiscriminately. Healthy ageing is the outcome of interest in the empirical analysis.

1.3.6. Implications

Bowling and Dieppe argue that if high social functioning is accepted as part of ageing successfully then people should be encouraged and supported to build up their social networks and activities, with the provision of enabling community facilities (Bowling & Dieppe, 2005). Many domains of successful ageing are inter-related, and those with multiple social activities and better relationships have greater life satisfaction, improved health and function, greater autonomy and improved survival (Vaillant, 2002; Menec, 2003). Consequently, poorer environments and community services are liable to cause unhealthy ageing.

People with low expectations place less importance on seeking health care (Sarkisian *et al.,* 2002). If those experiencing greater deprivation have lower expectations, and if their access to services is also poor this may compound their health behaviours, with the interaction leading to worse outcomes. A wide variety of data exists demonstrating that those who are more deprived realise that their behaviours are deleterious to health (e.g., smoking and alcohol intake) but tend to persist in their activities, making additional services for these vulnerable groups more important, but also destined for limited success or abject failure as they do not address what may be the root cause i.e. something associated with deprivation.

Bowling and Dieppe (2005) argue that interventions to promote successful ageing must target vulnerable groups early on, they cite Vaillant's work as an example of middle aged variables predicting outcomes in old age. They also remark that adaptation to old age is linked to experience of stressful events, which is also associated with social class (Caspi *et al.,* 1986).

Godfrey (2000) highlighted the need for research into the precise mechanisms of successful ageing and how they are shaped by individual's socioeconomic circumstances. Other researchers note that there is a lack of research on the 'place effects on health' and how place of residence is associated with health outcomes (Green *et al.,* 2005; Macintyre *et al,.* 2002). Furthermore, Strifler (2011) comments that the neglect of society level and environmental factors in operational definitions of successful ageing is an important and significant gap in the current literature. Given the early environmental aspects of the models this omission is curious, supporting investigating the impact of deprivation and quality of care upon healthy ageing.

1.4. Health and resources

Understanding the impact of individual endowments (assets and human capital), external constraints (family, community, society, governance) and individuals' internal constraints on health is complex (Stern *et al.,* 2004). Numerous studies demonstrate that health follows the social gradient, and that social conditions limit freedom and autonomy. Consequently, greater limitations have been shown to translate into worse health outcomes (Marmot, 2006).

The Care Quality Commission State of Care report 2013-14 found wide variation and differences in the quality of care people experienced from different providers and different places. They inspected GP practices for the first time in 2014 concluding that *"GP practices in areas with the highest social deprivation tended to provide a lower quality of care than practices in other areas, and on average larger practices delivered better quality of care than smaller practices"*. Furthermore, they commented that until then Primary Care *"had no robust way of assessing overall quality of care"* (CQC, 2014).

Clearly, socioeconomic status must be considered when planning health services because social and material deprivation causes increased consulting and morbidity (Baker *et al.,* 2002) as well as mortality (Ross *et al.,* 2013). However, material deprivation is only part of the puzzle. Ill health can also be caused by failing to meet the human needs of autonomy, empowerment and human freedom (Marmot, 2006), and many studies note that lower perceived control results in poorer health outcomes (Chandola *et al.,* 2004) & (Griffin *et al.,* 2002). Providing improved services is simpler and more achievable than removing deprivation, but may be ineffective if patients lack the means to access said services.

1.5. Factors associated with unhealthy ageing

The evidence base on factors associated with worse outcomes and thereby ‘unhealthy ageing’ is vast. The following are examples of factors linked to less healthy ageing. A seminal study investigated the long-term predictors of high physical functioning (taken as a measure of healthy ageing) in a sample of Alameda County, California residents. Observations from 1965 to 1984 provided clear evidence of health inequalities secondary to financial and social deprivation. After adjustment for age and functional status at baseline, race (those not Black), higher family income level, absence of hypertension, absence of arthritis, absence of back pain, being a non-smoker, having normal weight, and consuming moderate amounts of alcohol were predictive of high functioning at follow-up (Guralnik & Kaplan, 1989). Subsequent studies have identified significant associations between greater alcohol use, lower education, incarceration (Pruchno *et al.,* 2010), reduced cognitive functioning (Castro-Lionard *et al.,* 2011), poorer early life influences (Schafer & Ferraro, 2012), high BMI, high waist/hip ratio, physical inactivity, having arthritis, asthma, hypertension or gallstones (Hodge *et al.,* 2013), being single or divorced, lower socioeconomic conditions, poor social network (Fukuda *et al.,* 2005), absence of confidant (Michael *et al.,* 1999), lack of engagement in paid work (Di Gessa & Grundy, 2014) and widespread musculoskeletal pain (Wilkie *et al.,* 2013) with unhealthy ageing.

Notably, for those with musculoskeletal pain, there is strong evidence of correlation between pain severity and quality of life. Prevention and treatment of chronic pain may be of significant help in increasing the healthy lifespan (Leadley *et al.,* 2013). Even after age seventy-five lifestyle behaviours' such as not smoking and physical activity are associated with longer survival. A low risk profile (healthy lifestyle behaviours', participation in at least one leisure activity, and a rich or moderate social network) can add five years to women's lives and six years to men's (Rizzuto *et al.,* 2012).

Future research is needed to advance the knowledge base from an awareness of age associated diseases and factors associated with worse outcomes to a better understanding of the ageing processes which underlie the vulnerability to these pathologies (Hayflick, 2000). Ageing is often perceived clinically as a collection of diseases (Hayflick, 2000), but an understanding of the mechanisms that provoke a vulnerability to age related disorders is needed (Franco *et al.,* 2007). Furthermore, Franco *et al.,* (2007) noted the imbalance in the amount of UK research funding associated with age-related disorders rather than the other areas of ageing research, namely the mechanisms of ageing, research aimed at achieving healthy ageing and the socio-economic factors of ageing. All must be considered to achieve effective ways to extend healthy life expectancy.

1.6. Deprivation

> *"People are deprived if they lack the types of diet, clothing, housing, household facilities and fuel and environmental, educational, working and social conditions, activities and facilities which are customary…"* (Townsend, 1987; p125-126).

The United Kingdom's National Health Service is publicly funded and aims to provide universal healthcare to those in need regardless of socioeconomic status. However, inequalities in healthcare are well documented. Townsend defines poverty as: *"Individuals, families and groups can be said to be in poverty if they lack the resources to obtain the types of diet, participate in the activities and have the living conditions and amenities which are customary, or at least widely encouraged or approved in the societies to which they belong"* (Townsend, 1979; p31). Clearly this is a relative definition and whereas poverty is often used to refer mainly to the financial resources needed to meet an individuals needs and escape deprivation, people can be deprived because of a lack of many resources (described in section 1.6.1). Such deprivation can lead to unequal health outcomes (Marmot, 2006).

1.6.1. Health inequalities

Kunst and Mackenbach define health inequalities as *"differences in the prevalence or incidence of health problems between individual people of higher and lower socioeconomic status"* (Kunst & Mackenbach, 1995). Urwin *et al.*, 1998; Jordan *et al.*, 2008; Shi *et al.*, 2010; and Dorner *et al., 2011;* all provide examples of inequalities in health associated with musculoskeletal pain (discussed in section 1.6.4. below).

Three broad categories are employed for debating inequalities:

1. Social demography (age, area of residence, sex and ethnicity)
2. Social and economic status (car ownership, employment, income, occupational social class, socio-economic groupings, tenure status)
3. Social environment (housing conditions, social networks, social support) (Carr-Hill & Chalmers-Dixon, 2005) and social capital (features of social organisation that act as resources available to individuals through membership of social networks or communities that facilitates individual and collective action) (Bordieu, 1985).

Social capital is a collective dimension of society external to the individual, a feature of the social structure not of the individual actors within the social structure (an ecological characteristic). Social capital can be distinguished from social networks and support (which are seen as attributes of individuals) (Carr-Hill & Chalmers-Dixon, 2005). Associations between high levels of social capital and reduced all cause mortality (Kawachi *et al.,* 1997) and better self rated health (Kawachi *et al.,* 1999) have led to suggestions that social capital may mediate the realtionship between income inequality and health (Lynch & Davey Smith, 2002). Promotion of community organisations and social support by local planners has been seen as one way to reduce barriers to care (Perry *et al.,* 2008), thereby improving access and healthy ageing.

People in Japan have the longest life expectancy at birth in the world. Health disparities across regions and socioeconomic groups are small in this egalitarian society and have narrowed over time with an increase in average population health. A Lancet review concluded that this longevity was achieved by reducing communicable diseases, successful implementation of primary and secondary preventive community health strategies for non-communicable diseases and increased use of advanced medical technologies through the universal insurance scheme (a scheme similar to NHS provision). The reduction in health inequalities with improved average population health was also partly attributable to equal educational opportunities and financial access to care (Ikeda *et al.,* 2011). Others argue that the rapid reduction in mortality rates in Japan may be partly attributable to the narrowing gap in income during the period of high economic growth in the 1960s and 1970s (Marmot & Smith, 1989). These contrasting views highlight a common problem in the healthy ageing literature, namely that effects are oversimplified, often dependent on the school of thought the researchers bring to bear on the problem and consequently the data collected and the way it is analysed, influencing the conclusions reached. Ageing outcomes are likely to be multifactorial with complex interactions. Research on social capital provides a case in point where the attention to psychosocial risk factors was criticised for obscuring the contributions to poor health of other influences such as material deprivation, unequal distribution of infrastructure and toxic environmental exposures (Lynch & Smith, 2002; Muntaner, 2004). Future research should clarify the relative importance of and potential interaction between social capital and structural factors as predictors of health care experiences (Megan *et al.,* 2008) and outcomes.

Despite our growing ability to prevent and cure disease, thereby extending life, disparities in health between and within countries remain common and challenging (Marmot, 2006). The disproportionate burden of illness experienced by deprived populations (Kunst & Mackenbach, 1995) is associated with structural inequalities that reflect the unequal distribution of income and power (Japan illustrates improvements in health in a more equal society). However, which of the experiences associated with deprivation causes the unhealthy ageing, and in which setting, and how other factors (such as access and quality of care) interact is less clear. Ageing is undoubtedly a complex process, it is critical that ageing research involves multidisciplinary teams to allow ageing to be contextualised in terms of the social, economic and physical environments in which it takes place. Learning how such factors interact will satisfy the ultimate goal of ageing research, namely increasing the quality and length of life (Franco *et al.,* 2007).

1.6.2. Deprivation and mortality

The Alameda County Study demonstrated that adjusted mortality risk (age, race, sex) was significantly higher for residents living in poor areas compared to those in more affluent neighbourhoods despite adjustment for individual factors. These results illustrated that properties of the socio-physical environment may be important contributors to the association between low socioeconomic status and excess mortality, and that this contribution is independent of individual behaviors (Haan *et al.,* 1987). Subsequently, the researchers analysed the neighbourhood social environment and mortality. A neighbourhood social environment scale composed of commercial stores, population socioeconomic status and environment/housing was used. Age and sex adjusted risk of death was higher for residents in low social environment neighborhoods independent of individual factors. These results demonstrated the role of area characteristics as a health risk factor and focused attention on the meaning and measurement of neighborhood quality (Yen *et al.,* 1999).

The research is divided as to whether social inequalities in health widen or converge as people age. The evidence often reports cross sectional data, with comparisons of different individuals at different ages. For example, Huisman *et al.,* (2004) demonstrated that for pooled European populations relative inequalities in mortality decreased with increasing age, but persisted. However, a Scottish longitudinal study taking account of selective mortality and employing more proximal measures of SES disputes this convergence, suggesting that health inequalities continue into old age (Benzeval *et al.,* 2011).

An American study followed 10 thousand people aged between 51 and 61 years for 10 years. Lower levels of education, income and wealth were strongly associated with higher mortality risk after controlling for demographic variables. However, after further adjustment for health status and behavioural risk factors, only household income remained significant. They concluded that baseline health aged 50 is an important pathway in the association between midlife socioeconomic status and mortality risk to age 70. The continuing effect of low household income on mortality risk was concentrated amongst respondents reporting excellent to good health at baseline. This provides evidence for socioeconomic disparities in middle age limiting disability free life expectancy at older ages (Feinglass *et al.,* 2007).

A 22 year follow up of 500,00 Canadians addressed two of the main weaknesses in the literature, namely insufficient sample size and inadequate length of follow up. Their index was composed of six variables (% adults without a high school diploma, employment population ratio, average income, population living alone, population separated, widowed or divorced, and lone parent families). The first three were combined to create an index of material deprivation, the last three were combined into an index of social deprivation. Those living in the most materially and socially deprived neighbourhoods had elevated risks of mortality when compared to those living in the least deprived neighbourhoods after adjustment for individual factors. Being poor and living in the most socially advantageous neighbourhoods translated into a survival gap of 10% over those in the most socially deprived neighbourhoods. The gap for material neighbourhood deprivation was 7%, termed the ‘healthy immigrant neighbourhood effect’. For those with low family incomes, living in socially and materially deprived areas negatively affected survival beyond their individual circumstances (Ross *et al.,* 2013). Their results are consistent with the Almeda County Study showing an influence of neighbourhood on mortality risk beyond individual factors.

Mortality is higher in poorer areas, independent of individual risk factors (Haan *et al.,* 1987; Yen *et al.,* 1999) (supporting investigating the effect of area deprivation on healthy ageing). Furthermore, mortality is higher with greater material and social deprivation, with evidence that these factors interact in both a protective and harmful manner (Ross *et al.,* 2013), as hypothesized by O’Rand (2002) {postulated that pathways between neighbourhood socioeconomic status (SES), individual SES and health may have reciprocal, reinforcing cycles that contribute to cumulative disadvantage and cumulative advantage throughout the life course}. Consequently, evaluating the impact of individual level deprivation (ILD), area level deprivation (ALD) as well as quality of care on the healthy ageing of older persons with musculoskeletal pain is worthwhile, given mortalities significant link with health.

1.6.3. Deprivation, health and ageing

Inequalities in health have been demonstrated at many ages, and across time (Townsend *et al.,* 1992; CSDH, 2008; Acheson, 1998). However, Bowling & Stafford (2007) comment that little is known about how area versus individual level factors influence health in older populations.

Disability free life expectancy estimates for different socioeconomic groups in America (4 thousand patients over 65 years) illustrated that those with more education had longer lives free of disability and a shorter proportion of their lives lived with disability (Jack *et al.,* 1993). Furthermore, a British study observing 10 thousand people aged 65 years and over (Melzer *et al.,* 2000) reported that the prevalence of disability overall and need for 'constant care' was lower in men and women in social classes I and II compared to the rest. Men aged 65-69 in classes I and II could expect 14 years of life free from disability, compared to 11.5 years for those in classes III to V, for women the equivalent expectations were 15.5 and 13.8. Men in social classes I an II also had a shorter duration of disability, 1 year compared to 1.6 years. So privileged socioeconomic groups in England can expect fewer years of disability despite longer overall life expectancy (Melzer *et al.,* 2000).

Sumarising 1.6.2 & 1.6.3.; Huisman *et al.,* (2004) found that mortality inequality decreases with increasing age, whereas Benzeval *et al.,* (2011) suggests that health inequalities continue into old age, a view supported by Feinglass *et al.,* (2007) who noted that the continuing effect of low household income on mortality risk was concentrated amongst those who had better health at baseline. Finally Melzer *et al.,* (2000) reported that privileged socioeconomic groups in England can expect fewer years of disability as well as longer overall life expectancy. It is a reasonable supposition that similar results will be found with deprivation and quality of care upon healthy ageing in those with musculoskeletal pain as were reported with material and social deprivation upon mortality, disability free life and life expectancy.

1.6.4. Deprivation and pain

People living in more deprived areas are more likely to report musculoskeletal pain and the prevalence of physical disability rises with age (Urwin *et al.,* 1998). Low educational attainment and nonprofessional occupations are also associated with poorer osteoarthritis outcomes (Luong *et al.,* 2012). Additionally, inadequate income, neighbourhood deprivation and education (Jordan *et al.,* 2008; Shi *et al.,* 2010; Dorner *et al.,* 2011) are associated with interfering pain in older people. Using a stepwise logistic regression model, adjusted for age, gender, diseases, number of painful body sites and intensity of pain, Dorner *et al.,* (2011) reported that people with lower SES gradually reported greater disability through pain.

A Norwegian study investigated the association between the severity of non-inflammatory musculoskeletal pain and area socioeconomic status. Living in the less affluent areas was associated with strong and widespread pain, with high levels of physical disability and mental distress and low life satisfaction. Living in the less affluent area was also associated with frequent use of analgesics and low level of involvement in own health care, after adjustment for age, pain intensity and levels of physical disability and mental distress (Brekke *et al.,* 2002). Non-inflammatory musculoskeletal pain seems to be more serious in populations living in less affluent residential areas compared with a more affluent one, even in an egalitarian society like Norway. Increased disease severity may thus amplify the impact of greater chronic morbidity in the disadvantaged part of the population. This has implications for health care provision if the goal is treatment according to need.

Weden *et al.,* (2008) note that subjective and objective constructs are both related to health. However the subjective construct (perceived neighbourhood quality) is most strongly associated with health and also moderates the associations between health and the objective constructs (neighbourhood disadvantage and affluence). Also, individual characteristics play an important role in shaping the contribution of neighbourhood conditions through selection and mediation. They note the independent association between objective and perceived neighbourhood quality and health, as well as the particularly strong association between neighbourhood quality and health (Weden *et al.,* 2008).

The greater disability noted by Dorner *et al.,* (2011) and the more serious non inflammatory musculoskeletal pain affecting those who are socioeconomically disadvantaged reported by Brekke *et al.,* (2002) should lead to unhealthier ageing.

This thesis will examine if there are differences in healthy ageing with ILD & ALD. Prior research notes that the onset of pain interference varies by local area deprivation status (Jordan, Thomas *et al.,* 2008) and the onset of disabling pain is also influenced by where one lives. This thesis will assess the relative impact of neighbourhood deprivation and income inequalities upon healthy ageing in those with musculoskeletal pain.

The relationship between area and individual level factors influence upon healthy ageing amongst those with MSK pain is poorly understood. Less affluent areas may have poorer amenities and services (Carr-Hill & Chalmers-Dixon, 2005), with lower social capital (Bordieu, 1985) leading to less interaction and support and worse outcomes with pain (Brekke *et al.,* 2002; Jordan *et al.,* 2008; Shi *et al.,* 2010; Dorner *et al.,* 2011). Poorer areas may also be further disadvantaged by both subjectively and objectively worse healthcare (CQC, 2014). Compounding this those in poorer areas demonstrate lower levels of involvement in their own health care (Brekke *et al.,* 2002).

Satariano's (2013) ecological approach to healthy ageing proposes that as part of the environment social and cultural factors should be taken into account. Furthermore he argues that any work on healthy ageing should investigate housing, land mix (mix of residential to non residential use), street design, traffic patterns, as well as health and functional status, psychosocial factors, living arrangements, social networks, social support, health practices and access to health and social services. This global approach to healthy ageing is attractive, and was central to investigating the effect of deprivation and access upon healthy ageing.

The effect of ILD and ALD on other health outcomes, rather than healthy ageing amongst those specifically with MSK pain is better understood (and likely to have a similar relationship), consequently outlined in section 1.6.5. & 1.6.6. below.

1.6.5. Individual level deprivation (ILD) and health outcomes

The association between low socioeconomic status and poorer health is well supported (Van Jaarsveld *et al.,* 2007). Individual level indicators (income, occupation, educational level) and neighborhood-level characteristics demonstrate a graded relationship with health outcomes (Marmot *et al.,* 1991; Pickett *et al.,* 2001; Huisman *et al.,* 2005), for example additional schooling reduces mortality (Fischer, Karlsson *et al.,* 2013).

It is unclear whether neighbourhood effects are independent of individual socioeconomic status (SES) (Macintyre & Ellaway, 1998; Reijneveld, 2001). Successive adjustment for individual level markers of SES had been shown to progressively reduce the magnitude of the association between neighborhood level SES and health (Davey *et al.,* 1998; Stafford & Marmot, 2003; Martikainen *et al.,* 2003). This prompted Van Jaarsveld *et al.,* (2007) to question whether there was a real independent neighborhood effect or if incomplete adjustment for individual SES explains the residual differences in health between residential areas. They concluded that there were at least partly independent influences on poor health of ILD and area level deprivation (ALD) (Van Jaarsveld *et al.,* 2007).

1.6.6. Area level deprivation (ALD) and health outcomes

One conceptualisation of neighbourhood effect is to think of a neighbourhood as a site for "multiple jeopardy" or "deprivation amplification" (Macintyre *et al.,* 1993). This postulates that individual poverty is compounded by the attributes of the poor neighbourhood, which may include both material and social characteristics (underinvestment in services and public goods; exposure to noise and pollutants, crime, conflict, disarray; socialisation effects on behavior and transmission of health compromising social norms; social isolation and isolation from economic opportunity). Socioeconomically disadvantaged areas could influence individuals social functioning by having poorer infrastructures and higher crime rates, which may undermine social interaction and civic engagement (Cummins *et al.,* 2005). If poor areas also undermine patients desire to access care (described by Brekke *et al.,* 2002), and poor areas have worse care provision (CQC, 2014), it is likely that poor people in poor areas with poor access will have worse outcomes.

Area characteristics make up social capital (social networks and support at the level of the community). Social capital can be beneficial to those experiencing financial difficulty, protecting people from individual level deprivation (Allen, Inder *et al.,* 2013). It seems logical that those with pain would also benefit, potentially leading to healthier ageing. Bowling and Stafford argue that improving neighbourhood social capital (by increasing access to social resources, services and facilities, translating to opportunities for social and civic participation) is one way of increasing social networks/interaction/support available for people, with consequent improvements in health and function (Bowling, Stafford 2007).

People living in affluent areas also have better levels of social activity independent of individual socioeconomic and demographic characteristics, i.e. ILD measures (Bowling, Stafford 2007), again demonstrating the benefits of a better area. Individuals' perceptions of areas being neighbourly and having good facilities' is also independently associated with lower likelihood of low social activities (Bowling, Stafford 2007). Less affluent areas have poorer amenities and public services, are deficient in social capital and unable to promote social integration and support (Wen *et al.,* 2006). The relative impact these factors have on healthy ageing is unclear (compared to ILD).

Some researchers argue that improving social capital (area level characteristics) may mitigate the effects of individual deprivation (Bowling & Stafford, 2007). If people have unhealthier ageing due to deprivation where they live and the services that are available to them it would be prudent to assess the effects of interventions to reduce these inequalities. If patients who are in similarly disadvantaged areas have different outcomes due to the services they can access, which is probable, if better services and/or improved access to these services act in a similar manner to better areas as per Allen *et al.,* (2013) discussed above, improving the services available to them offers an intervention to improve their ageing.

1.6.7. Access to care/quality of care

1.6.7.1. Challenges to access and quality in NHS primary care

Levesque *et al.,* (2013) define access as *'the opportunity to identify healthcare needs, to seek healthcare services, to reach, to obtain or use healthcare services and to actually have the need for services fulfilled'.* They identified five dimensions of accessibility (approachability, acceptability, availability and accommodation, affordability and appropriateness) and five corresponding abilities of populations (ability to perceive, ability to seek, ability to reach, ability to pay, and ability to engage).

NHS England's definition of quality of care is care that is clinically effective (in the eyes of patients and clinicians'), care that is safe, and care that provides as positive an experience for patients as possible (NHS England 2014). Providing good access to good quality services is not straightforward. The number of consultations in general practice has increased as the population has increased, become older and more people have multiple conditions (negatively impacting upon access and quality). These challenges are exacerbated by policy initiatives for more care to be provided closer to home without the provision of adequate services.

As the populations needs have changed reflecting the aforementioned older population with more complex health needs, General Practitioners have moved from treating episodic illness to working in partnership with patients to improve health and treat people in the community (more cost effectively). Increased demand has required practices to improve information and communication around diagnosis and treatment options, develop shared decision-making and self-management strategies to manage chronic conditions. All practices are unlikely to be equally able or provisioned to meet these challenges with corresponding impact on the outcomes of their patients.

The Health and Social Care Act 2012 introduced comprehensive changes to the way the NHS will operate. GPs are expected to take a lead role in independent Clinical Commissioning Groups. The central tenet of the reform ‘no decision about me without me’ is aimed at increasing choice and service integration, providing care closer to home and placing greater emphasis on patient involvement. This again asks a lot in disadvantaged areas.

However, on this background of increasing challenges and demand, the share of government spending on health invested in primary care has been falling since 2005/6, despite 90% of NHS patient contact occurring in General Practice (RCGP News, 2014). Furthermore, funding for general practice is projected to fall by 17% in real terms by 2017/18, from £9.29 billion of the current total NHS budget of £110.9 billion to £7.7 (Deloitte, 2014). Currently General Practice receives 8.5% of the NHS budget. Deloitte estimates that even to stand still, general practice would need £11.47bn – or 9.81% – out of a projected NHS budget of £116.86bn by 2017/18 (Deloitte, 2014). Whilst investment falls, the number of patient consultations has risen (in 2008/09 the number of consultations was 304 million, in 2012/13 there were 340 million consultations, with 409 million projected in 2017/18). The Royal College of General Practitioners warn that the combination of rising demand and diminishing funding will have disastrous consequences for patient care.

Poor allocation of resources compounds the impact of inadequate funding. There are wide regional variations in the number of GP practitioners per 100,000 people, with access to GPs inequitably distributed between areas of high and low deprivation. For example, in 2008 the average number of GPs weighted for age and need in the most deprived quintile was 56.4 per 100,000 population, whilst in the most affluent it was 62.9 per 100,000, the range was from 53 to 90 GPs per 100,000 (NOA, 2010). The standardised mortality ratio for all cause mortality between 15-64 years of age is lower in areas with a greater supply of general practitioners. Each additional general practitioner was associated with a 6% decrease in mortality in one English study (Gulliford, 2002). However complicating this, a later study found that after controlling for socioeconomic deprivation and partnership size the significance of this relationship disappeared. Furthermore, they noted that each 15-20% increase in GP supply per 10,000 people generated a decrease in hospital admission rates of approximately 14 per 100,000 for acute illnesses and 11 per 100,00 for chronic illnesses (after controlling for social deprivation, class, ethnicity and limiting long term illness). The authors surmised that the structural characteristics of the practices might have had greater impact on health outcomes than the mere presence of a primary care doctor (quality aspect) (Gulliford *et al.,* 2004).

Given the evidence that the quality as well as quantity (influencing access) of doctors providing care impacts upon outcomes it is important to note that a third of care is now delivered by salaried and locum GPs or by practice nurses (NHS Information Centre, 2009), who are generally less experienced. The impact on quality is unclear. Despite extensive searching for this review, no data on the proportion of primary care consultations delivered by salaried or locum GPs or practice nurses by area deprivation could be identified.

Between 1999-2000 and 2010-11 spending on the NHS increased on average by 6.6% a year (NAO, 2011). The era of austerity heralds an increase of only 0.4% per year (HM Treasury, 2010). Efficiency improvements and productivity gains are seen as vital to achieving this, saving around 20 billion a year by 2015 (DoH, 2010). Whilst reducing real terms funding the NHS Outcomes Framework 2012 sets out the outcomes that the NHS should be looking to improve. It is structured around five domains with 35 indicators. The domains include:

1. Preventing people dying prematurely
2. Enhancing quality of life for people with long-term conditions
3. Helping people to recover from episodes of ill health or following injury
4. Ensuring people have a positive experience of care
5. Treating and caring for people in a safe environment, and protecting them from avoidable harm.

However, in the first week of December 2014 NHS England data noted that those waiting more than four hours in A&E was up 66% compared to the same week in the proceeding year, those waiting 4-12 hours on a trolley waiting to be admitted was up 112%, and those admitted as emergencies was up 6% (Campbell, 2014). Clearly, this reflects inadequate access as well as poor quality (that services are failing the needs of patients with acute needs, and that secondary services are flooded due to insufficient access and or quality of care in primary care) (Porter, 2014). Given that a significant association between waiting time and the probability of dying was demonstrated in an outpatient setting (Prentice & Pizer, 2007), this is unacceptable (discussed 1.6.7.3.).

If quality of care and access to care has an impact on the healthy ageing of older people with musculoskeletal pain it would justify increased primary care funding and exploring in more detail what about the care is effective in one practice over another, and how outcomes could be replicated elsewhere.

1.6.7.2. Practice resources and the Carr-Hill allocation formula

General Practices in more deprived areas care for patients with greater need and fewer personal assets, this has obvious implications for access and quality as defined in section 1.6.7.1. However, there is no national funding strategy to account for practices providing care for patients in areas of higher deprivation. The Carr-Hill allocation formula was introduced to underpin the 2004 GP contract (replacing the previous allocation formula the Jarman index). It is used to adjust the financing provided to individual general practices based on the global sum total for a number of local demographic and other factors which may affect General Practice workload. Factors included in the Carr-Hill formula include age and sex of patients (to reflect frequency of home and surgery visits), nursing and residential home patients, list turnover (adjusted for number of new registrations), additional needs (Standardised Mortality Ratio and Standardised Long-Standing Illness for patients under the age of 65 years), staff market forces factor, rurality and London weighting. There is nothing taking into account the deprivation status of patients, which is likely to generate greater need leading to poorer access and consequences for quality of care.

In 2007 the Carr Hill Formula was reviewed but the findings were never implemented. In 2012 the Government pledged to increase funding for practices in the most deprived areas via a ‘patient premium’. The changes were agreed in principle for implementation in 2013/14, then postponed to 2014/15, then 2015/16 (Lind, 2014), the current target is 04/2018 (Lind, 2016). A move towards more equitable funding for all GP practices, based on the number of patients they serve, with an appropriate weighting for demographic factors that affect relative patient needs and practice workload is essential. The department of health plans to make changes to ensure that sufficient weight is given to deprivation factors (Hakin, 2012). Such funding is essential to provide access to quality care that can reduce health inequalities and promote healthier ageing (discussed 1.6.7.3).

1.6.7.3. Literature surrounding access to care/quality of care and outcomes

The positive impact of access to healthcare on health and survival among older adults is well evidenced in Western societies. However, few studies have investigated the association between access to healthcare services and health conditions at the oldest ages, mainly due to poor data availability (Gu *et al.,* 2009).

The supply of primary care physicians (access) has been shown to significantly reduce the effects of income inequality on self-reported health status (Shi & Starfield, 2000).

Greater access to healthcare also yields positive effects on health and mortality. A Spanish study reported that non-institutionalised elderly persons with unmet health care needs (defined as no visits to or from a physician in the previous 12 months) suffered a higher risk of mortality, relative risk of 2.55 (95% CI 1.22, 5.32) (Alonso *et al.,* 1997). An American study noted that insurance cover and better access to care increased survival chances and reduced the odds of transitions from independence to disability by 30% amongst community residents aged 66 years or older. They concluded that access to care made the most difference in delaying or slowing down functional decline among functionally independent elderly persons (Porell & Miltiades, 2001). Another American study looked at Veteran Affairs patients aged 65 years or older who visited geriatric outpatient clinics. They concluded that longer waits for health care were associated with an increased risk of individual mortality even when controlling for prior individual health status and facility levels available. Furthermore there was a significant association between the linear form of wait time and the probability of dying (Prentice & Pizer, 2007).

Guimarães (2007) comments that if the follow up period is not sufficiently long influences on health outcomes will be missed. Also, many studies examine the associations between access to healthcare and a specific health condition. The benefit of access to health for one health condition may not translate into benefit for another or coexisting conditions (Alonso, 1997). The growing body of research noting that community or neighbourhood characteristics have a significant influence on later life health and mortality mean that these are potential confounders in the association between access to healthcare and health. It would be useful therefore to look at both.

Perceived neighbourhood trust has been associated with reduced levels of psychological distress, possibly because perceived neighbourliness generates stress-buffering effects (Phongsavan *et al.,* 2006). In theory perceptions are linked to psychological processes which may act as pathways linking objective features of the environment to health (Wen *et al.,* 2006). Good perceived care (both access and quality) might therefore translate into healthier ageing. Exploring the role of subjective and objective access to care and quality of care measures upon the healthy ageing outcomes of individuals with musculoskeletal pain, as well as investigating any interplay with deprivation measures could offer a variety of future interventions to improve outcomes.

1.6.8. Service implications

Clinicians working in deprived areas treating patient with common physical disorders have a greater number of both physical and mental health disorders to manage simultaneously than do their colleagues in the most affluent areas (Barnett *et al.,* 2012). Providing satisfactory care is consequently harder in more deprived areas, compounded by less resources in these areas (Gulliford *et al.,* 2004; Lind, 2014).

Exploring how socioeconomic position and perceived care impact on healthy ageing may offer area level interventions to reduce ageing inequality and improve population healthy ageing (Acheson 1998).

Failing to provide care which satisfies the needs of the community can lead to the classic mismatch noted by Tudor Hart in which the most socially deprived communities receive the poorest quality healthcare services, yet have the highest prevalence of chronic disease (Tudor Hart, 1971). The variability in quality of care offered by different practices has been a concern for decades (CQC, 2014). Some argue that variations are explained by the difficulties in providing care for needy populations, but how much is due to differences in the care offered? For example, researchers noted that in the UK more deprived patients with hip pain were less likely to be referred (older patients were also less likely to be referred); adjusted hazard ratios for those in the most deprived Townsend fifth compared to the least deprived were 0.72 (95% CI 0.62 – 0.82) and 0.76 (0.68 – 0.85) respectively (McBride *et al.,* 2010). Furthermore, a UK study analysed data from 8,970 general practices in England and Scotland. They measured performance against 26 cardiovascular disease QOF indicators and linked this with data on practice characteristics and census data. Despite wide variations in practice list sizes and deprivation, the prevalence was remarkably consistent (raising questions regarding the effectiveness of identification of morbidity in deprived areas, whether this is an access or quality problem is unclear). Practices in affluent areas also had higher achievement of indicators requiring referral for further investigations (Saxena *et al.,* 2007).

Additionally, multimorbidity is strongly related to age and deprivation in the UK. Those with multimorbidity had higher consultation rates and less continuity of care compared to those without multimorbidity, even though they are more likely to gain from it (Salisbury *et al.,* 2011).

GPs in more deprived areas have larger, more unmanageable lists, with higher turnover of patients (Ashworth & Armstrong, 2006). Consequently, delivering equivalent care (both access and quality) is challenging. Furthermore, deprived areas are likely to expose patients to an accumulation of other corrosive factors that may further contribute to unhealthy ageing.

1.7. The effect of deprivation and quality of care on the healthy ageing of those with musculoskeletal pain: a review of the literature

Clearly, pain is common amongst older people (Gauthier & Gagliese, 2011), pain interfering with life rises with age (Thomas, Mottram *et al.,* 2007) and musculoskeletal pain is associated with unhealthy ageing (Wilkie *et al.,* 2013). Musculoskeletal pain is also more prevalent (Urwin et al., 1998), with poorer outcomes in populations living in less affluent areas (Urwin et al., 1998; Brekke *et al.,* 2002; Jordan *et al.,* 2008; Shi *et al.,* 2010; Dorner *et al.,* 2011). It seems likely that the greater disability noted by Dorner *et al.,* (2011) and the more serious non inflammatory musculoskeletal pain affecting those who are socioeconomically disadvantaged reported by Brekke *et al.,* (2002) would translate into unhealthy ageing. Less affluent areas may have poorer amenities and services (Carr-Hill & Chalmers-Dixon, 2005), lower social capital (Bordieu, 1985) and both subjectively and objectively worse healthcare (CQC, 2014). Given that better access reduces functional decline amongst independent elderly persons (Porell & Miltiades, 2001), that privileged socioeconomic groups in England can expect fewer years of disability as well as longer overall life expectancy (Melzer *et al.,* 2000) and Weden and colleagues' (2008) report of an independent association between objective and perceived neighbourhood quality and health, it is probable that deprivation, quality and access impact upon musculoskeletal pain and unhealthy ageing. The association between low socioeconomic status and poorer health is well supported (Van Jaarsveld *et al.,* 2007) and both individual level indicators and neighborhood-level characteristics demonstrate a graded relationship with health outcomes (Marmot *et al.,* 1991; Pickett *et al.,* 2001; Huisman *et al.,* 2005). However the roles of deprivation, quality and access to care on the association between pain and healthy ageing is unknown. A systematic search of relevant literature was undertaken to identify studies that had looked at these roles.

1.7.1. Review methodology

1.7.1.1. Search strategy

A literature search strategy was developed and refined after consultation with a professional healthcare research librarian (Andrew Hough - who was consulted due to the paucity of papers identified in an initial search) and applied to seven key databases on the seventh of March 2014. The NICE Healthcare Databases engine (www.library.nhs.uk) was searched using the advanced search facility. The seven databases were the Allied and Complementary Medicine Database (AMED), British Nursing Index (BNI), Cumulative Index to Nursing and Allied Health Literature (CINAHL), Excerpta Medica database (EMBASE), Medical Literature Analysis and Retrieval System Online (Medline), Healthcare Management Information Consortium

(HMIC) and the American Psychological Association database (PsycINFO). These databases were chosen to allow a comprehensive search of the various fields whose journals might include relevant papers (informed by the background reading described in prior sections); including medicine, nursing, community healthcare, health and social care services, allied health, public health, sociology, psychology and gerontology.

1.7.1.2. Identification of studies

Studies were identified by searching the electronic databases and scanning the references of review articles and eligible studies for additional relevant studies. The search was restricted to English language articles (translating non-English articles was not feasible for this review) and published studies. Database index headings were found by searching the list of terms of each relevant database. Other terms were based on synonyms for the index terms and from study of database entries from previous search results. No time periods were specified and databases were searched from inception to when the search was conducted.

The main terms were to identify

(i) Deprivation (deprivation, inequality, social class, socioeconomic, occupational group/class, education, social capital/network/demography/isolation/support, income, living arrangement), access terms including quality of care AND/OR access to care (access, health insurance, quality, general practice patient survey, quality outcomes framework),

(ii) Pain (nociception, analgesia, hyperalgesia, allodynia, musculoskeletal, arthritis, osteoarthritis) and

(iii) Healthy ageing terms (successful ageing)

The search strategy was formed by combining all terms (deprivation terms or pain terms or healthy ageing terms) with the OR operator, and then combining the terms using the AND operator. Each database was searched individually *(the full search strategy for each database is provided in the appendix)*.

Identified studies were excluded following a title and abstract search by a single observer (Gwydion Rhys). Eligibility for study inclusion was structured around the PICO framework (Population, Intervention/Exposure, Control/Comparator, Outcome, Study type).

I. Population: older people (aged ≥50 years)

II. Intervention/Exposure: pain OR deprivation OR quality of care/access to care

III. Control/Comparator: no eligibility criteria specified as some studies may not have control groups but may still provide useful information on the impact of deprivation upon healthy ageing.

IV. Outcome: healthy ageing OR successful ageing

1.7.1.3. Literature search results

Table a. Number of titles identified with combined search terms by database

	Search term combinations		
Electronic database	**Deprivation AND ageing**	**Deprivation AND pain**	**Deprivation AND pain AND ageing**
AMED	3	2217	0
BNI	10	826	1
CINAHL	19	4070	0
EMBASE	83	22885	6
MEDLINE	65	14858	3
HMIC	25	459	3
PsycINFO	49	3337	2

The search identified fifteen titles *(Table a)*. Thirteen titles were excluded following the title and abstract search. Four were duplicates of the Wilkie *et al.,* (2013) paper discussed below, nine were not relevant to the PICO framework above *(all search results can be viewed in the appendix)*, two remaining papers discussed below.

1.7.1.4. Review of the two papers identified in the literature search

One, ‘Healthy aging for older women’ (Young & Cochrane, 2004) was a review article of health issues for older women which included cardiovascular disorders, diabetes, arthritis, hip fractures and cancer as well as psychological disorders such as depression and dementia. The authors surmised that the promotion of healthy ageing was advisable by improving access to health care, healthy eating and exercising.

The only relevant study was ‘The Onset of Widespread Musculoskeletal Pain Is Associated with a Decrease in Healthy Ageing in Older People: A Population-Based Prospective Study’ (Wilkie *et al.,* 2013). The onset of widespread pain was associated with a decrease in the healthy ageing index score, which was unchanged when adjusted for age, sex, education and social networks. Low educational attainment and medium/low social networks were also shown to be associated with a decrease in the healthy ageing index score and socio-economic status was included as a confounder (Wilkie, Tajar *et al.,* 2013).

The only paper of relevance identified (Wilkie, Tajar *et al.,* 2013) did not clearly look at the role of deprivation on the association between musculoskeletal pain and healthy ageing. There is a need to investigate the role of deprivation (including quality and access to care) upon healthy ageing in older people with musculoskeletal pain.

1.8. Summary

This thesis will examine the relationship between deprivation and quality of care and access to care, upon healthy ageing in older people with musculoskeletal pain. The literature review highlighted the paucity of information regarding the effect of deprivation, quality of care and access to care upon healthy ageing in older people with musculoskeletal pain (section 1.7).

Review of the background literature relating to the questions main subjects (sections 1 – 1.6.8) illustrated recurring themes highlighting and explaining the lack of research specific to the question. Namely; pains subjectivity meant it was previously treated as a symptom rather than a disease (Turk & Melzack, 2011); various pain classifications subdivide the research base, reducing the volume of research concerning musculoskeletal pain in older adults, whilst concurrently improving its relevance; healthy ageing also includes a subjective component, but unlike the pain literature, there is no consensus regarding the terminology, definition or measurement of healthy ageing (Depp *et al.,* 2010; Bowling & Dieppe, 2005) leading to a fragmented research base whose relevance is difficult to judge, with a variety of terms employed measuring healthy ageing (section 1.3).

However, the main ageing models suggest that deprivation will impact upon healthy ageing. Rowe and Kahn (1987) noted accumulated 'modifiable' environmental risk factors (section 1.3.2.1.), whilst Baltes and Baltes (1990) commented that the way strategies are realised depends on personal and societal circumstances faced as individual's age (1.3.3.1), Riley (1998) noted that success is reliant on the availability of structural opportunities or interventions in society (1.3.5), whereas O'Rand (2002) spoke of individual level and area level deprivation having reciprocal, reinforcing cycles contributing to cumulative disadvantage across the life course {a view endorsed by Ross *et al.,* (2013) and the Alameda County data (see section 1.6.2.)}.

A wealth of literature describes the general health impacts of deprivation and access to care (section 1.6.). Regarding associations with unhealthy ageing; Guralnik & Kaplan (1989) reported less income leading to worse function, Pruchno *et al.,* (2010) noted lower education, Fukuda *et al.,* (2005) described the impact of lower socioeconomic status, lower social networks and lack of partner, Feinglass *et al.,* (2007) described how socioeconomic disparities in middle age limit disability free life expectancy in old age, echoed by Melzer *et al.,* (2000) describing privileged socioeconomic groups experiencing less disability and increased life expectancy, whilst Di Gessa & Grundy

(2014) commented on a lack of engagement in paid work. Essentially, greater limitations translate into worse outcomes (Marmot, 2006). Concerningly, GP practices in areas of higher social deprivation tend to provide lower quality care (CQC, 2014), and poorer areas have less social capital (Carr-Hill & Chalmers-Dixon, 2005), with strong associations noted between neighbourhood quality and health (Weden *et al.,* 2008).

The evidence base progressively contracts when becoming more specific e.g. looking at deprivation or access and pain, then more specifically at musculoskeletal pain, before finally considering musculoskeletal pain in older people only. Urwin *et al.,* (1998) comment that more deprived persons are more likely to report musculoskeletal pain and the prevalence of physical disability increases with age. Luong *et al.,* (2012) noted that those with less educational attainment and non-professional occupations had poorer osteoarthritis outcomes. Whereas Jordan *et al.,* (2008), Shi *et al.,* (2010) and Dorner *et al.,* (2011) reported that inadequate income, neighbourhood deprivation and lower education were associated with interfering pain, and consequently are likely to lead to unhealthy ageing. Dorner further comments that lower socioeconomic status is associated with increasing disability with pain. Brekke *et al.,* (2002) report that those with lower socioeconomic status experienced more pain and disability, less life satisfaction and crucially lower levels of involvement in health care. Also, lack of engagement amongst disadvantaged groups is a concern; evidenced by Porell & Miltiades (2001) conclusion that access to care made the most difference in delaying or slowing down functional decline amongst functionally independent elderly persons.

Clearly, a better understanding of the influence of deprivation (individual level, area level, access to care and quality of care) upon healthy ageing in older people with musculoskeletal pain is required *(Table a, see appendix for full search strategy)*. Wilkie *et al.,* (2013) clearly illustrated that the onset of widespread musculoskeletal pain was associated with a decrease in healthy ageing. Deprivation measures were not included in their healthy ageing index (barring financial strain). Given the literatures support for including measures of deprivation in healthy ageing models and the notable lack of research describing the effect of deprivation measures on the outcomes of older people with musculoskeletal pain this thesis was undertaken.

The thesis will investigate whether greater deprivation and/or worse quality of care or access to care is not merely associated (the values of one variable generally co-occurring with certain values of the other) with lower healthy ageing index scores in those with musculoskeletal pain (reflecting more unhealthy ageing) but act as a moderator (i.e. the association between musculoskeletal pain and healthy ageing differs by level of deprivation/quality of care/access to care; indicating an interaction effect between musculoskeletal pain and deprivation/quality of care/access to care). If moderation occurs this suggests that the mechanism to reduced healthy ageing in people with musculoskeletal pain is different in older adults experiencing more deprivation compared to those experiencing less deprivation.

Deprivation is not easily modifiable, but evidence that those who are more deprived suffer worse outcomes with musculoskeletal pain would further strengthen the argument to reduce inequalities. Furthermore, if particular deprivation characteristics were found to lead to worse outcomes in particular pain groups, resource allocation to areas of greatest need may improve ageing outcomes. Consequently, the aims and objectives for the data analysis were as follows.

1.8.1. Thesis aim and objectives

The aim of the body of work described in this thesis is to determine the role of deprivation, quality of care and access to care upon healthy ageing in older people with musculoskeletal pain. This aim will be achieved by satisfying the following objectives;

In the cross sectional analysis at baseline:

(i) Determine whether healthy ageing index scores differ by levels of deprivation (individual level deprivation, area level deprivation, access to care and quality of care) at baseline.

(ii) Establish if the association between pain and healthy ageing is moderated by deprivation (individual level, area level, access to care and quality of care) at baseline.

In the longitudinal analysis:

(iii) Establish if there is an association between deprivation level (individual level, area level, access to care and quality of care) and healthy ageing across 6 years.

(iv) Establish if the association between pain and healthy ageing is moderated by deprivation (individual level, area level, access to care and quality of care) across 6 years.

2. Methods

2.1. Study design

This prospective cohort study combines data collected in the North Staffordshire Osteoarthritis Project (NorStOP) (Thomas *et al.,* 2004), the GP Patients Survey 2007/08 (GPPS) (NHS Information Centre, 2008), the Quality and Outcomes Framework 2005/06 (QOF) (The Information Centre, 2006) and English Index of Multiple Deprivation 2004 (IMD).

Secondary data analysis was chosen for its economy. In the broadest sense, secondary data analysis is analysis of data collected by someone else (Boslaugh, 2007), and examined to answer a research question other than the question(s) for which the data were initially collected (Vartanian & Thomas, 2011). The advantage of secondary data analysis is that the study design and data collection is already complete, saving time and money. Further use of data already collected, which has been cleaned and prepared, allows the investigator to focus their time on analysis (Boslaugh, 2007). It also allows exploring longitudinal associations without waiting for waves of data collection. The disadvantages are that as the study design and data collection is already complete, the data may not facilitate a particular research question. Additionally, the information regarding study design and data collection procedures may be scarce, data may potentially lack depth (the greater the breadth the harder it is to measure any one construct in depth), also, constructs may be operationally defined by a single survey item, or a subset of test items that can lead to reliability and validity concerns.

The prospective cohort design used in NorStOP was suitable for the aims of this study. Data collected at baseline (2002/03) allowed identification of older individuals with musculoskeletal pain. Healthy ageing (i.e. the outcome for this study) was measured at baseline, 3 year (2005/06) and 6 year (2008/09) follow up. Data from the other sources could be linked to the NorStOP participants via their postcode and general practice.

2.1.1. Data collection by questionnaire

NorStOP and GPPS collected information using questionnaires. Postal questionnaires allow the quick collection of data from large samples, which are representative of defined populations (Bowling, 1997). In NorStOP, questionnaires were used to collect self-report information on health, function and socio-demographic factors at all three time points. The GPPS was developed to collect information to reward GP practices in England for performance on patient access to GP services and choice of hospital services (NHS Information Centre, 2008). The survey measured GP practices' performance against standards set out in the Direct Enhanced Services known as the "Improved Access Scheme" and "Choice and Booking". Questionnaires were mailed directly to patients, and completed forms mailed directly to Ipsos MORI (NHS Information Centre, 2008).

Section 2.2 outlines the strengths, weaknesses and potential validity issues of postal surveys.

2.2. Strengths and limitations of population surveys using postal questionnaires

Postal questionnaires are commonly used in health and social research (Sim & Wright, 2000:74). Meeting the often underestimated methodological challenges (Sim & Wright, 2000:62) of postal questionnaires allows valid and reliable data gathering (Layte & Jenkinson, 1997). Postal surveys have numerous advantages over other forms of survey administration. Questionnaire surveys are; cheaper than face to face or telephone questionnaires (Bourque & Fielder 1995), allow efficient coverage of large samples over variable geographical areas at single time points (Czaja & Blair, 1996) which can be generalised to wider populations (Kelley *et al.,* 2003), provide good data quality - encouraged by completion at recipients convenience (Sim & Wright, 2000:76), acceptable to potential recipients (Webb & Bain, 2011), protect participant anonymity, and reduce the effects of direct contact between researcher and participants (Sim & Wright, 2000:62). Questionnaires include a series of written items in a fixed order, with guidance, which respondents answer. Items are tailored to reflect the information sought, and may be open or closed ended, generating qualitative and quantitative data respectively. However, selection bias (sampling, non-response and attrition bias) and measurement bias due to poor questionnaire content, design and administration are limitations of the postal questionnaire method and must be minimised (Fenton *et al.,* 2001).

2.2.1. Sampling bias in postal questionnaires

Potential sources of bias and systematic error must be considered during the design, analysis and interpretation of a study to prevent inaccurate conclusions (Bowling, 1997). Results can only be generalised if data from the sample included in the analysis is representative of the target population (Sim & Wright, 2000). The final sample for analysis will be affected by sampling method, sampling error, non-coverage and non-sampling error. Sampling, response, attrition and information bias are common challenges during longitudinal cohort studies using postal questionnaires.

Sampling is the selection of a group of cases from a larger collection of such cases according to a specific procedure (Sim & Wright, 2000: 111). Random sampling is the most commonly used method because if the sample size is sufficient it should derive a representative population from which it is drawn; this will enhance the generalisability to the target population (Bowling, 1997). The representativeness of a sample depends on the extent that it is both precise (free from random sampling error) and unbiased (free from systematic sampling error – systematic error in choosing the individuals to take part in the study, leading to a non-random sample) (Sim & Wright, 2000).

The sampling frame for postal questionnaires requires complete and up to date addresses; errors in these contact details will lead to sample bias (Bowling, 2005). In the UK, 98% of the population are registered with a General Practitioner (Bowling, 1997) making practice registers a convenient sampling frame for the general population (minimising non-coverage, exclusion of some members of population from potential selection by chosen method of contact, in this case 2%) (Crombie & Davies, 1996).

2.2.2. Response bias in postal questionnaires

Response bias occurs when there are differences in the characteristics of respondents and non-respondents (Bowling, 1997). Non-response can be due to no contact, inability to respond to the questionnaire or a lack of cooperation from the respondent (Bowling, 1997). Lack of contact may be due to failed delivery of the questionnaire or inaccurate contact details. A high proportion of non-respondents reduces the sample size and threatens the generalisability of the study by potentially introducing differences in the characteristics of the analysed sample and target population (Hox *et al.,* 2012 & Nummela *et al.,* 2011).

Response rates can depend on the topics relevance to respondents (Sudman & Bradburn, 1982). Response rates above 50% are acceptable for postal questionnaires (Mangione, 1998). However high response rates alone do not guarantee representativeness; a small proportion of non-responders differing systematically from responders will introduce bias. Examining the characteristics of non-responders and comparison with respondents is useful to determine if their characteristics systematically differ indicating that the sample in which the analysis occurs differs to the target sample and may have limited generalisability (Sim & Wright, 2000:267). Despite selective recruitment into a cohort study potentially resulting in a difference in the prevalence of baseline characteristics between the 'selected' cohort and the wider population from which it was derived, simulation studies suggest the validity of associations between baseline exposures and future outcomes is relatively unaffected by baseline selectivity (Pizzi *et al.,* 2011).

Item non-response can be a problem with postal surveys (Bowling, 1997), reducing sample size in the analysis and threatening the representativeness of the achieved sample. This should be addressed before survey administration through pilot studies that test if questions are unclear. Questionnaire items are largely closed items, which constrain participant's responses and may not be comprehensive or appropriate, limiting the scope for participants to qualify answers or introduce their own issues. The wording and structure of individual items may bias responses (Sim & Wright, 2000).

2.2.3. Attrition in longitudinal studies

Attrition is the loss of participants between baseline and follow-up in longitudinal studies (Bowling, 1997). Significant differences between the characteristics of the sample with complete data sets, and those without can lead to attrition bias. Such attrition reduces the power of longitudinal statistical analysis and reduces confidence in study conclusions (Mein *et al.,* 2012). Attrition is inevitable in cohort studies of older people, however this does not inevitably lead to bias (Lacey *et al.,* 2013). Non-participation at follow-up is more likely in those reporting poorer health (Vega *et al.,* 2010) and cognitive impairment (Matthews *et al.,* 2004).

2.2.4. Information bias

Information bias results from flaws in measuring exposure, covariate or outcome variables, leading to inaccurate data within comparison groups (Porta, 2008). Potential sources of information bias in postal surveys include inaccurate recall, false information and completion by a person other than the intended respondent (Bowling, 1997).

Postal questionnaires completed incorrectly or inappropriately (Sim & Wright, 2000:77) undermine validity and reliability (the degree to which the questionnaires measurement is free from error). Recall bias can occur if inaccurate or incomplete responses are provided by study participants regarding past events or experiences (Porta, 2008). Item non-response occurs when sections of a questionnaire are not completed. This can occur due to poor understanding of the question or unwillingness to disclose information. Minimising bias from non-response can be achieved by considering cognitive requirements and topic sensitivity during study design (Shoemaker *et al.,* 2002). Respondent perception of socially desirable answers (response acquiescence) can lead to selective reporting of information, again undermining validity. A study's validity represents the likely extend to which measurements or conclusions correspond accurately to the truth (Bowling, 1997), or data is valid when it represents what it is purported to represent, and meaningful inferences can therefore be drawn from it (Sim & Arnel, 1993). In contrast, reliability is a measure of how reproducible and consistent the data is (Sim & Wright, 2000).

2.2.5. Selection of instruments

Instruments differ in their qualitative attributes (i.e. construct measured, purpose and target population, format, interpretability and ease of use) as well as their measurement properties. The ability of instruments to measure constructs is linked to the extent of measurement bias. The COSMIN checklist provides a framework to review the measurement properties of instruments designed to measure health outcomes (Mokkink *et al.,* 2010a). The three key domains are reliability, validity and responsiveness.

2.2.5.1. Reliability

Reliability is the extent of reproducibility or consistency of values measured under specified conditions (Sim & Wright, 2000: 32). Three forms of reliability exist (equivalence, stability and internal consistency) (Sim & Wright, 2000: 126). Equivalence (reproducibility) is the degree to which an instrument produces consistent measurements for a given entity when used by two or more investigators or when used in two different forms (inter-rater reliability). Stability (repeatability) denotes whether an instrument performs consistently when used to measure the same entity repeatedly (intra-rater reliability) (Sim & Wright, 2000: 332). Whereas internal consistency measures the homogeneity of a multi item instrument. When multi item scales are used it is important that all the individual items are measuring the same construct. Scales with items demonstrating high intercorrelation have high internal consistency reliability (Sim & Wright, 2000: 257). Postal questionnaires completed incorrectly or inappropriately (Sim & Wright, 2000:77) undermine reliability because the reproducibility and consistency of the values measured is reduced, leading to inaccurate conclusions.

2.2.5.2. Validity

The degree to which the questionnaire measures intended constructs (Mokkink *et al.,* 2010b). The four main constituents are face validity, content validity, criterion-related validity and construct validity (Sim & Wright, 2000: 32).

Face validity is a measure of the data's validity judged by the researcher or subject (Rothstein, 1985. Cited in Sim & Wright, 2000: 126). Notably, respondents should relate to the content and purpose of a questionnaire so that they are motivated to complete it. It is a measure of the credibility of the process of data collection, not the psychometric properties of an instrument (Kazdin, 1992. Cited in Sim & Wright, 2000: 126).

Content validity assesses the scope of a tool and its ability to measure the full domain of content of a concept (Sim & Wright, 2000: 126). Consequently, determining content validity involves examining the conceptual and theoretical background against which a research question has been generated (Sim & Wright, 2000: 126).

Three forms of criterion related validity are described; concurrent, predictive and diagnostic. Concurrent validity involves comparing the performance of a measuring instrument against an independent standard (usually another instrument of accepted validity) (Polit & Hungler, 1995. Cited in Sim & Wright, 2000: 126). Predictive validity is determined by observing whether the future events are in line with the tests predictions (Sim & Wright, 2000: 128). Diagnostic validity is composed of sensitivity and specificity. The sensitivity of a test is the extent to which it identifies those patients who have the disease, whereas the specificity of a test is the extent to which it fails to pick up those without the disease (Farmer & Miller, 1991. Cited in Sim & Wright, 2000: 129). Sensitivity and specificity usually have an inverse relationship, with attempts to improve one leading to a reduction in the other (Streiner & Geddes, 1998. Cited in Sim & Wright, 2000: 129). A tests positive predictive value and negative predictive value are related to sensitivity and specificity. But, sensitivity and specificity are constant for any prevalence of disease, whereas the positive predictive value of a test will vary with prevalence. A given test will have a higher positive predictive value in a population of high prevalence as opposed to lower prevalence, and the change in the negative predictive value is the opposite (Gray, 1997; Greenhalgh, 1997. From Sim & Wright, 2000: 129).

Construct validity is used to describe a measure of a variable which corresponds with measures of other variables in ways that are predicted by, or make sense according to a theory of how the variables are related (Vogt, 1999. Cited in Sim & Wright, 2000: 129). If there is a match between theoretical and empirical relationships, construct validity has been established (Sim & Wright, 2000: 130).

The topic should be carefully planned and relate to the research question (Kelley *et al.,* 2003). Involving colleagues, experts and target population members in question design ensures the content validity.

2.2.5.3. Responsiveness

In a longitudinal study involving the collection of quantitative data the researcher is usually looking for evidence of change in an outcome variable(s) (Sim & Wright, 2000: 135). Whichever tool is used to measure this must be able to detect the magnitude of this change over time. This is termed the responsiveness of the instrument (Cole *et al.,* 1994. Cited in Sim & Wright, 2000: 135).

The instrument must be sufficiently responsive to detect the minimum change that is clinically relevant (Sim & Wright, 2000: 135). When assessing an instruments responsiveness, the period of time over which responsiveness is tested must be of sufficient length for any change to have occurred, there must be an independent measure of whether change has occurred, and responsiveness ought be tested against a relevant range of underlying change (Sim & Wright, 2000: 136).

2.2.6. Pre-testing and piloting

As noted, questionnaires offer a convenient vehicle for collecting comparable data from large numbers of individuals, but the data can only provide meaningful and valid results if the questionnaires used are clear, precise and well responded to. Assessing the studies validity prior to data collection and analysis is essential. Pre-testing questionnaires with knowledgeable others ensures that many methodological challenges are met before piloting (Grant & Davies, 1997). Piloting involving a small number of the sample population identifies remaining problems *e.g.* ambiguity, missed items, problematic response options and unclear instructions. Face validity and content validity is assessed and the questionnaire modified accordingly (Sim & Wright, 2000:72, 254).

The measurement properties of the NorStOP survey instrument were tested as follows: responder burden and face and content validity in two interview studies; completion rates, distribution, repeatability, and construct validity (convergent and discriminant validity) in a larger pilot questionnaire study.

During the pre-piloting interview stage participants completed the draft instrument and were observed for any difficulties encountered, which was timed. Semi-structured interviews asked questions related to face validity, responder burden and content validity and a 'think aloud' protocol was used to explore individual in-depth interpretations of questions. Misinterpretations were recorded. Analysis of face validity considered how items were completed with reference to the conceptual model of each instrument and item, participants' comprehension and interpretation of items, and participants' opinion of the relevance and acceptability of items. Responder burden was assessed by time taken to complete and difficulties with completion, both observed and probed. Content validity of new instruments, such as the Keele Assessment of Participation (KAP), was examined using participants' opinions on the comprehensiveness. Particular to the KAP, qualitative interviews were conducted to generate narrative accounts of the impact and experience of living with health conditions. From these, stem questions for the interview were generated which allowed participants to respond openly about their experiences in relation to each domain. The interview transcripts were scrutinised and face validity assessed from participants views as they completed the questionnaires, and their opinions of the relevance of the KAP to their problems and whether it reflected their restrictions assessed. Content validity was judged by analysing the transcripts for descriptions of functional restrictions and these answers were then compared to the answers provided by the same participant in filling out their KAP questionnaire. All participants interviewed reported the questions to be easy to understand and complete and relevant for the assessment of tasks of daily life. The NorStOP survey questionnaire was then examined for response rate (as a measure of acceptance and face validity) and for missing data in a pilot study. The questionnaire was mailed to a random sample of 1461 adults aged 50 years and over drawn from the registered population of one general practice belonging to the North Staffordshire Primary Care Research Consortium.

The pre-pilot studies indicated that all items were considered acceptable and relevant (good face validity). Further to this, the response rate in the pilot study was acceptable (i.e. over 70%) and the extent of missing data was low (less than 5% for all instruments); both of these values indicated minimal responder burden and acceptability (face validity) supporting the potential usefulness of the survey instrument to collect good quality information from a representative sample population (Wilkie *et al.,* 2005).

2.3. NorStOP

The North Staffordshire Osteoarthritis Project (NorStOP) is a population based cohort study that was designed to examine the long-term prognosis of musculoskeletal pain in older people (Thomas *et al.,* 2004). The study specifically focused on the course and prognosis of hand, hip, knee and foot pain and the impact of these syndromes on function and health care use.

2.3.1. NorStOP study design and procedure

2.3.1.1. Sampling frame

The sampling frame for NorStOP was individuals aged 50 years and over who were registered with six general practices in North Staffordshire, United Kingdom (Thomas *et al.,* 2004). North Staffordshire is a mixed urban and rural area in the North West of England, with a population of approximately 457,165 (according to the 2001 UK Census).

The general practice registers provided convenient sampling frames of the local general population and allowed survey data to be linked to medical records; 98% of the UK population are registered with a general practice (Bowling, 1997). Contact details of all adults aged 50 years and over were taken from the practice list. No UK national level data is available determining the accuracy of contact details on GP registers at any time-point (Thomas *et al.,* 2004). Researchers have compared GP register data to other general population registers e.g. national census, which has its own inaccuracies (Bowling *et al.,* 1989). Such findings indicate that 5-30% of contact information does not match on the two sources contributing to the apparent non response in population surveys using general practice registers as their sampling frame (Pope & Croft, 1996). There may also be duplicate registrations of individuals and not all individuals in a community will be registered (RCGP, 2006). The samples were then checked by the GPs for exclusions (e.g. severe psychiatric or terminal illness) prior to the mailing procedure.

Recruitment involved a two stage mailing process. The first stage was the invitation to complete a 'Health Survey' questionnaire. This collected information on several areas of life including socio-demographics, general health, physical function, participation and bodily pain. In order to limit the chance of people with joint pain being more likely to take part in the study the questionnaire was entitled "Health Questionnaire" and the covering letter stated "We are very interested in your reply even if you have not had any pain or other symptoms in the recent past", although reference to the topic was made "Researchers…are trying to find out about joint pain and other symptoms experienced by people". For the second stage, participants who reported any hand problems or pain in their hands, hips, knees or feet in the previous 12 months, and also gave permission to be re-contacted were mailed a 'Regional Pains Survey' questionnaire that collected information on the four selected body regions (hands, hips, knees and feet). At each stage non-responders were sent a postcard reminder after 2 weeks and a further questionnaire at four weeks. The same administration procedure was followed at baseline (2002), three year (2005) and six year (2008) follow-up. Details (name, date of birth, NHS number) of those found to have departed from the practice were sent to the NHS tracing system to establish either current contact details or that the participant had died. On receiving completed questionnaires responses were recorded by administrative staff. Respondent's date of birth and gender were checked against those from the surgery records to ensure replies were from the intended respondent. Unusual data values were identified during data cleaning and checked against the corresponding questionnaire.

At baseline, all participants who consented to their GP records being accessed had their computerised medical records tagged by a member of the Centre's Health Informatics Specialist team. All consultations for the 12 months before recruitment and for six years following recruitment were identified. All general practice staff entered a READ code for each patient contact (NHS Digital, 2017). READ codes are widely used in the UK National Health Service and can be mapped to the International Classification of Diseases. The practices underwent annual audits completed by the Centre's Health Informatics team to assess the quality and completeness of data entry at the practices. The practice information provided all consultations, medications and referrals. All sensitive data (name, contact details) was removed and consultation data was linked with survey data through the unique survey identifier.

The North Staffordshire Local Research Ethics Committee granted approval and all participants gave written consent to participate.

2.4. Variables included in this study

2.4.1. Key exposure: Pain

In this analysis pain was considered as the key exposure and was measured using a single item and manikin. The single item was "In the past 4 weeks have you had pain that lasted for one day or longer in any part of your body?” (Yes/no). Those answering ‘yes’ were asked to shade their painful areas on a full body manikin (front and back views). The manikin was separated into 44 mutually exclusive areas, and these were recorded using a standard transparent template marked with borders, a method shown to be repeatable (Lewis *et al.,* 2002). These methods to determine the location and extent of pain are commonly used in population-based studies of pain, and have been shown to be valid and reliable (Margolis *et al.,* 1988 & Lacey *et al.,* 2005).

For this study on the basis of their reports of pain, participants were classified into 1 of 3 groups (no/some/widespread pain). The widespread pain group (WP) comprised participants that indicated pain in body areas above and below the waist, in the right and left-hand sides of the body, and in the axial skeleton; this met the criteria for WP outlined by the American College of Rheumatology (Wolfe *et al.,* 1990). Those participants who reported pain that did not satisfy the criteria for WP were classified as having some pain, and those who did not report pain were classified as having no pain.

2.4.2. Outcome: Healthy Aging Index (HAI) - development and validity

Healthy ageing is the outcome of interest in the empirical analysis. As discussed in Chapter 1 healthy ageing has been defined in various ways. Biomedical models emphasise the absence of disease and maintenance of physical and mental functioning, the psychosocial models focus on life satisfaction and social participation, whereas lay models emphasize accomplishments and contributions to life. Models combining these three approaches are more effective at predicting poor outcomes than one-dimensional approaches that were proposed to evaluate independence in older adults (Bowling & Iliffe, 2006). The main constituents of the various approaches are health, psychological factors, social roles and activities, finances, social relationships and neighbourhood factors (Bowling & Dieppe, 2005).

NorStOP measured the long-term prognosis of musculoskeletal pain in older people (Thomas *et al.,* 2004) and captured multiple constructs associated with ageing; this allowed the construct of healthy ageing to be operationalised with a total of 33 variables, that were linked to age related decline included in a healthy ageing index (HAI) (Wilkie *et al.,* 2013). These variables produced an index of the maintenance and continued achievement of these different aspects, and the index was constructed using methods previously successfully employed in biomedical models of frailty capturing the rate of deficit accumulation (Rockwood K & Mitnitski, 2007; Rockwood K, Rockwood MR & Mitnitski, 2010).

2.4.2.1. Measurement model of the HAI

The score range of individual variables ranged from 0 to 1. The HAI index score was a simple count of all variables and ranged from 0 to 33. The participants total score was expressed as a healthy ageing index by dividing the total score by the maximum score (i.e. 33) and expressed on a scale from 0 to 100 (this was similar to the method employed by Rockwood *et al.,* 2007 & 2010). Higher scores indicated healthier ageing and were calculated for each participant at baseline, 3 and 6 years.

Table b: Healthy ageing index constituent variables

Domain of healthy ageing	Variables	Score (0-1)
Physical function	Limitation in vigorous activities Limitation in moderate activities Limitation in lifting or carrying groceries Limitation climbing one flight of stairs Limitation bending, kneeling or stooping Limitation walking half a mile Limitation bathing and dressing	For each item: 1 – no limitation 0.5 – limited a little 1 – limited a lot
Biomedical	Self-rating of health	1 – excellent, 0.75 – very good, 0.5 – good, 0.25 – fair, 0 - poor
	Unhealthy weight	1 = normal weight (BMI 20 – 24.9), 0.5 = overweight (25 – 29.9), 0 = underweight (<20) or obese (≥30)
	Chest problems Heart problems Diabetes Deafness Problems with eyesight Raised blood pressure Suffered a fall Dizziness or unsteadiness Weakness in an arm or leg	For each item: 1 – absent 0 – present
	Cognitive impairment	1 – not impaired 0 – impaired
Psychological	Anxiety	1 – non-case, 0.5 – possible, 0 - probable
	Depression	1 – non-case, 0.5 – possible, 0 - probable
	Sleep problems	1 – no sleep problems, 0 – any sleep problem
Lay	Accomplishment of daily activities	1 – no limitation in accomplishing daily tasks, 0 – not accomplishing daily tasks
	Feeling of calm and peace Feeling of having a lot of energy	For each item: 1 – all the time, 0.8 – most of the time, 0.6 – a good bit of the time, 0.4 – some of the time, 0.2 – a little bit of the time, 0 – none of the time
	Financial strain	1 - manage/comfortable, 0 – strain/have difficulty
Perceived social participation	Restrictions in mobility within home Restrictions in mobility out of the home Restrictions in self-care Restrictions looking after the home Restrictions looking after belongings Restrictions communicating with others Restrictions in social activities	For each item: 1 – not restricted 0 – restricted

At each time point the healthy ageing index score ranges from 0 to 100; higher scores indicate a greater level of “healthy ageing”. The formula to calculate the score at each time point is: (total score/33)*100 (Wilkie *et al.,* 2013).

2.4.2.2. Assessment tools used for constituent variables of HAI

2.4.2.2.1. Physical function

The HAI included seven items from the physical function scale (PF-10) of the Medical Outcomes Survey Short Form 36 (SF-36) (Ware & Sherbourne, 1992). The SF-36 is a multi-purpose, short-form health survey with 36 questions, and is a generic measure, as opposed to one that targets a specific age, disease, or treatment group. The SF-36 has proven useful in surveys of general and specific populations, comparing the relative burden of diseases, and in differentiating the health benefits produced by a wide range of different treatments (McHorney *et al.,* 1993). The SF-36 has been found to be a valid measure of generic HRQOL in musculoskeletal disorders (Hagen *et al.,* 1999), and the PF-10 has good content validity as a measure of physical functioning (Haley *et al.,* 1994).

2.4.2.2.2. Biomedical

The HAI included 12 items in its biomedical domain. This included respondent self-rating of health using a single question from the Medical Outcomes Short Form – 12 (MOS SF-12) (Ware *et al.,* 1996). Respondents were asked to self rate their health and scored as follows, 1 – excellent, 0.75 – very good, 0.5 – good, 0.25 – fair, 0 – poor. The SF-12 reproduces the eight-scale profile with fewer levels than SF-36 scales and yields less precise scores, as would be expected for single-item and two-item scales. For large group studies, these differences are not as important, because confidence intervals for group averages in health scores are largely determined by sample size. Extensive psychometric testing has determined the SF-12's validity as a measure of general health and it demonstrates suitable test-retest reliability, internal consistency and discriminatory power (Ware *et al.,* 1996).

The remainder of the biomedical domain is composed of self-report data regarding their height and weight, as well as medical problems. Body mass index (BMI) was calculated from the participants' reported height and weight. Based on these calculations, participants scored 1 if they had a normal weight (BMI 20 – 24.9 kg/m^2), 0.5 if they were overweight (BMI 25 – 29.9 kg/m^2), or 0 if underweight (BMI <20 kg/m^2) or obese (BMI ≥30 kg/m2)

Comorbidity was defined using self-report of health conditions and impairments. Self-report data was used because it reflects an individual's perception of how he or she appraises the presence of morbidities and how he or she may relate to the use of health and social care. Participants were asked to report the presence of three common chronic health conditions in older adults (chest problems, heart problems, diabetes) and six impairments commonly associated with disability (deafness, problems with eyesight, raised blood pressure, suffered a fall, dizziness or unsteadiness, weakness in an arm or leg). The reports were scored for each item, 1 if absent, 0 if present. Cognitive impairment was assessed using the Functional Limitations Profile (FLP) alertness sub-scale score (Patrick & Peach, 1989) a British version of the Sickness Impact Profile (Bergner *et al.,* 1981). Respondents answered ten yes or no questions. These included; I am confused and start to do more than one thing at a time, I have more minor accidents than usual, I react slowly to things that are said or done, I do not finish things

I start, I have difficulty reasoning and solving problems, I sometimes get confused, I forget a lot, I do not keep my attention on any activity for long, I make mistakes more than usual, I have difficulty doing things which involve thought and concentration. Responders' reports were scored 1 if not impaired, 0 if impaired. There is no validity work on this. The points awarded to these self-reports account for only 10 of a total of 33 making up the HAI, but given that they are self-reports they are potentially inaccurate and susceptible to measurement error. However, the self-report of impairments and functional problems (e.g. falls) has been demonstrated to be accurate in older people (Hauer *et al.,* 2006, Thinggaard *et al.,* 2010)

2.4.2.2.3. Psychological domain

The psychological domain included measurements of anxiety, depression and sleep problems. Levels of anxiety and depression were measured using the Hospital Anxiety and Depression (HAD) scale (Zigmond & Snaith, 1983). The HAD scale was originally designed for use in a hospital setting but is commonly used in population-based studies to assess the extent of an individual's symptoms of depression and anxiety. It consists of 14 items scored on a Likert scale of 0–3. Seven items address symptoms of anxiety and give a total score of 0–21, and 7 items address symptoms of depression, giving a total score of 0–21. For both scales, scores of 0–7 were classified as a non-case (1 score for the HAI), scores of 8–10 were classified as a possible case (0.5 score for the HAI), and scores ≥11 were classified as a definite case (0 point for the HAI).

The 4-item Estimation of Sleep Problems Scale (Jenkins *et al.,* 1988) was used to examine sleep problems. The scale asks about recent problems with sleep and contains items related to the most commonly occurring symptoms of poor sleep quality, including the following items: sleep onset (“during the past four weeks did you have trouble falling asleep?”), sleep maintenance (“during the past four weeks did you wake up several times per night?”), early wakening (“during the past four weeks did you have trouble staying asleep, including waking up far too early?”), and non-restorative sleep (“during the past four weeks did you wake up after your usual amount of sleep feeling tired and worn out?”). Participants were scored either 0 for no sleep problems or 1 for any sleep problem indicated on any of the four items.

2.4.2.2.4. Lay domain

The lay domain included measurements of accomplishment of daily activities, feeling of calm and peace and having a lot of energy and financial strain. The accomplishment of daily activities was assessed using two items from the SF-12 (one due to physical problems and another due to emotional problems). Feeling calm and peaceful and the feeling of having a lot of energy were also SF-12 items. The SF-12 has been used before in population studies of pain (Carmona *et al.,* 2001). Accomplishment of daily activities was scored as either 1 no limitation in accomplishing daily tasks, or 0 not accomplishing daily tasks. Feeling calm and peaceful and feeling of having a lot of energy were scored respectively; 1 all the time, 0.8 most of the time, 0.6 a good bit of the time, 0.4 some of the time, 0.2 a little bit of the time or 0 none of the time.

Financial strain was assessed using a single item in the health survey. Respondents were asked, “Thinking about the cost of living as it affects you, which of these description best describes your situation: find it a strain to get by from week to week, have to be careful with money, able to manage without much difficulty, quite comfortably off”. Respondents were scored as 1 manage/comfortable if responding to either of the latter two statements, or 0 strain/have difficulty if answering either of the first two. Financial strain was assessed using a single item in the health survey (using multiple items to measure a construct in general improves the reliability or precision of the measurement), so may not be accurate, (no evidence of reliability or validity) but only one point applied.

2.4.2.2.5. Social participation

Social participation was assessed using single items from the Keele Assessment of Participation (KAP) (Wilkie *et al.,* 2002). This short self-report instrument is designed to measure, from the perspective of the individual, the extent of restriction from participation in 11 aspects of life that comprehensively measure participation in older adults. Items are phrased to capture performance (“I have”) and individual judgment, and the nature and timeliness of participation (“as and when I have wanted”). Responses are indicated on a five point ordinal scale (all/most/some/a little/none of the time). Responders were considered restricted in an aspect of life (score of 0) if they did not participate in it “as and when they wanted” for “all” or “most of the time.” Seven items were included in the index. The reliability and validity of the KAP have been established as adequate for providing estimates of perceived participation restriction in population studies (Wilkie *et al.,* 2005).

2.4.2.3. HAI validity

The construct validity of the healthy ageing index was examined by testing its relationship with mortality. As hypothesised and in support of construct validity, lower index scores were associated with an increased risk of mortality; median baseline healthy ageing index scores for the participants who died during the six year follow up (836 participants) was significantly lower at baseline than for those included in the analysis (n = 2949) (57.7 *cf.* 79.0; p<0.001) (Wilkie *et al.,* 2011).

2.5. Measures of deprivation (and considered as moderators)

A number of measures of deprivation were included assessing area level and individual deprivation as well as quality of and access to care. These were included as moderators.

2.5.1. Measuring deprivation

Objective measures (normally based on census data) may not well characterise the range of neighbourhood domains that are relevant to health (Cummins *et al.,* 2007). Objective measurements consequently may not provide the best assessment of how neighbourhood residents are exposed to, experience or interact with surroundings in ways influencing their health (Weden *et al.,* 2008). Consequently as well as including the area level deprivation (via IMD 2004) in the analysis, further measures of individual level deprivation were also included.

2.5.1.1. Individual level deprivation (ILD)

The two measures of socio-economic status {measured by self-report in the NorStOP baseline questionnaire} (*part 9 about you, Health Survey, Appendix*) were:

1. Occupational class.

   Responders were asked to provide their current or most recent job title. This was then categorised (to provide the socio-economic classification/occupational class) using the 2002 National Statistics Socio-economic Classification (NS-SEC) framework- managerial/professional, intermediate (non-manual)/self-employed and lower supervisory/lower technical/semi-routine/routine occupations (manual) (Office for National Statistics 2002).
2. Educational attainment.

   Respondents were asked if they went on from school to full time education or university. Categorised as school age education or further education.

The baseline NorStOP "Health Survey" questionnaire *(part 6 access, Health Survey, Appendix)* included questions regarding access to material goods and services including:

1. Do you have access to a car when you personally need it? Yes/no.
2. Do you have access to public transport? Yes/no.
3. Do you have access to a telephone? Yes/no.
4. Do you have good access to your doctor (GP), as and when you need it? Yes/no.
5. Do you have access to a chemist? Yes/no.
6. Do you have access to a bank? Yes/no.
7. Do you have access to advice or help with your income (for example relatives or the benefits system)? Yes/no
8. If you wanted to take part in an education course, is there the opportunity? Yes/no.
9. If you wanted to do paid or voluntary work, is there the opportunity? Yes/no

2.5.1.2. Area level deprivation (ALD)

ALD will be measured using the English Index of Multiple Deprivation 2004 scores. Place of residence (via postcode) can be utilised as a sensitive measure of potential inequality and need, especially if combined with other measures of socioeconomic or demographic status (Carr-Hill & Chalmers-Dixon, 2005). The English Index of Multiple Deprivation 2004 (IMD) measures levels of deprivation in small geographical areas of England, known as super output areas (LSOAs); each LSOA is ranked with 1 being the most deprived. The model of multiple deprivation that underpins the IMD 2004 is based on the idea of distinct dimensions of deprivation that can be recognised and measured separately. The overall IMD is a weighted aggregation of the seven domains:

1. Income deprivation (22.5%)
2. Employment deprivation (22.5%)
3. Health deprivation and disability (13.5%)
4. Education, skills and training deprivation (13.5%)
5. Barriers to housing and services (9.3%)
6. Living environment deprivation (9.3%)
7. Crime (9.3%)

Each domain contains a number of indicators. The criteria for inclusion includes that they are ‘domain specific’ and appropriate for the purpose (as directly as possible measuring that form of deprivation), measuring major features of that deprivation (not conditions experienced by a small number of people or areas), up to date, capable of being updated regularly, statistically robust, and available for the whole of England at a small areas level in consistent form.

2.5.2.2.1. Income Deprivation Domain

This domain aims to capture the proportion of the population experiencing income deprivation in an area. It is composed of adults and children in Income Support households (2001), adults and children in Income Based Job Seekers Allowance households (2001), adults and children in Working Families Tax Credit Households whose equivalent income (excluding housing benefits) is below 60% of the median before housing costs (2001), national asylum support service supported asylum seekers in England in receipt of subsistence only and accommodation support (2002).

2.5.2.2.2. Employment Deprivation Domain

Measures employment deprivation conceptualised as involuntary exclusion of the working age population from the world of work. Includes unemployment claimant count of women aged 18-59 and men aged 18-64 averaged over 4 quarters (2001), Incapacity Benefit claimants women aged 18-59 and men aged 18-64, Severe Disablement Allowance claimants aged 18-59 and men aged 18-64 (2001), participants in New Deal for the 18-24s who are not included in the claimant count (2001), participants in New Deal for 25+ who are not included in the claimant count (2001), participants in New Deal for Lone Parents aged 18 and over (2001).

2.5.2.2.3. Health Deprivation and Disability Domain

This domain describes areas with higher rates of people who die prematurely or whose quality of life is impaired by poor health or who are disabled, across the whole population. It includes years of potential life lost (1997-2001), Comparative Illness and Disability Ratio (2001), measures of emergency admissions to hospital (1999-2002), and adults under 60 suffering from mood or anxiety disorders (1997-2002).

2.5.2.2.4. Education, Skills and Training Deprivation Domain

Captures extent of deprivation in terms of education, skills and training in a local area. The domain is divided into two sub domains. One relates to education deprivation for children/young people in the area, the other relates to lack of skills and qualifications among the working age adult population. Sub domain children/young people includes average points score of children at Key Stage 2, 3 and 4 (2002), proportion of young people not staying on in school or school level education above 16 years (2001), proportion of those aged under 21 not entering Higher Education (1999-2002), and secondary school absence rate (2001-2002). Sub domain skills includes proportion of working age adults (aged 25-54) in the area with no, or low qualifications (2001).

2.5.2.2.5. Barriers to Housing and Services Domain

Measures barriers to housing and key local services. Contains two sub domains, wider barriers and geographical barriers. Sub domain wider barriers includes household overcrowding (2001), local authority level percentage of households for whom a decision on their application for assistance under the homeless provisions of housing legislation has been made, assigned to SOAs, difficulty of access to owner occupation (2002). Sub domain: geographical barriers includes road distance to GP premises (2003), road distance to supermarket or convenience store (2002), road distance to primary school (2001-2002), and road distance to Post Office (2003).

2.5.2.2.6. Crime Domain

This domain measures the incidence of recorded crime for four major crime themes representing the occurrence of personal and material victimisation at a small area level. These include burglary, theft, criminal damage and violence between April 2002 and March 2003.

2.5.2.2.7. The Living Environment Deprivation Domain

Focuses on deprivation with respect to characteristics of the living environment. Includes two sub domains**.** The indoor living environment assesses social and private housing in poor condition and houses without central heating (2001). The outdoor living environment includes air quality and road traffic accidents involving injury to pedestrians and cyclists (2000-2002).

In these analyses, indicator data from 2001 was used to link with the baseline data collection (2002). The IMD ranks were split into quintiles of neighbourhood deprivation (quintile 1 having the lowest level of neighbourhood deprivation and 5 the highest) (Barnett *et al.,* 2012; Hayward *et al.,* 2013; Jordan *et al.,* 2013).

2.6. Access to care and quality of care

Access to care and quality of care were included in the analyses as potential moderators (and considered as measures of deprivation); the hypothesis being that the association between pain and healthy ageing differs by strata of access to care and quality of care. Longitudinal studies should capture both objective and subjective area measurements in order to identify potential causal pathways between variables (Bowling, Stafford 2007). Access to care was measured subjectively using the General Practice Patient Survey and quality was measured objectively using the Quality Outcomes Framework.

2.6.1. Access to care

The National Survey of NHS Patients programme consists of a series of surveys designed to contribute to monitoring the performance of the NHS, as seen from the patients' perspective. The 1998 General Practice survey was the first in this series. It covered a wide range of issues, including access and waiting times, complaints, patient-GP communication, patients' views of GPs and practice nurses in terms of knowledge, skills, courtesy and the quality and range of services such as out-of-hours care and hospital referrals available to patients (Airey, Erens 1999). Unfortunately, the 1998 survey and subsequent 2002 General Practice Survey did not link respondents replies regarding the quality of GP care to individual practices. The primary aim of the surveys was to provide comparative data across different localities (in 1998 Health Authorities; in 2002 Primary Care Organisations). At no point in the questionnaire was the respondent asked to identify the GP with whom (s)he was registered (Department of Health 2003b), consequently the data could not be used.

The Healthcare Commission conducted further surveys of General Practice in 2003 (Healthcare Commission 2003), 2004 (Chisholm, Reeves *et al.,* 2004), 2005 (Healthcare Commission 2005) and 2008 (The Healthcare Commission 2008), again, unfortunately none provided practice level data. The first survey to provide practice level data was the 2006 GP patient survey. The current GP patient survey is conducted by Ipsos MORI. It assesses patients' experiences of the access and quality of care they receive from their local GPs, dentists and out-of-hours doctor services. People are eligible for the survey if they are aged 16 or over and registered with a GP. The survey included three sections, section a included ten questions about getting to see a doctor, section b included two questions about referrals to hospital and section c included twelve questions about the respondent *(The GP Patient Survey questionnaire 2008, appendix)*.

The 6 practices in our study were ranked in comparison to each other based on their results for 5 questions selected from section a (getting to see the doctor) of the GPPS from 2007/2008 based on their relevance to being able to access GP care (The GP Patient Survey, 2008). For each question the practices were ranked 1-6, one corresponding to the best or highest score with stepwise reductions to sixth place for the lowest or worse score. Each of the practice' ranks for individual questions was then summed. Each practice was then given an overall rank based on the totals. This was done to prevent a particularly high or low percentage score for one question disproportionately influencing the overall access score for the practice *(GPPS table appendix)*.

The five GPPS questions used in this study were {chosen as they best satisfied our chosen definition of access, Levesque *et al.,* (2013), section 1.6.7.1.}:

1. Question 2. In general, are you satisfied with how easy it is to get through to someone on the phone at your doctor's surgery? Yes/no.
2. Question 4. Think about the last time you tried to get an appointment with a doctor fairly quickly. Were you able to get the appointment on the same day or on the next 2 days the surgery was open? Yes/no.
3. Question 6. Last time you wanted to, were you able to get an appointment with a doctor more than 2 full days in advance? Yes/no
4. Question 8. Last time you wanted to, were you able to make an appointment with a particular doctor – even if it meant waiting longer? Yes/no
5. Question 9. Over the last 6 months or so, were you satisfied with the hours your GP surgery was open? Yes/no

The GPPS questions from section a not used were:

- Question 1. When was the last time you saw a doctor at your surgery? Less than 3 months ago/between 3 and 6 months ago/more than 6 months ago.
- Question 3. In the last 6 months, have you tried to get an appointment with a doctor fairly quickly about any matter? Yes/no.
- Question 5. In the last 6 months, have you wanted to book ahead for an appointment with a doctor? Yes/no.

- Question 7. In the last 6 months, have you ever wanted to make an appointment with a particular doctor at your GP surgery? Yes/no.
- Question 10. I was dissatisfied because the surgery was not open; early enough in the morning/around lunchtime/late enough in the evening/on a Saturday/on a Sunday/some other reason.

2.6.2. Quality of care

From 2004 a new system of reimbursement linked to performance indicators (the ‘Quality and Outcomes Framework’ or QOF) provided new measures of primary care (Department of Health, 2003a). The quality variable was taken from the Quality and Outcomes Framework 2005/06 (QOF) (The Information Centre, 2006). The QOF 2005/06 contained four main components, known as domains. Each domain consisted of a set of measures of achievement, known as indicators, against which practices scored points according to their level of achievement:

- Clinical domain: 76 indicators in 11 areas (coronary heart disease, left ventricular dysfunction, stroke and transient ischaemic attack, hypertension, diabetes mellitus, chronic obstructive pulmonary disease, epilepsy, hypothyroidism, cancer, mental health and asthma). Indicators in the clinical domain were worth up to a maximum of 550 points (52.4% of the total).
- Organisational domain: 56 indicators in 5 areas (records and information, patient communication, education and training, medicines management, clinical

and practice management). Indicators in the organisational domain were worth up to 184 points (17.5% of the total).

- Patient experience domain: 4 indicators in 2 areas (patient survey and consultation length), worth up to 100 points (9.5% of the total).
- Additional services domain: 10 indicators in 4 areas (cervical screening, child health surveillance, maternity services and contraceptive services), worth up to 36 points (3.4% of the total).

The QOF also rewarded practices against three depth of quality measures. A holistic care payment measured achievement across the clinical domain and was worth up to 100 points (9.5% of the total). A quality practice payment measured overall achievement in the organisational, patient experience and additional services domains and was worth up to 30 points (2.9% of the total). A target level of achievement on patient access to clinical care (access bonus) was rewarded with 50 points (4.8% of the total). The maximum number of QOF points available for a practice was therefore 1,050 (The Information Centre, 2006).

The 6 practices were ranked on their overall QOF achievement for 2005/06 *(QOF score table appendix)*.

2.7. Putative confounders

Confounding refers to a non-causal association between an exposure (pain) and outcome (healthy ageing score) being observed due to the influence of a third variable (or group of variables). This can result in the appearance or strengthening of an association not due to direct causal effect or in the apparent absence or weakening of a true causal association (Szklo & Nieto, 2014: 153). Each model (statistical analysis is outlined later in this chapter) was adjusted for putative confounders. Putative confounders included in this study were:

- Demographic factors {age, sex, social networks [Berkman-Syme Social Network Index, provides data on 4 levels of social connection, 'Most integrated' to 'Most isolated'. Presence and frequency of contact with confidante, "Is there any one special person you know that you feel very close to; someone you can share confidences and feelings with? Score range 0-4, categorised as high/medium, score 3 to 4, or low, score 0 to 2 (Berkman & Syme, 1979)] and educational attainment (completed high school only or went on to further education)}.
- Behavioural factors {smoking status (never/previous/current), frequency of alcohol consumption (monthly or weekly, never or yearly/daily), physical inactivity (two items: frequency of going to activities outside the home and frequency of going for a walk for at least ten to fifteen minutes (both categorised as daily, every other day, twice per week, less than twice per week, not at all)}, and
- Clinical factors {diagnosed musculoskeletal disorders and medication use identified by Read code in the primary care medical records (i.e. osteoarthritis and inflammatory arthropathies) (NHS Information Authority, 2000)}. Pain analgesia was identified in the medical records and categorised using a validated model based on the strongest prescribed analgesia during the six year period, namely none, basic (e.g. paracetamol), weak, moderate, strong, very strong (e.g. morphine) (Bedson *et al.,* 2010). The prescription of non-steroidal anti-

inflammatory drugs was recorded (prescribed/not prescribed). The consultation data has shown to provide accurate measurement of morbidity and prescribed medication (Porcheret *et al.,* 2004).

2.8. Sample derivation and participant flow

All adults aged 50 years and over registered with the six general practices (n=19818) were mailed the health survey questionnaire at baseline. 13986 (71%) responded, of which 9611 consented to medical record review and follow up. During the first 3 year follow-up period 535 (5.6%) died. A further 198 (2%) were excluded (in line with the exclusion criteria described above) or no longer at their mailing address. 8878 were mailed another survey at three years. 7230 (81.4%) responded. 999 (13.8%) declined further contact. 301 (4.2%) died between 3 and 6-year follow up. 157 (2.2%) excluded pre-mailing by their GP. 5773 were mailed at 6 years. 964 (16.7%) did not respond. 53 (0.9%) were excluded during mailing. 4756 (82.4%) responded at 6 years. 1807 (37.9%) had missing index data. 2949 had complete index data at all three time points across the 6 years *(figure 8, flow diagram of participants, appendix)*.

Table c. Characteristics of those included in the analysis, those who withdrew or had incomplete data and those who died during the 6 year study period.

	Overall (n = 2949)	Withdrawn or incomplete data (n = 5826)	Died (n = 836)	p - value
Age (years) *	61.7 (0.25)	64.3 (0.51)	73.9 (0.25)	< 0.001
Healthy Ageing Index score *	78.97 (0.38)	70.3 (0.39)	55.9 (0.38)	< 0.001
Gender (Male)	1334 (45.3%)	2612 (44.8%)	486 (58.1%)	< 0.001
Education (Further Education)	478 (16.4%)	661 (11.7%)	67 (8.3%)	< 0.001
Physical health *	47.7 (0.38)	42.0 (0.38)	30.9 (0.57)	< 0.001
Mental health *	55.1 (0.20)	55.2 (0.88)	47.3 (0.29)	< 0.001
Cognitive impairment	1154 (39.1%)	2894 (49.7%)	517 (61.8%)	< 0.001
Depression	422 (14.3%)	1398 (24.0%)	293 (34.8%)	< 0.001

All values are n (%) except * which are median (standard error).
Kruskal Wallis test for age and index, chi square for gender and education.
(Wilkie *et al.,* 2013).

With reference to non-response and attrition, compared to those who had moved address, withdrew from the study or had incomplete data (n=5826), those included in the analysis were younger (mean age: 64.3 *cf.* 61.7; p <0.001), more likely to have gone on to further education (9.8% *cf.* 11.7%; p <0.001), have better mental and physical health-related quality of life scores (Mean SF-12 mental component: 55.1 *cf.* 52.2; p <0.001) and physical component (Mean SF-12 physical health scores: 47.7 *cf.* 42.0; p <0.001), have higher baseline index scores indicating more healthy ageing (74.6 *cf.* 78.5; p <0.001) and lower levels of cognitive impairment (49.7% *cf.* 39.1%; p <0.001) and depression (possible/probable cases of depression: 24.0% *cf.* 14.3%; p <0.001) *(Table c)*. However there was no difference for gender (male: 45.3% *cf.* 44.8%; p=0.72) or in the relationship between widespread pain and healthy ageing index score at baseline (i.e. proportional difference (i.e. the proportion (%) that the healthy ageing index score is higher in those with widespread pain compared to those with no pain): 126% (116%, 138%) in the attrition group *cf.* 127% (114%, 141%) in the analysed sample). Those who died after baseline (n=836) had significantly lower baseline index scores (57.7; p<0.001); were older (mean age 73.9 years), had lower levels of health (Mean SF-12 mental health component: 47.3; Mean SF-12 physical health component: 30.9), higher levels of cognitive impairment (61.8%) and depression (34.8%) and a weaker relationship between widespread pain and health ageing (proportional difference: 87% (68%, 108%)) compared to those included in the analysis (Wilkie *et al.,* 2013). See characteristics of questionnaire respondents and non-respondents table in appendix for further analysis by ILD, ALD, ATC and QOC variables.

2.9. Statistical analysis

2.9.1. Stage 1: Description of participant characteristics

The distribution of the healthy ageing index score had moderate skewness and kurtosis (baseline index: skewness 1.09; kurtosis 4.01) and for analysis was log transformed with the log of the index used as the outcome in the analyses.

2.9.1.1. Description of participants' individual level socio-demographic characteristics at baseline overall and stratified by baseline pain status

The participants' baseline individual level socio-demographic characteristics were described overall and stratified by baseline pain status. Differences in age, healthy ageing index score, marital status, social networks and frequency of contact with confidante between the groups were tested using Kruskal Wallis test. Differences in gender, living arrangements and presence of confidant were tested using Chi-square test.

2.9.1.2. Description of participants' deprivation characteristics at baseline overall and stratified by baseline pain status

The participants' baseline deprivation characteristics were described overall and stratified by baseline pain status. Differences in participants individual level deprivation (occupational class, education, access to car, access to public transport, access to telephone, access to GP, access to chemist, access to help with income and access to work were tested using Chi-square test. Differences in participants overall area level deprivation, ranked access to care and ranked quality of care at baseline, overall and stratified by baseline pain status were tested using Kruskal Wallis.

2.9.1.3. Description of healthy ageing index scores overall and stratified by pain, deprivation, access and quality of care at baseline

Median healthy ageing index scores at baseline overall and stratified by baseline pain status were calculated. Median healthy ageing index scores at baseline were stratified by individual level deprivation and area level deprivation variables, as well as practice ranked access to care and quality of care variables at baseline.

2.9.2. Stage 2: Analysis of the relationship between deprivation, access to care and quality of care upon healthy ageing at baseline

Linear regression models tested cross-sectional associations between baseline pain status and healthy ageing index scores at baseline, first of all in univariate analysis and then in multivariate analysis adjusting for age (continuous variable), gender (reference: male), social networks (reference: high), smoking status (reference: non-smoker), alcohol consumption (reference: no alcohol), social and physical inactivity (reference: daily physical activity), use of non steroidal anti-inflammatory drugs (reference: no prescriptions for NSAIDs), use of pain analgesia (reference: no prescriptions for pain analgesia) and diagnosis of chronic musculoskeletal condition (reference: no diagnosis). Results were expressed as beta coefficients (β) with 95% confidence intervals (CI) and transformed to percentage change (100* (exp(β) -1)) to facilitate interpretation.

The same methodology was applied to examine for cross sectional associations between individual level deprivation variables, area level deprivation variables, ranked practice access to care and ranked practice quality of care upon healthy ageing at baseline.

To determine if there was an interaction between pain and deprivation, an interaction term between pain and each deprivation variable was entered into the multivariate model separately (i.e. the association between each interaction and healthy ageing index score was adjusted for age, gender, social networks, smoking status, alcohol consumption, social and physical inactivity, use of non steroidal anti-inflammatory drugs, use of pain analgesia and diagnosis of chronic musculoskeletal condition).

2.9.3. Stage 3: Analysis of the relationship between deprivation, access to care and quality of care upon healthy ageing across 6 years

A mixed modelling regression approach was used to analyse the longitudinal data of this study (Singer & Willet, 2003). This strategy accounts for within participant correlation and between participant variations in healthy ageing index scores and takes into account the correlation between measurements of the same participant (Singer & Willett, 2003). First, the mean percentage change in healthy ageing index score associated with time was estimated. Then in the univariate analysis, pain and each deprivation variable was entered into the model separately; pain status was entered into the model as a time-varying variable (i.e. over the follow up period participants can move between pain states), baseline status was entered for all deprivation variables. The mean percentage change in healthy ageing index score associated with the onset of pain was then estimated using published methods (Singer & Willet, 2003). For example, the mean percentage change in healthy ageing index score among participants with no pain at baseline who reported widespread pain at follow up = time + (mean percentage change for widespread pain – mean percentage change for no pain). These mean percentage changes were then adjusted for potential confounders: socio-demographic, behavioural factors, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnoses of chronic musculoskeletal conditions.

The same methodology was applied to describe the mean percentage change in healthy ageing index score associated with the individual level deprivation variables, area level deprivation variables, practice ranked access to care and practice ranked quality of care variables and healthy ageing across 6 years.

To determine if there was an interaction between pain and deprivation, an interaction term between pain and each deprivation variable was entered into the multivariate model separately (i.e. the association between each interaction and healthy ageing index score was adjusted for age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs and diagnosis of chronic musculoskeletal conditions).

2.9.4. Model goodness of fit

Model goodness of fit for the cross sectional analysis was assessed using R-squared values (quote modified R-squared). In general, a model fits the data well if the differences between the observed values and the model's predicted values are small and unbiased (Dytham, 1999). R-squared is a statistical measure of how close the data are to the fitted regression line, it is the percentage of the response variable variation that is explained by a linear model. In general, the higher the R-squared, the better the model fits the data. It provides an estimate of the relationship between the model and the response variable (Dytham, 1999).

Model goodness of fit for the longitudinal analysis was assessed using Akaike Information Criteria (AIC), with lower values indicating improved model fit and greater likelihood of a model to predict/estimate the future values. This was done to assess if model fit improved with adjustment, a good model is the one that has the minimum AIC amongst the other models, although it is not a measure of absolute quality, it will merely indicate the best of the compared models (Burnham & Anderson, 2002).

All analyses were conducted using Intercooled Stata version 9.2 (StataCorp, College Station TX).

3. Results

3.1. Sample characteristics

2949 participants completed questionnaires at baseline, three and 6 years. At baseline, median age was 61.7 (IQR 7.95 years), 54.76% were women, 17.69% lived alone and 74.56% were married. 57.70% had medium or low social networks, 7.43% had no confidant and 59.28% had daily contact with a confidante *(Table 1)*.

Table 1. Participants socio-demographic characteristics at baseline overall and stratified by baseline pain status (n=2949)

	Overall (n =2949)	No pain (n = 873)	Some pain (n = 1296)	Widespread pain (n = 780)	p - value
Median age in years[K] (IQR)	61.72 (7.95)	61.94 (8.17)	61.91 (7.97)	61.30 (7.65)	0.17
Healthy Ageing Index score[K] (SD)	75.39 (15.40)	83.89 (10.45)	75.85 (13.54)	65.11 (16.83)	0.0001
Gender[C]					
Male	1,334 (45.24%)	419 (48%)	611 (47.15%)	304 (38.97%)	<0.001
Female	1,615 (54.76%)	454 (52%)	685 (52.85%)	476 (61.03%)	
Living arrangements[C]					
Alone	509 (17.69%)	152 (17.92%)	216 (17.05%)	141 (18.50%)	0.692
Not living alone	2,368 (82.31%)	696 (82.08%)	1,051 (82.95%)	621 (81.50%)	
Marital status[C]					
Married	2192 (74.56%)	652 (75.12%)	968 (74.75%)	572 (73.62%)	0.007
Separated	28 (0.95%)	6 (0.69%)	16 (1.24%)	6 (0.77%)	
Divorced	192 (6.53%)	52 (5.99%)	81 (6.25%)	59 (7.59%)	
Widowed	320 (10.88%)	78 (8.99%)	144 (11.12%)	98 (12.61%)	
Cohabiting	61 (2.07%)	16 (1.84%)	29 (2.24%)	16 (2.06%)	
Single	147 (5.00%)	64 (7.37%)	57 (4.40%)	26 (3.35%)	
Social networks[K]					

Socially integrated	694 (27.98%)	194 (26.98%)	312 (28.60%)	188 (28.06%)	0.5383
Moderately integrated	355 (14.31%)	108 (15.02%)	159 (14.57%)	88 (13.13%)	
Moderately isolated	993 (40.04%)	289 (40.19%)	440 (40.33%)	264 (39.40%)	
Socially isolated	438 (17.66%)	128 (17.80%)	180 (16.50%)	130 (19.40%)	
Presence of confidant ^{C}					
Yes	2,702 (92.57%)	796 (92.24%)	1,192 (92.98%)	714 (92.25%)	0.752
No	217 (7.43%)	67 (7.76%)	90 (7.02%)	60 (7.75%)	
Frequency of contact with confidante ^{K}					
Daily	1,606 (59.28%)	462 (58.04%)	724 (60.64%)	420 (58.41%)	0.464
Weekly	891 (32.89%)	264 (33.17%)	383 (32.08%)	244 (33.94%)	
Monthly	125 (4.61%)	36 (4.52%)	57 (4.77%)	32 (4.45%)	
Few times a year	70 (2.58%)	27 (3.39%)	25 (2.09%)	18 (2.50%)	
Less than once a year	17 (0.63%)	7 (0.88%)	5 (0.42%)	5 (0.70%)	

^{K} Kruskal Wallis test
^{C} Chi square test

3.1.2. Socio-economic status at baseline

3.1.2.1. Individual level deprivation

47.04% were classified as lower supervisory or routine occupational class, 83.64% had school education only, 87.64% had access to a car, 95.47% had access to public transport, 99.69% had access to a telephone, 92.70% had access to GP, 99.56% had access to a chemist, 76.57% had access to help with income and 82.09% had access to work *(Table 2)*.

Table 2. Participants individual level deprivation characteristics at baseline overall and stratified by baseline pain status

	Overall (n =2949)	No pain (n = 873)	Some pain (n = 1296)	Widespread pain (n = 780)	p - value
Occupational class {NS-SEC (ONS, 2002)} ^{C}					
Managerial or professional	735 (25.86%)	249 (29.33%)	310 (24.94%)	176 (23.47%)	0.027
Intermediate or self employed	770 (27.09%)	213 (25.09%)	359 (28.88%)	198 (26.40%)	
Lower supervisory or routine	1,337 (47.04%)	387 (45.58%)	574 (46.18%)	376 (50.13%)	
Education ^{C}					
School age education	2444 (83.64%)	702 (81.34%)	1072 (83.49%)	670 (86.45%)	0.020
Further education	478 (16.36%)	161 (18.66%)	212 (16.51%)	105 (13.55%)	
Access to car ^{C}					
Yes	2560 (87.64%)	769 (89.00%)	1139 (88.85%)	652 (84.13%)	0.002
No	361 (12.36%)	95 (11%)	143 (11.15%)	123 (15.87%)	
Access to public transport ^{C}					
Yes	2782 (95.47%)	836 (96.98%)	1239 (96.72%)	707 (91.70%)	<0.001
No	132 (4.53%)	26 (3.02%)	42 (3.28%)	64 (8.30%)	
Access to telephone ^{C}					
Yes	2913 (99.69%)	861 (99.65%)	1278 (99.69%)	774 (99.74%)	0.948
No	9 (0.31%)	3 (0.35%)	4 (0.31%)	2 (0.26%)	
Access to GP ^{C}					
Yes	2705 (92.70%)	818 (94.79%)	1188 (92.81%)	699 (90.19%)	0.002
No	213 (7.30%)	45 (5.21%)	92 (7.19%)	76 (9.81%)	
Access to chemist ^{C}					
Yes	2909 (99.56%)	862 (99.77%)	1275 (99.45%)	772 (99.48%)	0.529
No	13 (0.44%)	2 (0.23%)	7 (0.55%)	4 (0.52%)	
Access to help with income ^{C}					
Yes	2225 (76.57%)	645 (75.35%)	980 (76.62%)	600 (77.82%)	0.501
No	681 (23.43%)	211 (24.65%)	299 (23.38%)	171 (22.18%)	
Access to work ^{C}					
Yes	2384 (82.09%)	74 (86.73%)	1055 (82.62%)	584 (76.04%)	<0.001
No	520 (17.91%)	114(13.2%)	222 (17.38%)	184 (23.96%)	

^{C} Chi square test

3.1.2.2. Area level deprivation

13.81% were in the most deprived overall area level deprivation quintile *(Table 3)*.

Table 3. Participants overall area level deprivation at baseline, overall and stratified by baseline pain status ^{K}

	Overall (n =2949)	No pain (n = 873)	Some pain (n = 1296)	Widespread pain (n = 780)	p - value
Most deprived	407 (13.81%)	113 (12.94%)	166 (12.81%)	128 (16.43%)	0.0019
Second most deprived	469 (15.91%)	127 (14.55%)	208 (16.05%)	134 (17.20%)	
Mid-deprived	586 (19.88%)	171 (19.59%)	258 (19.91%)	157 (20.15%)	
Second least deprived	694 (23.54%)	213 (24.40%)	296 (22.84%)	185 (23.75%)	
Least deprived	792 (26.87%)	249 (28.52%)	368 (28.40%)	175 (22.46%)	

^{K} Kruskal Wallis test

3.1.2.3. Access to care

26.18% were registered at the practice with the lowest access to care score *(Table 4)*.

Table 4. Participants practice ranked access to care at baseline, overall and stratified by baseline pain status ^{K}

	Overall (n =2949)	No pain (n = 873)	Some pain (n = 1296)	Widespread pain (n = 780)	p - value
Highest	770 (26.11%)	224 (25.66%)	355 (27.39%)	191 (24.49%)	0.0329
Second highest	286 (9.70%)	77 (8.82%)	132 (10.19%)	77 (9.87%)	
Third highest	434 (14.72%)	133 (15.23%)	205 (15.82%)	96 (12.31%)	
Fourth highest	341 (11.56%)	103 (11.80%)	141 (10.88%)	97 (12.44%)	
Fifth highest	346 (11.73%)	108 (12.37%)	148 (11.42%)	90 (11.54%)	
Lowest	772 (26.18%)	228 (26.12%)	315 (24.31%)	229 (29.36%)	

^{K} Kruskal Wallis test

The columns illustrate the number of patients registered at each practice overall and by pain status (the lowest ranked practice by access contributed the most patients to the sample, 772). The percentages are column percentages (illustrating that despite contributing 26.18% of the sample the lowest ranked practice has a disproportionally high amount of patients reporting widespread pain, 29.36%). There is a statistically significant difference between the practices patients pain reporting at baseline (p = 0.0329).

3.1.2.4. Quality of care

26.18% were registered at the practice with the lowest quality of care score *(Table 5).*

Table 5. Participants ranked quality of care at baseline, overall and stratified by baseline pain status ^{K}

	Overall (n =2949)	No pain (n = 873)	Some pain (n = 1296)	Widespread pain (n = 780)	p - value
Highest	286 (9.70%)	77 (8.82%)	132 (10.19%)	77 (9.87%)	0.0709
Second highest	770 (26.11%)	224 (25.66%)	355 (27.39%)	191 (24.49%)	
Third highest	346 (11.73%)	108 (12.37%)	148 (11.42%)	90 (11.54%)	
Fourth highest	434 (14.72%)	133 (15.23%)	205 (15.82%)	96 (12.31%)	
Fifth highest	341 (11.56%)	103 (11.80%)	141 (10.88%)	97 (12.44%)	
Lowest	772 (26.18%)	228 (26.12%)	315 (24.31%)	229 (29.36%)	

^{K} Kruskal Wallis test

3.1.3 Pain status at baseline

A total of 873 (29.6%) subjects had no pain, 1296 had some pain (43.9%) and 780 (26.4%) had widespread pain at baseline.

3.1.3.1. Pain by socio-demographic characteristics at baseline

Women were more likely than men to report widespread pain (61.03% *cf.* 38.97%; p <0.001). Divorced and widowed respondents were more likely to report widespread pain, making up a greater proportion of the total number reporting widespread pain compared to all pain (7.59% *cf.* 6.53% and 12.61% *cf.* 10.88% respectively; p = 0.007).

There was no significant difference in median age between the pain groups (p = 0.17). There was no significant difference in living arrangements (p = 0.692), social networks (p = 0.538), presence of confidant (p = 0.752), or frequency of contact with confidante (p = 0.464) between the pain groups *(Table 1).*

3.1.3.2. Pain by deprivation characteristics at baseline

Generally, participants who experienced or reported greater deprivation reported more extensive pain at baseline.

3.1.3.2.1. Pain by individual level deprivation variables at baseline

A greater proportion of those with widespread pain were categorised as having a lower supervisory or routine occupational history compared to those with no pain (50.13% *cf.* 45.58%; p = 0.027). The same pattern was observed for school age education only (86.45% *cf.* 81.34%; p = 0.020), no access to car (15.87% *cf.* 11%; p = 0.002), no access to public transport (8.30% *cf.* 3.02%; p <0.001), no access to GP (9.81% *cf.* 5.21%; p = 0.002) and no access to work (23.96% *cf.* 13.2%; p < 0.001) *(Table 2).*

Additionally a greater proportion of those with some pain were categorised as having a lower supervisory or routine occupational history compared to those with no pain (46.18% *cf.* 45.58%; p = 0.027). Those with some pain were also more likely to report higher levels of deprivation, compared to no pain, namely; school age education only (83.49% *cf.* 81.34%; p = 0.020), access to car (11.15% *cf.* 11%; p = 0.002), access to public transport (3.28% *cf.* 3.02%; p < 0.001), access to GP (7.19% *cf.* 5.21%; p = 0.002) and access to work (17.38% *cf.* 13.2%; p < 0.001) *(Table 2).* The difference in proportions was noticeably smaller between the some pain and no pain groups, compared to the widespread pain and no pain groups.

Reporting pain did not differ with access to telephone (p = 0.948), access to chemist (p = 0.529) or access to help with income (p = 0.501) *(Table 2).*

3.1.3.2.2. Pain by area level deprivation variables at baseline

A greater proportion of those with widespread pain compared to no pain were in the most deprived quintile (16.43% *cf.* 12.94%; p = 0.0019) *(Table 3).* A similar pattern was seen in the second most deprived (17.20% *cf.* 14.55%; p = 0.0019) and mid-deprived quintiles (20.15% *cf.* 19.59%; p = 0.0019) *(Table 3).*

A greater proportion of those with some pain compared to no pain were in the second most deprived (16.05% *cf.* 14.55%%; p = 0.0019) and mid- deprived (19.91% *cf.* 19.59%; p = 0.0019) quintiles. This relationship between some pain and deprivation was not apparent for the most deprived quintile (12.81% *cf.* 12.94%; p = 0.0019) *(Table 3)*.

3.1.3.2.3. Pain by access to care at baseline

A greater proportion of those with widespread pain compared to no pain were registered at the general practice ranked lowest according to access to care (29.36% *cf.* 26.12%; p = 0.0329) *(Table 4)*.

3.1.3.2.4. Pain by quality of care at baseline

A greater proportion of those with widespread pain compared to no pain were registered at the general practice ranked lowest according to quality of care although it was not significant (29.36% *cf.* 26.12%; p = 0.0709) *(Table 5)*.

3.1.4. Healthy ageing index scores at baseline

3.1.4.1. Healthy ageing index scores overall and stratified by pain at baseline

The median HAI score was 78.97 at baseline (IQR 67.21, 87.06). There was a significant difference in healthy ageing between the pain groups ($p < 0.001$) *(Table 6)*. Those with some and widespread pain had aged less healthily at baseline. Median HAI score for the no pain group at baseline was 87.06 (79.26, 91.03), some pain group 78.90 (68.38, 86.03) and widespread pain group 68.24 (55.00, 78.23).

Table 6. Median healthy ageing index scores at baseline overall and stratified by baseline pain status[K]

	Overall (n = 2949)	No pain (n = 873)	Some pain (n = 1296)	Widespread pain (n = 780)	p - value
Median healthy ageing index score (IQR)	78.97 (67.21, 87.06)*	87.06 (79.26, 91.03)	78.90 (68.38, 86.03)	68.24 (55.00, 78.23)	<0.001

* Inter Quartile Range. [K] Kruskal Wallis test.

3.1.4.2. Healthy ageing index scores stratified by deprivation variables at baseline

Those experiencing greater deprivation had aged less healthily at baseline. Healthy ageing index scores were lower with greater deprivation across individual level deprivation, area level deprivation, access to care and quality of care variables *(see following subsections).*

3.1.4.2.1. Healthy ageing index scores stratified by individual level deprivation variables at baseline

Healthy ageing was linked to all the individual level deprivation variables at baseline, namely non manual work, further education, access to car, access to public transport, access to GP and access to work.

Median HAI scores were significantly higher amongst; non-manual workers at baseline (non manual workers median HAI 80.44 {69.56, 88.01} *cf.* manual workers median HAI 78.09 {65.59, 86.32}; p < 0.001), those who received further education (further education median HAI 81.18 {71.47, 88.68} *cf.* school aged education only median HAI 78.53{66.32, 86.76}; p < 0.001), participants with access to a car (access to car median HAI 79.85 {68.68, 87.65} *cf.* no access to car median HAI 71.03 {59.12, 82.35}; p < 0.001), access to public transport (access to public transport median HAI 79.41 {68.38, 87.21} *cf.* no access to public transport median HAI 59.49 {43.01, 76.25}; p < 0.001), access to GP (access to GP median HAI 79.26 {67.79, 87.35 } *cf.* no access to GP median HAI 75.59 {62.65, 84.12}; p < 0.001), and access to work (access to work median HAI 80.74 {70.29, 87.94} *cf.* no access to work median HAI 67.13 {52.28, 78.82}; p < 0.001) *(Table 7).*

Table 7. Median healthy ageing index scores at baseline stratified by individual level deprivation variables[C]

		Median HAI score (IQR)	p - value
Employment category	Non manual worker	80.44 (69.56, 88.01)	< 0.001
	Manual worker	78.09 (65.59, 86.32)	
Education	Further education	81.18 (71.47, 88.68)	< 0.001
	School age education only	78.53 (66.32, 86.76)	

Car access	Access to car	79.85 (68.68, 87.65)	< 0.001
	No access to car	71.03 (59.12, 82.35)	
Public transport access	Access to public transport	79.41 (68.38, 87.21)	< 0.001
	No access to public transport	59.49 (43.01, 76.25)	
GP access	Access to GP	79.26 (67.79 – 87.35)	< 0.001
	No access to GP	75.59 (62.65, 84.12)	
Work access	Access to work	80.74 (70.29 – 87.94)	< 0.001
	No access to work	67.13 (52.28, 78.82)	

[C] Chi-square test

3.1.4.2.2. Healthy ageing index scores stratified by area level deprivation variables at baseline

Healthy ageing was associated with all of the area level deprivation domains at baseline except barriers to housing and services domain.

Median HAI scores were significantly higher amongst participants in the less overall deprivation quintile at baseline reflecting healthier ageing. The most affluent quintile (1) had a median HAI score of 81.32 (IQR 70.29 – 88.53), compared to the least affluent quintile (5) score of 74.26 (IQR 59.41 – 84.12) (p < 0.001). There was also a stepwise reduction in healthy ageing at baseline with increasing overall area level deprivation *(Table 8)*.

Median HAI scores were significantly higher amongst participants in the less deprived quintiles for six of the seven subdomains of area level deprivation at baseline reflecting healthier ageing. Namely income deprivation domain (quintile 1 HAI 81.18 {70.00 – 88.08} *cf.* quintile 5 HAI 72.79 {59.41 – 84.41}; p < 0.001), employment deprivation domain (quintile 1 HAI 81.76{71.25 – 88.16} *cf.* quintile 5 HAI 73.24 {59.56 – 84.19};

p < 0.001), health deprivation and disability domain (quintile 1 HAI 81.91{70.59 – 88.09} *cf.* quintile 5 HAI 74.71 {60.15 – 84.41}; p < 0.001), education skills and training deprivation domain (quintile 1 HAI 81.32{70.44 – 88.24} *cf.* quintile 5 HAI 74.93 {59.41 – 84.56}; p < 0.001), crime deprivation domain (quintile 1 HAI 80.59{69.41 – 88.38} *cf.* quintile 5 HAI 75.29 {62.21 – 84.41}; p < 0.001), and living environment deprivation domain (quintile 1 HAI 80.37{69.12 – 87.79} *cf.* quintile 5 HAI 77.65 {66.32 – 85.51}; p < 0.001) *(Table 8)*.

Five of the seven subdomains of area level deprivation demonstrated a stepwise reduction in healthy ageing with increasing deprivation at baseline, the exceptions being the crime deprivation domain where HAI scores for the third quintile were slightly above the general reducing trend for HAI score with increasing deprivation and the barriers to housing and services domain which exhibited fairly flat HAI scores across the five quintiles (quintile 1 HAI 79.71{68.68 – 87.57} *cf.* quintile 5 HAI 80 {69.41 – 87.79}; p = 0.0096) *(Table 8)*.

Table 8. Median healthy ageing index score at baseline stratified by area level deprivation variables[K]

	Median HAI score (IQR) by quintile					p -value
Deprivation	1	2	3	4	5	
Overall	81.32 (70.29, 88.53)	80.15 (69.12, 87.65)	78.39 (68.24, 87.06)	76.47 (63.68, 85.29)	74.26 (59.41, 84.12)	< 0.001
Income deprivation domain	81.18 (70.00, 88.08)	80.74 (69.78, 88.09)	77.79 (66.76, 86.91)	77.5 (65.15, 85.74)	72.79 (59.41, 84.41)	< 0.001
Employment deprivation domain	81.76 (71.25, 88.16)	79.56 (68.09, 87.94)	78.82 (68.68, 87.35)	77.13 (64.71, 85.59)	73.24 (59.56, 84.19)	< 0.001
Health deprivation and disability domain	81.91 (70.59, 88.09)	79.71 (69.12, 87.79)	78.46 (68.24, 86.99)	76.62 (63.31, 85.81)	74.71 (60.15, 84.41)	< 0.001
Education,	81.32	80.81	78.46	76.62	74.93	< 0.001

skills and training deprivation domain	(70.44, 88.24)	(69.93, 88.09)	(66.18, 86.91)	(63.82, 85.29)	(59.41, 84.56)	
Barriers to housing and services domain	79.71 (68.68, 87.57)	77.28 (66.18, 86.47)	78.82 (67.06, 87.06)	78.46 (63.31, 86.91)	80 (69.41, 87.79)	0.0096
Crime deprivation domain	80.59 (69.41, 88.38)	78.97 (68.24, 87.06)	79.56 (67.94, 87.5)	78.82 (66.18, 87.06)	75.29 (62.21, 84.41)	< 0.001
Living environment deprivation domain	80.37 (69.12, 87.79)	80 (69.12, 87.79)	78.53 (66.54, 87.79)	78.09 (64.71, 86.18)	77.65 (66.32, 85.51)	< 0.001

^{K} Kruskal Wallis test.

3.1.4.2.3. Healthy ageing index scores stratified by access to care at baseline

Healthy ageing was linked to access to care at baseline. Those participants registered at the highest ranked practice according to access to care had higher HAI scores than those at the lowest ranked practice reflecting healthier ageing (highest access score ranked 0 HAI 79.85{68.53 – 87.65} *cf.* lowest access score ranked 5 HAI 77.94 {65.29 – 86.91}; p < 0.001) *(Table 9).* However, there was no trend of stepwise reduction in median HAI score across the ranked practices.

Table 9. Median healthy ageing index score at baseline stratified by ranked practice access to care^{K}

	Ranked practice access to care						p - value
	0	1	2	3	4	5	
Median HAI score (IQR)	79.85 (68.53, 87.65)	80.96 (69.71, 87.79)	80.59 (68.97, 87.79)	77.06 (63.09, 85.74)	78.31 (66.03, 85.44)	77.94 (65.29, 86.91)	< 0.001

^{K} Kruskal Wallis test.

3.1.4.2.4. Healthy ageing index scores stratified by quality of care at baseline

Healthy ageing was linked to quality of care at baseline. Those participants registered at the highest ranked practice according to quality of care had higher HAI scores than those at the lowest ranked practice reflecting healthier ageing (highest practice quality of care score ranked 0 HAI 80.96{69.71 – 87.79} *cf.* lowest QOF score ranked 5 HAI 77.94{65.29 – 86.91}; p < 0.001) *(Table 10).* There was a more consistent stepwise reduction in the median HAI score from the highest ranked practice to the lowest ranked practice, with the exception of the third ranked practice.

Table 10. Median healthy ageing index score at baseline stratified by ranked practice quality of care^K

	Quality of care						p -value
	0	1	2	3	4	5	
Median HAI score (IQR)	80.96 (69.71, 87.79)	79.85 (68.53, 87.65)	78.31 (66.03, 85.44)	80.59 (68.97, 87.79)	77.06 (63.09, 85.74)	77.94 (65.29, 86.91)	< 0.001

^{K} Kruskal Wallis test.

3.2. The relationship between pain and deprivation and healthy ageing at baseline

3.2.1. The relationship between pain and healthy ageing at baseline

There was a significant association between some and widespread pain and unhealthy ageing ($p < 0.001$). Compared to those with no pain healthy ageing index scores were -10.42% (95% CI -12.19, -8.61) and -25.17% (95% CI -26.66, -23.66) lower for those with some and widespread pain respectively. The reduction in scores attenuated (reduced) but remained significant after adjustment for potential confounders (confounders included age, gender, social networks, smoking status, alcohol consumption, social and physical inactivity, use of non-steroidal anti-inflammatory drugs, use of pain analgesia and diagnosis of chronic musculoskeletal condition). After adjusting for confounders the percentage change in baseline index for those with some pain as opposed to no pain was -7.62% (95% CI -10.42, -4.88), and for widespread pain compared to no pain -17.30% (95% CI -19.75, -14.79) *(Table 11).*

Increasing age (-0.4%; 95% CI -0.5, -0.3) and female gender (-4.08%; 95% CI -2.02, -5.13) was associated with lower baseline median HAI scores in the univariate analysis reflecting less healthy ageing. After adjustment for confounders age had no effect on healthy ageing index scores at baseline (0.00%; 95% CI 0.00, 0.00), however the percentage change in baseline index for those who were female as opposed to male was attenuated but remained significant (-2.02%; 0.00, -4.08), indicating that females aged less well than males *(Table 11).*

Table 11. The association between pain and healthy ageing at baseline

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Some pain (compared to no pain)	-10.42% (-12.19, -8.61)	-7.69% (-10.42, -4.88)
Widespread pain (compared to no pain)	-25.17% (-26.66, -23.66)	-17.30% (-19.75, -14.79)
Age (each additional year)	-0.4% (-0.5, -0.3)	0.00% (0.00, 0.00)
Gender (female)	-4.08% (-2.02, -5.13)	-2.02% (0.00, -4.08)

3.2.2. The relationship between individual level deprivation variables and healthy ageing at baseline

There was a significant association between reporting school age education only, manual work, no access to car, no access to public transport, no access to GP and no access to work and unhealthy ageing (p < 0.001) *(Table 7).* Compared to their less deprived contemporaries healthy ageing index scores were lower for school age education only (-4.88%; 95% CI -6.76, -1.98), manual work (-3.92%; 95% CI -5.82, -1.98), no access to car (-11.31%; 95% CI -13.91, -8.61), no access to public transport (-25.92%; 95% CI -28.82, -22.12), no access to GP (-8.61%; 95% CI -11.31, -4.88) and no access to work (-18.94%; 95% CI -20.55, -17.30) in the univariate analysis.

The reduction in scores for no access to car (-10.42%; 95% CI -13.93, -7.69), no access to public transport (-11.31%; 95% CI -15.63, -6.76), no access to GP (-5.82%; 95% CI -9.52, -1.98) and no access to work (-10.42%; 95% CI -13.06, -7.69) were attenuated but remained significant after adjustment for confounders. However, after adjustment for confounders education (-1; 95% CI -3.92, 1.01) and manual work (-1; 95% CI -2.96, 1.00) were no longer associated with a change in the baseline index *(Table 12).*

Table 12. The association between individual level deprivation and healthy ageing at baseline

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Education (school age education only compared to further education)	-4.88% (-6.76, -1.98)	-1% (-3.92, 1.01)
Manual work (compared to non manual)	-3.92% (-5.82, -1.98)	-1% (-2.96, 1.00)
No access to car (compared to access to car)	-11.31% (-13.91, -8.61)	-10.42% (-13.93, -7.69)
No access to public transport (compared to access to public transport)	-25.92% (-28.82, -22.12)	-11.31% (-15.63, -6.76)
No access to GP (compared to access to GP)	-8.61% (-11.31, -4.88)	-5.82% (-9.52, -1.98)
No access to work (compared to access to work)	-18.94% (-20.55, -17.30)	-10.42% (-13.06, -7.69)

3.2.3. The relationship between area level deprivation and healthy ageing at baseline

3.2.3.1. The relationship between overall area level deprivation and healthy ageing at baseline

There was a significant association between overall area level deprivation and unhealthy ageing ($p < 0.001$) *(Table 8).* Compared to those in the least deprived overall area level deprivation quintile healthy ageing index scores were -2.96% (95% CI -4.88,

-0.10), -6.76% (95% CI -9.52, -3.92) and -12.20% (95% CI -14.79, -9.52) lower for the mid deprived, second most deprived and most deprived quintiles respectively.

Adjustment for confounders (age, gender, social networks, smoking status, alcohol consumption, social and physical inactivity, use of non-steroidal anti-inflammatory drugs, use of pain analgesia and diagnosis of chronic musculoskeletal condition) attenuated the association, with the mid-deprived overall area level deprivation quintile no longer significantly associated with a percentage reduction in the HAI score at baseline (-0.30%; 95% CI -2.96, 3.05). However, the second most deprived and most deprived overall area level deprivation quintiles were still associated with lower HAI scores at baseline of -4.88% (95% CI -7.69, -1.98) and -7.69% (95% CI -11.31, -4.88) respectively *(Table 13).*

Table 13. The association between overall area level deprivation and healthy ageing at baseline

	Percentage change in baseline index (95% CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Least deprived	*Referent*	*Referent*
Second least deprived	-1.98% (-3.92, 0.6)	0.70% (-1.98, 4.08)
Mid-deprived	-2.96% (-4.88, -0.1)	-0.30% (-2.96, 3.05)
Second most deprived	-6.76% (-9.52, -3.92)	-4.88% (-7.69, -1.98)
Most deprived	-12.20% (-14.79, -9.52)	-7.69% (-11.31, -4.88)

Confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).

Lower 4 quintiles compared to referent (least deprived quintile)

3.2.3.2. The relationship between income deprivation and healthy ageing at baseline

There was a significant association between area level income deprivation and unhealthy ageing (p < 0.001) *(Table 8).* Compared to those in the least deprived area level income deprivation quintile healthy ageing index scores were -2.96% (95% CI -5.82, -0.6), -5.82% (95% CI -8.6, -2.96) and -11.30% (95% CI -13.93, -8.61) lower for the mid deprived, second most deprived and most deprived quintiles respectively.

Adjustment for confounders attenuated the association, with the mid deprived area level income deprivation quintile no longer significantly associated with a percentage reduction in the HAI score at baseline (0.02%; 95% CI -2.96, 3.05). However, the second most deprived and most deprived area level income deprivation quintiles were still associated with lower HAI scores at baseline of -4.88% (95% CI -8.61, -1.98) and -7.69% (95% CI -10.42, -3.92) respectively *(Table 14).*

Table 14. The association between area level income deprivation and healthy ageing at baseline

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Least deprived	*Referent*	*Referent*
Second least deprived	0.30% (-1.98, 3.05)	0.50% (-1.98, 3.05)
Mid-deprived	-2.96% (-5.82, -0.6)	0.02% (-2.96, 3.05)
Second most deprived	-5.82% (-8.6, -2.96)	-4.88% (-8.61, -1.98)
Most deprived	-11.30% (-13.93, -8.61)	-7.69% (-10.42, -3.92)

Confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).

Lower 4 quintiles compared to referent (least deprived)

3.2.3.3. The relationship between employment deprivation and healthy ageing at baseline

There was a significant association between area level employment deprivation and unhealthy ageing ($p < 0.001$) *(Table 8).* Compared to those in the least deprived area level employment deprivation quintile healthy ageing index scores were -2.96% (95% CI -4.88, -0.10), -2.96% (95% CI -5.82, -0.40), -6.76% (95% CI -9.52, -3.92) and -12.19% (95% CI -14.79, -9.52) lower for the second least deprived, mid deprived, second most deprived and most deprived quintiles respectively.

Adjustment for confounders attenuated the association, with the second least deprived and mid-deprived area employment deprivation quintiles no longer significantly associated with a percentage reduction in the HAI score at baseline {(1.01%; 95% CI -1.98, 4.08) & (-0.80%; 95% CI -3.92, 2.02)}. However, the second most deprived and most deprived employment quintiles were still associated with lower HAI scores at baseline of -3.92% (95% CI -6.76, -0.20) and -7.69% (95% CI -10.42, -3.92) respectively *(Table 15)*.

Table 15. The association between area level employment deprivation and healthy ageing at baseline

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Least deprived	*Referent*	*Referent*
Second least deprived	-2.96% (-4.88, -0.10)	1.01% (-1.98, 4.08)
Mid-deprived	-2.96% (-5.82, -0.40)	-0.80% (-3.92, 2.02)
Second most deprived	-6.76% (-9.52, -3.92)	-3.92% (-6.76, -0.20)
Most deprived	-12.19% (-14.79, -9.52)	-7.69% (-10.42, -3.92)

Confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).

Lower 4 quintiles compared to referent (least deprived)

3.2.3.4. The relationship between area level health deprivation and healthy ageing at baseline

There was a significant association between area level health deprivation and unhealthy ageing (p < 0.001) *(Table 8)*. Compared to those in the least deprived area level health deprivation quintile healthy ageing index scores were -3.92% (95% CI -6.76, -1), -7.69% (95% CI -10.42, -4.88) and -12.19% (95% CI -14.79, -9.52) lower for the mid-deprived, second most deprived and most deprived quintiles.

Adjustment for confounders attenuated the association, with the mid-deprived area health deprivation quintile no longer significantly associated with a percentage reduction in the HAI score at baseline (-0.90%; 95% CI -3.92, 2.02). However, the second most deprived and most deprived health deprivation quintiles were still associated with lower HAI score at baseline of -5.82% (95% CI -8.60, -1.98) and -7.69% (95% CI -10.42, -4.88) respectively *(Table 16)*.

Table 16. The association between area level health deprivation and healthy ageing at baseline

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Least deprived	*Referent*	*Referent*
Second least deprived	-2.96% (-4.88, 0.03)	-0.50% (-2.96, 2.02)
Mid-deprived	-3.92% (-6.76, -1.00)	-0.90% (-3.92, 2.02)
Second most deprived	-7.69% (-10.42, -4.88)	-5.82% (-8.60, -1.98)
Most deprived	-12.19% (-14.79, -9.52)	-7.69% (-10.42, -4.88)

Confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).
Lower 4 quintiles compared to referent (least deprived)

3.2.3.5. The relationship between area level education deprivation and healthy ageing at baseline

There was a significant association between area level education deprivation and unhealthy ageing ($p < 0.001$) *(Table 8).* Compared to those in the least deprived area level education deprivation quintile healthy ageing index scores were -3.92% (95% CI -6.76, -1.98), -6.76% (95% CI -9.52, -3.92), and -11.31% (95% CI -13.93, -8.61) lower for the mid-deprived, second most deprived and most deprived quintiles respectively.

Adjustment for confounders attenuated the association, with the mid-deprived and second most deprived area level education deprivation quintiles no longer significantly associated with a percentage reduction in the HAI score at baseline {(-1.00%; 95% CI -3.92, 2.02) & (-2.96%; 95% CI -5.82, 0.10)}. However, the most deprived area level education deprivation quintile was still associated with a lower HAI score at baseline of -6.76% (95% CI -10.42, -3.92) *(Table 17).*

Table 17. The association between area level education deprivation and healthy ageing at baseline

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Least deprived	*Referent*	*Referent*
Second least deprived	-0.20% (-2.96, 2.02)	0.70% (-1.98, 4.08)
Mid-deprived	-3.92% (-6.76, -1.98)	-1.00% (-3.92, 2.02)
Second most deprived	-6.76% (-9.52, -3.92)	-2.96% (-5.82, 0.10)
Most deprived	-11.31% (-13.93, -8.61)	-6.76% (-10.42, -3.92)

Confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).

Lower 4 quintiles compared to referent (least deprived)

3.2.3.6. The relationship between area level housing and services deprivation and healthy ageing at baseline

Area level housing and services deprivation exhibited fairly flat HAI scores across the five quintiles (p = 0.0096) *(Table 8)*. Compared to those in the least deprived area level housing and services deprivation quintile healthy ageing scores were -2.96% (95% CI -5.82, -0.50) and -3.92% (95% CI -6.76, -1) lower for those in the second least and second most deprived quintile respectively.

After adjustment for confounders the second least deprived area level housing and services deprivation quintile was no longer associated with unhealthy ageing (-1.98%; 95% CI -4.88, 1.00). Adjustment also attenuated the association for the second most deprived quintile but it remained associated with a lower HAI score at baseline of -4.88% (95% CI -8.61, -1.98) *(Table 18)*.

Table 18. The association between area level housing and services deprivation and healthy ageing at baseline

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Least deprived	*Referent*	*Referent*
Second least deprived	-2.96% (-5.82, -0.50)	-1.98% (-4.88, 1.00)
Mid-deprived	-1.98% (-4.88, 1.01)	-1.98% (-4.88, 0.80)
Second most deprived	-3.92% (-6.76, -1.00)	-4.88% (-8.61, -1.98)
Most deprived	0.50% (-1.98, 3.05)	-0.40% (-2.96, 3.05)

Confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).
Lower 4 quintiles compared to referent (least deprived)

3.2.3.7. The relationship between area level crime deprivation and healthy ageing at baseline

There was a significant association between area level crime deprivation and unhealthy ageing ($p < 0.001$) *(Table 8).* Compared to those in the least deprived area level crime deprivation quintile healthy ageing index scores were -2.96% (95% CI -5.82, -0.30), and -9.52% (95% CI -12.19, -6.76) lower for the second most deprived and most deprived quintiles respectively.

Adjustment for confounders attenuated the association, but both the second most deprived and most deprived area level crime deprivation quintiles were still associated with lower HAI scores at baseline of -2.96% (95% CI -5.82, -0.08) and -8.61 (95% CI -11.31, -4.88) respectively *(Table 19).*

Table 19. The association between area level crime deprivation and healthy ageing at baseline

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Least deprived	*Referent*	*Referent*
Second least deprived	-1.98% (-4.88, 0.40)	-1.00% (-3.92, 2.02)
Mid-deprived	-1.98% (-4.88, 0.70)	-1.98% (-4.88, 1.00)
Second most deprived	-2.96% (-5.82, -0.30)	-2.96% (-5.82, -0.08)
Most deprived	-9.52% (-12.19, -6.76)	-8.61% (-11.31, -4.88)

Confounders (age, gender, educational attainment, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).
Lower 4 quintiles compared to referent (least deprived)

3.2.3.8. The relationship between area level environment deprivation and healthy ageing at baseline

There was a significant association between area level environment deprivation and unhealthy ageing (p < 0.001) *(Table 8).* Compared to those in the least deprived area level environment deprivation quintile healthy ageing index scores were -3.92% (95% CI -6.76, -1.00), and -3.92% (95% CI -6.76, -0.90) lower for the second most deprived and most deprived quintiles respectively.

Adjustment for confounders attenuated the association, the second most deprived area level environment deprivation quintile remained associated with a lower HAI score at baseline of -3.92% (95% CI -6.76, -0.80). However, the most deprived area level environment deprivation quintile was no longer associated with a reduction in the baseline HAI score after adjustment for confounders (-1.98; 95%CI -4.88, 1.01) *(Table 20).*

Table 20. The association between area level environment deprivation and healthy ageing at baseline

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Least deprived	*Referent*	*Referent*
Second least deprived	-0.09% (-2.96, 3.05)	2.02% (-1.98, 5.13)
Mid-deprived	-1.98% (-4.88, 0.70)	-1.00% (-3.92, 2.02)
Second most deprived	-3.92% (-6.76, -1.00)	-3.92% (-6.76, -0.80)
Most deprived	-3.92% (-6.76, -0.90)	-1.98% (-4.88, 1.01)

Confounders (age, gender, educational attainment, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).
Lower 4 quintiles compared to referent (least deprived)

3.2.4. The relationship between ranked practice access to care and healthy ageing at baseline

There was a significant association between access to care and unhealthy ageing at baseline (p < 0.001) *(Table 9).* Compared to those in the highest ranked practice according to access to care healthy ageing index scores were -5.82% (95% CI -8.61, -2.96), -2.96% (95% CI -5.82, -0.10), and -3.92 (95% CI -5.82, -1.00) lower for the fourth highest, fifth highest and lowest ranked practice respectively.

After adjustment for confounders the fourth highest, fifth highest and lowest ranked practices remained associated with a lower HAI score at baseline with scores of -7.69% (95% CI -11.31, -3.92), -3.92% (95% CI -6.76, -0.02) and -2.96% (95% CI-5.82, -0.30) respectively *(Table 21).*

Table 21. The association between practice ranked access to care and healthy ageing at baseline

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Highest	*Referent*	*Referent*
Second highest	1.00% (-1.98, 5.13)	-0.50% (-3.92, 3.05)
Third highest	1.00% (-1.98, 4.08)	-1.98% (-4.88, 2.02)
Fourth highest	-5.82% (-8.61, -2.96)	-7.69% (-11.31, -3.92)
Fifth highest	-2.96% (-5.82, -0.10)	-3.92% (-6.76, -0.02)
Lowest	-3.92% (-5.82, -1.00)	-2.96% (-5.82, -0.30)

Confounders (age, gender, educational attainment, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).
Lower 5 ranked practices compared to referent (highest ranked)

3.2.5. The relationship between ranked practice quality of care and healthy ageing at baseline

There was a significant association between quality of care and unhealthy ageing at baseline ($p < 0.001$) *(Table 10).* Compared to those in the highest ranked practice according to quality of care healthy ageing index scores were -3.92% (95% CI -7.68, -0.50), -6.76% (95% CI -10.42, -2.96), and -4.88 (95% CI -7.69, -1.98) lower for the third highest, fifth highest and lowest ranked practice respectively.

After adjustment for confounders, the fifth highest ranked practice remained associated with a lower HAI score at baseline of -7.69% (95% CI -11.31, -2.96). The third highest and lowest ranked quality of care practices were no longer associated with a reduction in the HAI score at baseline after adjustment for confounders, -2.96% (95% CI -7.69, 1.01) and -2.96% (95% CI -5.82, 1.00) respectively *(Table 22).*

Table 22. The association between practice ranked quality of care and healthy ageing at baseline

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Highest	*Referent*	*Referent*
Second highest	-1.00% (-4.88, 2.02)	0.50% (-2.96, 4.08)
Third highest	-3.92% (-7.68, -0.50)	-2.96% (-7.69, 1.01)
Fourth highest	0.20% (-3.92, 4.08)	-1.00% (-4.88, 3.05)
Fifth highest	-6.76% (-10.42, -2.96)	-7.69% (-11.31, -2.96)
Lowest	-4.88% (-7.69, -1.98)	-2.96% (-5.82, 1.00)

Confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).

Lower 5 ranked practices compared to referent (highest ranked)

3.2.6. Assessing interactions between pain and deprivation variables at baseline

Table 23. Interactions between pain and deprivation and healthy ageing at baseline

Assessed interaction	Coefficient (95% CI)	p-value
Pain x individual level deprivation		
Some pain x school age education only	-0.02 (-0.09, 0.05)	0.538
Widespread pain x school age education only	-0.06 (-0.14, 0.01)	0.098
Some pain x manual work	0.0002 (-0.05, 0.05)	0.993
Widespread pain x manual work	-0.04 (-0.10, 0.01)	0.138
Some pain x no access to car	-0.03 (-0.12, 0.05)	0.450
Widespread pain x no access to car	**-0.15 (-0.23, -0.06)**	**0.001**
Some pain x no access to public transport	-0.06 (-0.22, 0.11)	0.485
Widespread pain x no access to public transport	**-0.18 (-0.33, -0.02)**	**0.029**
Some pain x no access to GP	0.01 (-0.12, 0.14)	0.913
Widespread pain x no access to GP	0.07 (-0.06, 0.21)	0.272
Some pain x no access to work	-0.05 (-0.13, 0.02)	0.188
Widespread pain x no access to work	**-0.11 (-0.19, -0.03)**	**0.005**
Pain x overall area level deprivation		
Some pain x second least deprived	0.03 (-0.04, 0.10)	0.360
Some pain x mid-deprived	0.02 (-0.06, 0.10)	0.562
Some pain x second most deprived	0.02 (-0.07, 0.10)	0.696
Some pain x most deprived	-0.04 (-0.13, 0.05)	0.353
Widespread pain x second least deprived	0.06 (-0.02, 0.14)	0.138
Widespread pain x mid-deprived	0.07 (-0.02, 0.15)	0.129
Widespread pain x second most deprived	-0.002 (-0.09, 0.09)	0.972
Widespread pain x most deprived	-0.03 (-0.13, 0.06)	0.532
Pain x area income level deprivation		
Some pain x second least deprived	0.04 (-0.03, 0.12)	0.222
Some pain x mid-deprived	0.01 (-0.07, 0.09)	0.740
Some pain x second most deprived	0.02 (-0.07, 0.10)	0.706
Some pain x most deprived	-0.02 (-0.11, 0.08)	0.737
Widespread pain x second least deprived	0.07 (-0.01, 0.15)	0.078
Widespread pain x mid-deprived	0.03 (-0.06, 0.12)	0.491
Widespread pain x second most deprived	-0.02 (-0.11, 0.07)	0.682
Widespread pain x most deprived	-0.02 (-0.12, 0.07)	0.637
Pain x area employment level deprivation		
Some pain x second least deprived	-0.03 (-0.11, 0.04)	0.388
Some pain x mid-deprived	-0.01 (-0.09, 0.06)	0.721

Some pain x second most deprived	-0.02 (-0.10, 0.07)	0.700
Some pain x most deprived	-0.04 (-0.13, 0.05)	0.337
Widespread pain x second least deprived	0.01 (-0.07, 0.09)	0.723
Widespread pain x mid-deprived	0.03 (-0.05, 0.11)	0.449
Widespread pain x second most deprived	-0.02 (-0.11, 0.07)	0.667
Widespread pain x most deprived	-0.03 (-0.13, 0.06)	0.504
Pain x area health level deprivation		
Some pain x second least deprived	0.02 (-0.06, 0.09)	0.670
Some pain x mid-deprived	0.01 (-0.07, 0.09)	0.833
Some pain x second most deprived	-0.03 (-0.11, 0.06)	0.533
Some pain x most deprived	-0.03 (-0.12, 0.06)	0.565
Widespread pain x second least deprived	-0.001 (-0.08, 0 .08)	0.978
Widespread pain x mid-deprived	0.01 (-0.08, 0.09)	0.905
Widespread pain x second most deprived	-0.06 (-0.15, 0.02)	0.157
Widespread pain x most deprived	-0.04 (-0.13, 0.05)	0.420
Pain x area education level deprivation		
Some pain x second least deprived	-0.003 (-0.07, 0.07)	0.934
Some pain x mid-deprived	-0.004 (-0.08, 0.07)	0.922
Some pain x second most deprived	-0.003 (-0.09, 0.08)	0.948
Some pain x most deprived	-0.04 (-0.14, 0.05)	0.350
Widespread pain x second least deprived	0.01 (-0.07, 0.09)	0.792
Widespread pain x mid-deprived	0.05 (-0.04, 0.13)	0.284
Widespread pain x second most deprived	0.01 (-0.08, 0.10)	0.816
Widespread pain x most deprived	-0.06 (-0.16, 0.03)	0.199
Pain x area housing level deprivation		
Some pain x second least deprived	-0.03 (-0.11, 0.06)	0.517
Some pain x mid-deprived	-0.001 (-0.08, 0.08)	0.981
Some pain x second most deprived	-0.02 (-0.10, 0.06)	0.554
Some pain x most deprived	-0.02 (-0.09, 0.06)	0.700
Widespread pain x second least deprived	0.03 (-0.06, 0.12)	0.541
Widespread pain x mid-deprived	-0.02 (-0.11, 0.07)	0.625
Widespread pain x second most deprived	-0.03 (-0.12, 0.05)	0.442
Widespread pain x most deprived	0.01 (-0.07, 0.10)	0.753
Pain x area crime level deprivation		
Some pain x second least deprived	0.02 (-0.06, 0.10)	0.609
Some pain x mid-deprived	0.002 (-0.07, 0.08)	0.949
Some pain x second most deprived	0.05 (-0.04, 0.13)	0.266
Some pain x most deprived	-0.05 (-0.14, 0.04)	0.303
Widespread pain x second least deprived	0.007 (-0.08, 0.09)	0.870
Widespread pain x mid-deprived	-0.04 (-0.12, 0.04)	0.352
Widespread pain x second most deprived	0.03 (-0.06, 0.11)	0.555
Widespread pain x most deprived	**-0.10 (-0.19, -0.001)**	**0.047**
Pain x area environment level deprivation		
Some pain x second least deprived	0.05 (-0.03, 0.13)	0.266
Some pain x mid-deprived	0.004 (-0.07, 0.08)	0.922
Some pain x second most deprived	-0.08 (-0.17, 0.003)	0.057
Some pain x most deprived	-0.006 (-0.08, 0.07)	0.889

Widespread pain x second least deprived	0.06 (-0.02, 0.14)	0.165
Widespread pain x mid-deprived	-0.04 (-0.12, 0.04)	0.358
Widespread pain x second most deprived	-0.08 (-0.17, 0.01)	0.091
Widespread pain x most deprived	0.008 (-0.07, 0.09)	0.840
Pain x access to care		
Some pain x second highest	-0.02 (-0.12, 0.07)	0.620
Some pain x third highest	-0.009 (-0.10, 0.08)	0.838
Some pain x fourth highest	-0.07 (-0.17, 0 .04)	0.202
Some pain x fifth highest	-0.008 (-0.10, 0.08)	0.866
Some pain x lowest	-0.02 (-0.09, 0.05)	0.630
Widespread pain x second highest	0.005 (-0.09, 0.10)	0.927
Widespread pain x third highest	0.006 (-0.09, 0.10)	0.899
Widespread pain x fourth highest	**-0.13 (-0.23, -0.02)**	**0.018**
Widespread pain x fifth highest	-0.01 (-0.11, 0.09)	0.823
Widespread pain x lowest	-0.03 (-0.11, 0.04)	0.373
Pain x quality of care		
Some pain x second highest	0.02 (-0.07, 0.12)	0.620
Some pain x third highest	0.02 (-0.09, 0.12)	0.784
Some pain x fourth highest	0.01 (-0.09, 0.12)	0.779
Some pain x fifth highest	-0.04 (-0.16, 0.07)	0.473
Some pain x lowest	0.005 (-0.09, 0.10)	0.909
Widespread pain x second highest	-0.005 (-0.10, 0.09)	0.927
Widespread pain x third highest	-0.02 (-0.13, 0.10)	0.788
Widespread pain x fourth highest	0.002 (-0.11, 0.11)	0.979
Widespread pain x fifth highest	**-0.13 (-0.25, -0.01)**	**0.033**
Widespread pain x lowest	-0.04 (-0.14, 0.06)	0.430

Adjusted for potential confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, diagnosis of chronic musculoskeletal conditions).

3.2.6.1. Interactions between individual level deprivation and pain at baseline

There were significant interactions between widespread pain and; not having access to a car, (p = 0.001), having no access to public transport (p = 0.029) and no access to work (p = 0.005). There was no interaction between some pain and; no access to car (p = 0.450), no access to public transport (p = 0.485) or access to work (0.188). There was no interaction between some pain or widespread pain and; school age education only (p = 0.538 & 0.098 respectively), manual work (p = 0.933 & 0.138) and no access to GP (p = 0.913 & 0.272) *(Table 23 above for interactions, significant interactions in bold* *and underlined).*

The reduction in healthy ageing for those with widespread pain compared to those with no pain was significantly greater for those with no access to a car (-25.17% {95% CI -32.97, -15.63%} {Coef. -0.29; 95% CI -0.40, -0.17. p = 0.001}) compared to those with access to car (-14.79% {95% CI -17.30, -13.06} {Coef. -0.16; 95% CI -0.19, -0.14. p < 0.001}).

The reduction in healthy ageing for those with widespread pain compared to those with no pain was significantly greater for those with no access to public transport (-19.75% {95% CI -35.60, 0.04%} {Coef. -0.22; 95% CI -0.44, 0.0004. p = 0.05}) compared to those with access to public transport (-16.47% {95% CI -18.94, -13.93%} {Coef. -0.18; 95% CI -0.21, -0.15. P = 0.000}).

The reduction in healthy ageing for those with widespread pain compared to those with no pain was significantly greater for those with no access to work (-21.34% {95% CI -28.82, -13.06%} {Coef. -0.24; 95% CI -0.34, -0.14}) compared to those with access to work (-15.63% {95% CI -18.13, -13.06%} {Coef. -0.17; 95% CI -0.20, -0.14. p < 0.001}).

3.2.6.2. Interactions between area level deprivation and pain at baseline

There was a significant interaction between widespread pain and the most deprived quintile for crime (p = 0.047) *(Table 23).* There was no interaction between some pain and either area crime level deprivation or area environment level deprivation. There was no interaction between pain and; other area crime deprivation quintiles, other area environment deprivation quintiles, overall area level deprivation, income level deprivation, employment level deprivation, health level deprivation, education level deprivation or housing level deprivation *(Table 23).*

The reduction in healthy ageing for those with widespread pain compared to those with no pain was significantly greater for those in the most deprived area crime deprivation quintile (-22.12% {95% CI -29.53, -13.93%} {Coef. -0.25; 95% CI -0.35, -0.15. p < 0.001}) compared to those in the least deprived area crime deprivation (-16.47% {95% CI -21.34, -12.19%} {Coef. -0.18; 95% CI -0.24, -0.13. p < 0.001}).

3.2.6.3. Interactions between access to care and pain at baseline

There was a significant interaction between widespread pain and the fourth highest ranked practice according to access to care (p = 0.018) *(Table 23).* There were no other interactions between pain and access to care *(Table 23).*

The reduction in healthy ageing for those with widespread pain compared to those with no pain was significantly greater for those at the practice ranked fourth highest according to access to care (-24.42% {95% CI -32.29, -15.63%} {Coef. -0.28; 95% CI -0.39, -0.17. p < 0.001}) compared to those in the practice ranked highest according to access to care (-16.47% {95% CI -21.34, - 11.31%} {Coef. -0.18; 95% CI -0.24, -0.12. p < 0.001}).

3.2.6.4. Interactions between quality of care and pain at baseline

There was a significant interaction between widespread pain and the fifth highest practice according to quality of care (p = 0.033) *(Table 23).* There were no other interactions between pain and quality of care *(Table 23).*

The reduction in healthy ageing for those with widespread pain compared to those with no pain was significantly greater for those at the fifth highest practice according to quality of care (-24.42% {95% CI -32.29, -15.63%} {Coef. -0.28; 95% CI -0.39, -0.17. p < 0.001}) compared to those in the practice ranked highest according to quality of care (-14.79% {95% CI -21.34, -8.61 %} {Coef. -0.16; 95% CI -0.24, -0.09. p < 0.001}).

3.2.7. Cross sectional models goodness of fit

The cross sectional models goodness of fit was assessed using R-squared values (adjusted R-squared).

The extent of adjusted R squared can be considered as the proportion of the variance in the HAI explained by the variables in the model. On it's own, of all the deprivation variables, no access to work explains the greatest variance (0.1190). For all deprivation variables, model fit increased with the addition of confounders and interaction terms (Table 23a). For all of the fully adjusted models there is no observable difference between variables with values ranging from 0.4102 for manual work, to 0.4358 for no access to work.

Table 23a. Adjusted R-squared values for deprivation variables in each model for cross sectional relationship between pain, deprivation and healthy ageing.

	Adjusted R-squared		
Deprivation variables	Univariate model	Model 1	Interactions
Education	0.0245	0.4167	0.4170
Manual worker	0.0268	0.4102	0.4109
No access to car	0.0449	0.4325	0.4377
No access to public transport	0.0794	0.4214	0.4236
No access to GP	0.0291	0.4182	0.4185
No access to work	0.1190	0.4358	0.4382
Access to care	0.0302	0.4210	0.4203
Quality of care	0.0302	0.4210	0.4203
Overall area level deprivation	0.0482	0.4270	0.4268
Area level income deprivation	0.0471	0.4268	0.4266
Area level employment deprivation	0.0485	0.4258	0.4247
Area level health deprivation	0.0473	0.4258	0.4241
Area level education deprivation	0.0480	0.4224	0.4215
Area level housing deprivation	0.0252	0.4193	0.4185
Area level crime deprivation	0.0345	0.4243	0.4244
Area level environment deprivation	0.0247	0.4180	0.4196

3.3. The longitudinal association between pain and healthy ageing across 6 years and the role of deprivation

3.3.1. The association between onset of pain and healthy ageing across 6 years

For the 2949 adults aged 50 years and over included in the analysis, prior to adjustment for any covariates, the mean healthy ageing index scores decreased by 7.25% over the six year follow up period. This attenuated slightly after adjustment for potential confounders (age, gender, education, social networks, smoking status, alcohol consumption, social and physical inactivity, use of non-steroidal anti-inflammatory drugs, use of pain analgesia and diagnosis of chronic musculoskeletal condition) to -6.18% (95% CI -5.13, -7.25. $p < 0.001$) *(Table 24)*.

The onset of some pain and widespread pain were associated with a reduction in healthy ageing across the six years of follow up ($p = 0.001$). Among subjects with no pain after adjustment for confounders (age, gender, education, social networks, smoking status, alcohol consumption, physical inactivity, diagnosed musculoskeletal conditions, analgesic and non-steroidal use) the onset of some pain was associated with a total decrease in the healthy ageing score of 25.9% (-19.72% + the decrease of 6.18% associated with time). Among subjects with no pain after adjustment for confounders the onset of widespread pain was associated with a total decrease in the healthy ageing index score of 41.17% (-34.99% + the decrease of 6.18% associated with time) *(Table 24)*.

Female gender was associated with a reduction in the healthy ageing score of 10.2% (-10.2%; 95% CI -5.4, -15.2), after adjustment for confounders female gender remained significantly associated with a reduction in the mean HAI score over 6 years of 6.18% (-6.18%; 95% CI -2.02, -10.52. p = 0.006) *(Table 24)* (Wilkie *et al.,* 2013).

Table 24. The association between onset of pain and healthy ageing across 6 years

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Time	-7.25% (-6.18, -8.33)	-6.18% (-5.13, -7.25)
Intercept		97.99 (97.91, 98.09)
Some pain (compared to no pain)	-19.7 (-17.3, -23.3)	-19.72% (-16.18, -22.14)
Widespread pain (compared to no pain)	-40.5 (-36.3, -43.3)	-34.99% (-31.00, -39.10)
Gender (female)	-10.2 (-5.4, -15.2)	-6.18% (-2.02, -10.52)

Adjusted for potential confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, diagnosis of chronic musculoskeletal conditions).

3.3.2. The association between individual level deprivation variables and healthy ageing across 6 years

There was a significant association between reporting school age education only, manual work, no access to car, no access to public transport, no access to GP and no access to work and an increase in unhealthy ageing in the univariate analysis (p < 0.001) *(Table 25)*. Compared to their less deprived contemporaries healthy ageing scores were lower for those reporting school education only (-19.72%; 95% CI -13.89, -27.12. p < 0.001), manual work (-9.42%; 95% CI -5.13, -15.03. p < 0.001), no access to car (-34.99%; 95% CI -25.86, -43.33. p < 0.001), no access to public transport (-

68.20%; 95% CI -52.20, -87.76. p < 0.001), no access to GP (-17.35%; 95% CI -8.33, -28.40. p < 0.001) and no access to work (-58.41%; 95% CI -50.68, -68.20. p < 0.001) in the univariate analysis.

After adjustment for confounders education (3.05%; 95% CI -1.99%, 8.33. p = 0.219) was no longer associated with unhealthy ageing. The reduction in healthy ageing scores for manual work (-4.08%; 95% CI -1.00, -8.33. p = 0.026), no access to car (-22.14%; 95% CI -15.03, -29.69. p < 0.001), no access to public transport (-16.18%; 95% CI -5.13, -27.12. p = 0.002), no access to GP (-17.35%; 95% CI -9.42, -25.86. p < 0.001) and no access to work (-22.14%; 95% CI -16.18, -28.40. p < 0.001) were attenuated but remained significantly associated with unhealthy ageing across 6 years after adjustment for confounders *(Table 25).*

Table 25. The association between individual level deprivation and healthy ageing across 6 years

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Education (school education only compared to further education)	-19.72% (-13.89, -27.12), p < 0.001	3.05% (-1.99%, 8.33), p = 0.219
Manual worker (compared to non manual)	-9.42% (-5.13, -15.03), p < 0.001	-4.08% (-1.00, -8.33), p = 0.026
No access to car (compared to access to car)	-34.99% (-25.86, -43.33), p < 0.001	-22.14% (-15.03, -29.69), p < 0.001
No access to public transport (compared to access to public transport)	-68.20% (-52.20, -87.76), p < 0.001	-16.18% (-5.13, -27.12), p = 0.002
No access to GP (compared to access to GP)	-17.35% (-8.33, -28.40), p < 0.001	-17.35% (-9.42, -25.86), p < 0.001
No access to work (compared to access to work)	-58.41% (-50.68, -68.20), p < 0.001	-22.14% (-16.18, -28.40), p < 0.001

Adjusted for potential confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, diagnosis of chronic musculoskeletal conditions).

3.3.3. The association between area level deprivation and healthy ageing across 6 years

3.3.3.1. The association between overall area level deprivation and healthy ageing across 6 years

There was a significant association between overall area level deprivation and unhealthy ageing across 6 years (p = 0.001) *(Table 26).* Compared to those in the least deprived overall area level deprivation quintile healthy ageing index scores were -11.63% (95% CI -4.08, -18.53), p = 0.001), -24.61% (95% CI -16.18, -33.64, p < 0.001) and -34.99% (95% CI -25.86, -44.77, p < 0.001) lower for the mid deprived, second most deprived and most deprived quintiles respectively in the univariate analysis.

The reduction in scores for the mid-deprived (-6.18%; 95% CI -0.02, -11.63, p = 0.049), second most deprived (-15.03%; 95% CI -8.33, -22.14, p < 0.001) and most deprived (–18.53%; 95% CI -11.63, -25.86, p < 0.001) overall area level deprivation quintiles were attenuated but remained significantly associated with unhealthy ageing after adjustment for confounders *(Table 26).*

Table 26. The association between overall area level deprivation and healthy ageing across 6 years

	Percentage change in baseline index (95% CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Least deprived	*Referent*	*Referent*
Second least deprived	4.08% (-1.98, 10.52), p = 0.177	0.10% (-4.88, 5.13), p = 0.966
Mid-deprived	-11.63% (-4.08, -18.53), p = 0.001	-6.18% (-0.02, -11.63), p = 0.049
Second most deprived	-24.61% (-16.18, -33.64), p < 0.001	-15.03% (-8.33, -22.14), p < 0.001
Most deprived	-34.99% (-25.86, -44.77), p < 0.001	-18.53% (-11.63, -25.86), p < 0.001

Confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).
4 most deprived quintiles compared to referent (least deprived)

3.3.3.2. The association between area level income deprivation and healthy ageing across 6 years

There was a significant association between area level income deprivation and unhealthy ageing ($p < 0.001$) *(Table 27).* Compared to those in the least deprived area level income deprivation quintile healthy ageing index scores were -15.03% (95% CI -7.25, -22.14, $p < 0.001$), -17.35% (95% CI -9.42, -25.86, $p < 0.001$) and -33.64% (95% CI -24.61, -43.33, $p < 0.001$) lower for the mid-deprived, second most deprived and most deprived quintiles respectively in the univariate analysis.

The reduction in scores for the mid-deprived (-7.25%; 95% CI -1.01, -13.88, $p = 0.016$), second most deprived (-11.63%; 95% CI -5.13, -18.53, $p < 0.001$) and most deprived (-18.53%; 95% CI -11.63, -25.86, $p < 0.001$) income area level deprivation quintiles were attenuated but remained significantly associated with unhealthy ageing after adjustment for confounders *(Table 27).*

Table 27. The association between area level income deprivation and healthy ageing across 6 years

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Least deprived	*Referent*	*Referent*
Second least deprived	-0.009% (-5.82, 6.18), p = 0.996	-1.00% (-6.76, 4.08), p = 0.587
Mid-deprived	-15.03% (-7.25, -22.14), p < 0.001	-7.25% (-1.01, -13.88), p = 0.016
Second most deprived	-17.35% (-9.42, -25.86), p < 0.001	-11.63% (-5.13, -18.53), p < 0.001
Most deprived	-33.64% (-24.61, -43.33), p < 0.001	-18.53% (-11.63, -25.86), p < 0.001

Confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).

Lower 4 quintiles compared to referent (least deprived

3.3.3.3. The association between area level employment deprivation and healthy ageing across 6 years

There was a significant association between area level employment deprivation and unhealthy ageing (p < 0.001) *(Table 28).* Compared to those in the least deprived area level employment deprivation quintile healthy ageing index scores were -9.42% (95% CI -3.05, -16.18, p = 0.004), -11.63% (95% CI -5.13, -19.72, p = 0.001), -23.37% (95% CI -15.03, -32.31, p < 0.001) and -40.49% (95% CI -29.69, -50.68, p < 0.001) lower for the second least deprived, mid deprived, second most deprived and most deprived quintiles respectively in the univariate analysis.

Adjustment for confounders attenuated the association, with the second least deprived and mid-deprived quintiles no longer significantly associated with unhealthy ageing {(1.01%; 95% CI -3.92, 6.18. P = 0.732) & (3.05%; 95% CI -1.98, 9.42. p = 0.221)}. However, the second most deprived and most deprived area level employment quintiles remained significantly associated with unhealthy ageing (-11.63%; 95% CI -5.13, -18.53. p < 0.001) and (-20.92%; 95% CI -12.75, -28.40. p < 0.001) respectively *(Table 28).*

Table 28. The association between area level employment deprivation and healthy ageing across 6 years

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Least deprived	*Referent*	*Referent*
Second least deprived	-9.42% (-3.05, -16.18), p = 0.004	1.01% (-3.92, 6.18), p = 0.732
Mid-deprived	-11.63% (-5.13, -19.72), p = 0.001	3.05% (-1.98, 9.42), p = 0.221
Second most deprived	-23.37% (-15.03, -32.31), p < 0.001	-11.63% (-5.13, -18.53), p < 0.001
Most deprived	-40.49% (-29.69, -50.68), p < 0.001	-20.92% (-12.75, -28.40), p < 0.001

Confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).

Lower 4 quintiles compared to referent (least deprived)

3.3.3.4. The association between area level health deprivation and healthy ageing across 6 years

There was a significant association between area level health deprivation and unhealthy ageing (p < 0.001) *(Table 29).* Compared to those in the least deprived area level health deprivation quintile healthy ageing index scores were -11.63% (95% CI -5.13, -19.72. p = 0.001), -23.37% (95% CI -15.03, -32.31. p < 0.001) and -33.64% (95% CI -24.61, -43.33. p < 0.001) lower for the mid-deprived, second most deprived and most deprived quintiles respectively in the univariate analysis.

Adjustment for confounders attenuated the association, with the mid deprived quintile no longer significantly associated with unhealthy ageing (5.13%; 95% CI -0.60, 10.52. p = 0.084). However, the second most deprived (-17.35%; 95% CI -10.52, -24.61. p < 0.001) and most deprived (-18.53%; 95% CI -11.63, -25.86. P = 0.000) quintiles remained significantly associated with unhealthy ageing *(Table 29).*

Table 29. The association between area level health deprivation and healthy ageing across 6 years

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Least deprived	*Referent*	*Referent*
Second least deprived	5.13% (-1.39, 11.63), p = 0.132	3.05% (-1.98, 9.42), p = 0.217
Mid-deprived	-11.63% (-5.13, -19.72), p = 0.001	5.13% (-0.60, 10.52), p = 0.084
Second most deprived	-23.37% (-15.03, -32.31), p < 0.001	-17.35% (-10.52, -24.61), p < 0.001
Most deprived	-33.64% (-24.61, -43.33), p < 0.001	-18.53% (-11.63, -25.86), p < 0.001

Confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).
Lower 4 quintiles compared to referent (least deprived)

3.3.3.5. The association between area level education deprivation and healthy ageing across 6 years

There was a significant association between area level education deprivation and unhealthy ageing ($p < 0.001$) *(Table 30).* Compared to those in the least deprived area level education deprivation quintile healthy ageing index scores were -17.35% (95% CI -10.52, -25.86. $p < 0.001$), -24.61% (95% CI -16.18, -33.64. $p < 0.001$) and -34.99% (95% CI -25.86, -46.23. $p < 0.001$) lower for the mid-deprived, second most deprived and most deprived quintiles respectively.

Adjustment for confounders attenuated the association. However, the mid-deprived (-10.52%, 95% CI-5.13, -17.35. $p < 0.001$), second most deprived (-13.88%; 95% CI -7.25, -20.92. $p < 0.001$) and most deprived (-18.53%; 95% CI -10.52, -25.86. $p < 0.001$) area level education deprivation quintiles remained significantly associated with unhealthy ageing *(Table 30).*

Table 30. The association between area level education deprivation and healthy ageing across 6 years

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Least deprived	*Referent*	*Referent*
Second least deprived	3.05% (-3.25, 9.42), p = 0.366	-1.00% (-5.82, 5.13), p = 0.844
Mid-deprived	-17.35% (-10.52, -25.86), p < 0.001	-10.52% (-5.13, -17.35), p < 0.001
Second most deprived	-24.61% (-16.18, -33.64), p < 0.001	-13.88% (-7.25, -20.92), p < 0.001
Most deprived	-34.99% (-25.86, -46.23), p < 0.001	-18.53% (-10.52, -25.86), p < 0.001

Confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).
Lower 4 quintiles compared to referent (least deprived)

3.3.3.6. The association between area level housing and services deprivation and healthy ageing across 6 years

The second least deprived area level housing quintile was associated with unhealthy ageing in the adjusted analysis compared to the least deprived quintile. The percentage reduction was -7.25% (CI -1.01, -13.88. p = 0.026) *(Table 31).* No other housing quintiles were significantly associated with unhealthy ageing in either model.

Table 31. The association between area level housing and services deprivation and healthy ageing across 6 years

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Least deprived	*Referent*	*Referent*
Second least deprived	5.13% (-1.98, 12.75), p = 0.137	-7.25% (-1.01, -13.88), p = 0.026
Mid-deprived	2.02% (-4.88, 9.42), p = 0.512	3.05% (-2.96, 9.42), p = 0.353
Second most deprived	6.18% (-0.10, 13.88), p = 0.095	6.18%, (-0.20, 11.63), p = 0.059
Most deprived	-4.88% (-10.42, 2.02), p = 0.168	-0.10% (-5.82, 5.13), p = 0.962

Confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).

Lower 4 quintiles compared to referent (least deprived)

3.3.3.7. The association between area level crime deprivation and healthy ageing across 6 years

There was a significant association between area level crime deprivation and unhealthy ageing (p < 0.001) *(Table 32).* Compared to those in the least deprived area level crime deprivation quintile, those in the second least deprived (-10.52%; 95% CI -4.08, -18.53. p = 0.003), second most deprived (-10.52%; 95% CI -3.05, -18.53. P = 0.006) and most deprived (-28.40%; 95% CI -18.53, -37.71%. p < 0.001) quintiles aged less healthily in the univariate analysis.

Adjustment for confounders attenuated the association, but the second least deprived (-8.33%; 95% CI -3.05, -15.03. p = 0.004), second most deprived (-6.18%; 95% CI -1.01, -12.75. p = 0.029) and most deprived (-20.92%; 95% CI -13.88, -28.40. p < 0.001) quintiles remained significantly associated with unhealthy ageing *(Table 32).*

Table 32. The association between area level crime deprivation and healthy ageing across 6 years

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Least deprived	*Referent*	*Referent*
Second least deprived	-10.52% (-4.08, -18.53), p = 0.003	-8.33% (-3.05, -15.03), p = 0.004
Mid-deprived	4.08% (-2.96, 10.52), p = 0.252	5.13% (-0.60, 10.52%), p = 0.084
Second most deprived	-10.52% (-3.05, -18.53), p = 0.006	-6.18% (-1.01, -12.75), p = 0.029
Most deprived	-28.40% (-18.53, -37.71%), p < 0.001	-20.92% (-13.88, -28.40), p < 0.001

Confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).
Lower 4 quintiles compared to referent (least deprived)

3.3.3.8. The association between area level environment deprivation and healthy ageing across 6 years

There was a significant association between area level environment deprivation and unhealthy ageing (p = 0.001) *(Table 33)*. The second most deprived and most deprived area level environment quintiles were significantly associated with unhealthy ageing over 6 years compared to those in the least deprived quintile in the univariate analysis. The percentage reductions were -13.88% (95% CI -6.18, -22.14. p < 0.001) and -15.03% (95% CI -7.25, -22.14). p < 0.001) respectively. Adjustment for confounders attenuated the association, however the second most deprived (-7.25%; 95% CI -1.01, -13.88. p = 0.025) and most deprived (-10.52%; 95% CI -4.08, -16.18. p = 0.001) quintiles remained significantly associated with unhealthy ageing *(Table 33)*.

Table 33. The association between area level environment deprivation and healthy ageing at baseline

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Least deprived	*Referent*	*Referent*
Second least deprived	3.05% (-3.92, 10.52), p = 0.393	0.10% (-5.82, 6.18), p = 0.967
Mid-deprived	4.08% (-2.96, 11.63), p = 0.219	1.01% (-3.92, 7.25), p = 0.666
Second most deprived	-13.88% (-6.18, -22.14), p < 0.001	-7.25% (-1.01, -13.88), p = 0.025
Most deprived	-15.03% (-7.25, -22.14), p < 0.001	-10.52% (-4.08, -16.18), p = 0.001

Confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).

Lower 4 quintiles compared to referent (least deprived)

3.3.4. The association between access to care and healthy ageing across 6 years

There was a significant association between access to care and unhealthy ageing (p = 0.027). Compared to those in the highest ranked practice according to access to care those in the fourth highest (-15.03%; 95% CI -6.18, -24.61. p < 0.001), fifth highest (-9.42%; 95% CI -1.01, -18.53. p = 0.024) and lowest ranked (-8.33%; 95% CI -2.02, -15.03. p = 0.009) practices aged more unhealthily in the univariate analysis.

Adjustment for confounders attenuated the association, however the fourth highest (-11.63%; 95% CI -5.13, -19.72. p < 0.001), fifth highest (-10.52%; 95% CI -4.08, -18.53. p = 0.002) and lowest (-6.18%; 95% CI -1.01, -11.63. p = 0.027) ranked practice remained significantly associated with less healthy ageing *(Table 34)*.

Table 34. The association between practice ranked access to care and healthy ageing across 6 years

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Highest	*Referent*	*Referent*
Second highest	-1.98% (-9.52, 7.25), p = 0.710	-1.00% (-7.69, 6.18), p = 0.793
Third highest	-1.98% (-8.61, 5.13), p = 0.598	2.02% (-3.92, 8.33), p = 0.578
Fourth highest	-15.03% (-6.18, -24.61), p < 0.001	-11.63% (-5.13, -19.72), p < 0.001
Fifth highest	-9.42% (-1.01, -18.53), p = 0.024	-10.52% (-4.08, -18.53), p = 0.002
Lowest	-8.33% (-2.02, -15.03), p = 0.009	-6.18% (-1.01, -11.63), p = 0.027

Confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).

Lower ranked practices compared to referent (highest ranked)

3.3.5. The association between quality of care and healthy ageing across 6 years

Compared to those in the highest ranked practice according to quality of care those at the third highest (-10.52%; 95% CI -1.01, -22.14. p = 0.032), fifth highest (-16.18%; 95% CI -6.18, -28.40. p = 0.002) and lowest ranked practice (-10.52%; 95% CI -1.01, -19.72. p = 0.021) aged less healthily in the univariate analysis.

Adjustment for confounders attenuated the relationship with the lowest ranked practice no longer associated with unhealthy ageing (7.25%; 95% CI -0.30, 15.03. p = 0.060). The third highest (-11.63%; 95% CI -3.05, -22.14. p = 0.006) and fifth highest (-12.75% (95% CI -4.08, -23.37. p = 0.004) ranked practices remained significantly associated with less healthy ageing *(Table 35).*

Table 35. The association between practice ranked quality of care and healthy ageing across 6 years

	Percentage change in baseline index (95 % CI) univariate analysis	Percentage change in baseline index (95% CI) adjusted for potential confounders
Highest	*Referent*	*Referent*
Second highest	-2.02% (-7.25, 10.52), p = 0.710	1.01% (-5.82, 8.33), p = 0.793
Third highest	-10.52% (-1.01, -22.14), p = 0.032	-11.63% (-3.05, -22.14), p = 0.006
Fourth highest	-0.40% (-8.61, 9.42), p = 0.938	3.05% (-4.88, 10.52), p = 0.496
Fifth highest	-16.18% (-6.18, -28.40), p = 0.002	-12.75% (-4.08, -23.37), p = 0.004
Lowest	-10.52% (-1.01, -19.72), p = 0.021	7.25% (-0.30, 15.03), p = 0.060

Confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, and diagnosis of chronic musculoskeletal conditions).
Lower ranked practices compared to referent (highest ranked)

3.3.6. Interactions between onset of pain and deprivation and healthy ageing across 6 years

There were 2 significant interactions between pain and deprivation and unhealthy ageing across 6 years *(Table 36, significant interactions in bold and underlined)*. There were significant interactions between widespread pain and manual work (p = 0.008) and some pain and area level education deprivation (p = 0.014).

Table 36. Interactions between pain and deprivation and healthy ageing across 6 years

Assessed interaction	Coefficient (95% CI)	p-value
Pain x individual level deprivation		
Some pain x school age education only	0.02 (-0.04, 0.08)	0.523
Widespread pain x school age education only	0.05 (-0.03, 0.13)	0.236
Some pain x manual work	-0.02 (-0.07, 0.02)	0.323
<u>Widespread pain x manual work</u>	**<u>-0.08 (-0.14, -0.02)</u>**	**<u>0.008</u>**
Some pain x no access to car	0.03 (-0.06, 0.11)	0.522
Widespread pain x no access to car	0.002 (-0.09, 0.10)	0.961
Some pain x no access to public transport	-0.03 (-0.18, 0.12)	0.715
Widespread pain x no access to public transport	-0.007 (-0.17, 0.15)	0.928
Some pain x no access to GP	0.08 (-0.03, 0.18)	0.139
Widespread pain x no access to GP	0.04 (-0.07, 0.16)	0.477
Some pain x no access to work	-0.04 (-0.11, 0.02)	0.209
Widespread pain x no access to work	-0.06 (-0.14, 0.02)	0.117
Pain x overall area level deprivation		
Some pain x second least deprived	-0.02 (-0.09, 0.04)	0.509
Some pain x mid-deprived	0.06 (-0.01, 0.13)	0.104
Some pain x second most deprived	-0.06 (-0.14, 0.01)	0.110
Some pain x most deprived	0.01 (-0.07, 0.09)	0.805
Widespread pain x second least deprived	-0.04 (-0.12, 0.04)	0.355
Widespread pain x mid-deprived	-0.03 (-0.12, 0.06)	0.541
Widespread pain x second most deprived	-0.04 (-0.14, 0.05)	0.367
Widespread pain x most deprived	0.006 (-0.09, 0.10)	0.906
Pain x area income level deprivation		

Some pain x second least deprived	-0.004 (-0.07, 0.06)	0.911
Some pain x mid-deprived	0.02 (-0.06, 0.09)	0.658
Some pain x second most deprived	-0.05 (-0.12, 0.03)	0.230
Some pain x most deprived	-0.02 (-0.10, 0.06)	0.651
Widespread pain x second least deprived	-0.05 (-0.14, 0.03)	0.205
Widespread pain x mid-deprived	-0.07 (-0.16, 0.02)	0.141
Widespread pain x second most deprived	-0.08 (-0.17, 0.02)	0.114
Widespread pain x most deprived	-0.01 (-0.11, 0.09)	0.856
Pain x area employment level deprivation		
Some pain x second least deprived	0.03 (-0.04, 0.09)	0.433
Some pain x mid-deprived	0.04 (-0.03, 0.11)	0.320
Some pain x second most deprived	-0.05 (-0.13, 0.03)	0.193
Some pain x most deprived	0.02 (-0.06, 0.10)	0.655
Widespread pain x second least deprived	0.03 (-0.06, 0.11)	0.514
Widespread pain x mid-deprived	-0.03 (-0.12, 0.06)	0.452
Widespread pain x second most deprived	-0.04 (-0.13, -0.06)	0.459
Widespread pain x most deprived	0.01 (-0.09, 0.11)	0.796
Pain x area health level deprivation		
Some pain x second least deprived	0.01 (-0.05, 0.08)	0.671
Some pain x mid-deprived	0.05 (-0.02, 0.12)	0.187
Some pain x second most deprived	-0.03 (-0.11, 0.04)	0.394
Some pain x most deprived	0.01 (-0.07, 0.09)	0.822
Widespread pain x second least deprived	-0.02 (-0.10, 0.07)	0.684
Widespread pain x mid-deprived	-0.01 (-0.10, 0.08)	0.769
Widespread pain x second most deprived	-0.02 (-0.12, 0.07)	0.670
Widespread pain x most deprived	0.01 (-0.09, 0.11)	0.809
Pain x area education level deprivation		
Some pain x second least deprived	-0.05 (-0.12, 0.01)	0.125
Some pain x mid-deprived	-0.05 (-0.12, 0.03)	0.224
Some pain x second most deprived	**-0.10 (-0.18, -0.02)**	**0.014**
Some pain x most deprived	-0.04 (-0.13, 0.04)	0.299
Widespread pain x second least deprived	0.003 (-0.08, 0.09)	0.953
Widespread pain x mid-deprived	-0.07 (-0.16, 0.02)	0.139
Widespread pain x second most deprived	-0.05 (-0.14, 0.05)	0.363
Widespread pain x most deprived	-0.0004 (-0.10, 0.10)	0.994
Pain x area housing level deprivation		
Some pain x second least deprived	-0.003 (-0.08, 0.08)	0.948
Some pain x mid-deprived	0.05 (-0.03, 0.13)	0.211
Some pain x second most deprived	0.008 (-0.07, 0.08)	0.839
Some pain x most deprived	0.05 (-0.03, 0.12)	0.218
Widespread pain x second least deprived	-0.04 (-0.13, 0.06)	0.428
Widespread pain x mid-deprived	0.05 (-0.04, 0.15)	0.291
Widespread pain x second most deprived	0.02 (-0.07, 0.11)	0.691
Widespread pain x most deprived	0.04 (-0.05, 0.13)	0.381
Pain x area crime level deprivation		
Some pain x second least deprived	0.03 (-0.05, 0.10)	0.482

Some pain x mid-deprived	0.02 (-0.05, 0.09)	0.505
Some pain x second most deprived	0.05 (-0.03, 0.12)	0.213
Some pain x most deprived	0.03 (-0.05, 0.12)	0.457
Widespread pain x second least deprived	0.04 (-0.06, 0.13)	0.437
Widespread pain x mid-deprived	0.01 (-0.07, 0.10)	0.775
Widespread pain x second most deprived	0.03 (-0.06, 0.13)	0.463
Widespread pain x most deprived	0.02 (-0.08, 0.12)	0.748
Pain x area environment level deprivation		
Some pain x second least deprived	0.01 (-0.06, 0.08)	0.743
Some pain x mid-deprived	0.005 (-0.07, 0.08)	0.900
Some pain x second most deprived	-0.01 (-0.08, 0.07)	0.832
Some pain x most deprived	-0.06 (-0.14, 0.01)	0.098
Widespread pain x second least deprived	0.04 (-0.05, 0.13)	0.426
Widespread pain x mid-deprived	-0.01 (-0.10, 0.08)	0.854
Widespread pain x second most deprived	0.01 (-0.08, 0.11)	0.767
Widespread pain x most deprived	-0.03 (-0.12, 0.06)	0.474
Pain x access to care		
Some pain x second highest	0.01 (-0.08, 0.10)	0.762
Some pain x third highest	0.02 (-0.06, 0.10)	0.617
Some pain x fourth highest	-0.002 (-0.09, 0.09)	0.962
Some pain x fifth highest	-0.03 (-0.11, 0.06)	0.539
Some pain x lowest	0.02 (-0.05, 0.04)	0.592
Widespread pain x second highest	0.03 (-0.08, 0.15)	0.561
Widespread pain x third highest	0.02 (-0.08, 0.12)	0.705
Widespread pain x fourth highest	0.04 (-0.06, 0.15)	0.424
Widespread pain x fifth highest	0.002 (-0.10, 0.11)	0.969
Widespread pain x lowest	0.04 (-0.04, 0.12)	0.360
Pain x quality of care		
Some pain x second highest	-0.01 (-0.10, 0.08)	0.762
Some pain x third highest	-0.04 (-0.15, 0.06)	0.449
Some pain x fourth highest	0.01 (-0.09, 0.11)	0.906
Some pain x fifth highest	-0.02 (-0.12, 0.09)	0.772
Some pain x lowest	0.004 (-0.09, 0.09)	0.928
Widespread pain x second highest	-0.03 (-0.15, 0.08)	0.561
Widespread pain x third highest	-0.03 (-0.16, 0.10)	0.643
Widespread pain x fourth highest	-0.01 (-0.14, 0.11)	0.825
Widespread pain x fifth highest	0.01 (-0.12, 0.14)	0.881
Widespread pain x lowest	0.004 (-0.11, 0.12)	0.944

Adjusted for potential confounders (age, gender, social networks, smoking status, alcohol consumption, physical inactivity, use of pain analgesia and non-steroidal anti-inflammatory drugs, diagnosis of chronic musculoskeletal conditions).

3.3.7. Models goodness of fit

The longitudinal models goodness of fit was assessed by the Akaike Information Criteria (AIC) with lower values indicating improved model fit.

Table 37. Akaike information criterion (AIC) values for deprivation variables in each model for longitudinal relationship between pain, deprivation and healthy ageing over six years.

	Akaike information criterion (AIC)		
Deprivation variables	Univariate model	Model 1	Interactions
Education	11839	8162	8165
Manual worker	11942	8159	8156
No access to car	11791	8114	8118
No access to public transport	11755	8147	8150
No access to GP	11845	8138	8140
No access to work	11570	8090	8092
Access to care	11943	8152	8169
Quality of care	11943	8152	8169
Overall area level deprivation	11877	8122	8124
Area level income deprivation	11875	8123	8129
Area level employment deprivation	11870	8123	8129
Area level health deprivation	11882	8123	8131
Area level education deprivation	11866	8119	8124
Area level housing deprivation	11952	8160	8171
Area level crime deprivation	11915	8133	8147
Area level environment deprivation	11939	8152	8162

In univariate models, of all the deprivation variables, no access to work explained the greatest variance (11570). With addition of confounders model fit improved but did not continue to increase with the addition of interaction terms. For all of the fully adjusted models there is no observable difference between variables with values ranging from 8090 for no access to work to 8162 for education.

Chapter 4. Discussion

4.1. Summary of main findings

4.1.1. Summary of cross sectional analysis addressing objectives from 1.8.1.

Women were more likely to report widespread pain at baseline. There was no other significant difference in baseline pain status by other demographic characteristics (*table 1*, Chapter 3). Female patients, and those with some pain and widespread pain had aged less healthily at baseline, having lower healthy ageing index scores *(table 6 & 11)*. There was a significant association between pain (some and widespread pain) and healthy ageing at baseline ($p < 0.001$, *table 11*). After adjustment for confounders, compared to those with no pain healthy ageing index scores were -7.69% (95% CI -10.42, -4.88) and -17.30% (95% CI -19.75, -14.79) lower for those with some and widespread pain respectively. Post adjustment for confounders' age had no effect on healthy ageing index scores at baseline (0.00%; 95% CI 0.00, 0.00) *(table 11)*.

Generally, those experiencing greater deprivation reported more extensive pain at baseline *(table 2 individual level deprivation, table 3 area level deprivation, table 4 access to care, table 5 quality of care)*. Those experiencing greater deprivation had also aged less healthily at baseline. Healthy ageing index scores were lower with greater deprivation across individual level deprivation *(table 7)*, area level deprivation *(table 8)*, access to care *(table 9)* and quality of care *(table 10)* variables.

At baseline participants experiencing greater individual deprivation had lower HAI scores (indicating less healthy ageing). After adjustment for confounders, education and manual work were no longer associated with a change in the baseline index. However, no access to car, or public transport, or GP, or work remained associated after adjustment for confounders with less healthy ageing at baseline *(table 12).* Those experiencing greater levels of area level deprivation according to the English IMD also had lower HAI scores at baseline representing less healthy ageing. This was true for all of the 7 sub domains of the IMD except barriers to housing and services *(table 8).* After adjustment for confounders the second most deprived and most deprived overall deprivation, area level income deprivation, area level employment deprivation, area level health deprivation and area level crime deprivation quintiles were associated with lower HAI scores at baseline. Only the second most deprived area level environment deprivation quintile and housing deprivation quintile and most deprived education deprivation quintile were associated with a reduction in the HAI at baseline *(tables 13 - 20)*.

Patients registered at the lowest ranked practices according to access (GPPS) and quality (QOF) also had lower HAI scores at baseline than patients registered at the highest ranked practices according to access and quality *(tables 9 & 10)* and both were associated with unhealthy ageing at baseline. The lowest 3 practices according to access to care were associated after adjustment for confounders with lower HAI scores at baseline *(table 21)*. The fifth highest ranked practice according to quality of care was associated with lower HAI scores at baseline after adjustment for confounders *(table 22)*.

There were significant interactions between widespread pain and; no access to car, no access to public transport, no access to work, the most deprived area crime level quintile, the fourth highest ranked practice according to access to care and the fifth highest ranked practice according to quality of care *(table 23)* translating to significant reductions in healthy ageing at baseline.

4.1.2. Summary of longitudinal findings addressing objectives from 1.8.2.

The onset of some pain and widespread pain were associated with a reduction in healthy ageing across the six years of follow up ($p < 0.001$). Among subjects with no pain after adjustment for confounders the onset of some pain and widespread pain was associated with a decrease in the healthy ageing score of 25.9% (-19.72% + the decrease of 6.18% associated with time) and 41.17% (-34.99% + the decrease of 6.18% associated with time) respectively *(table 24)*.

After adjusting for confounders all the individual deprivation variables except education were associated with lower healthy ageing scores and consequently poorer ageing. The reductions were as follows; manual work (-4.08%; 95% CI -1.00, -8.33. $p = 0.026$), no access to car (-22.14%; 95% CI -15.03, -29.69. $p < 0.001$), no access to public transport (-16.18%; 95% CI -5.13, -27.12. $p = 0.002$), no access to GP (-17.35%; 95% CI -9.42, -25.86. $p < 0.001$) and no access to work (-22.14%; 95% CI -16.18, -28.40. $p < 0.001$) *(table 25)*.

There was a significant association between overall area level deprivation and unhealthy ageing across 6 years (p < 0.001) *(table 26).* Compared to the least deprived area, after adjustment for confounders healthy ageing scores were reduced as follows; for the mid-deprived (-6.18%; 95% CI -0.02, -11.63, p = 0.049), second most deprived (-15.03%; 95% CI -8.33, -22.14, p < 0.001) and most deprived (–18.53%; 95% CI -11.63, -25.86, p < 0.001) *(table 26).* There was a significant association between; area level income deprivation (p < 0.001) *(table 27),* area level employment deprivation (p < 0.001) *(table 28)*, area level health deprivation (p < 0.001) *(table 29),* area level education deprivation (p < 0.001) *(table 30),* area level crime deprivation (p < 0.001) *(table 32),* and area level environment deprivation and unhealthy ageing (p < 0.001) *(table 33).* Only the second least deprived area level housing quintile was associated with unhealthy ageing in the adjusted analysis compared to the least deprived quintile. The percentage reduction was -7.25% (CI -1.01, -13.88. p = 0.026) *(table 31).*

There was a significant association between access to care and unhealthy ageing (p = 0.027). Compared to those in the highest ranked practice according to access to care healthy ageing scores were -11.63% (95% CI -5.13, -19.72. p < 0.001) -10.52% (95% CI -4.08, -18.53. p = 0.002) and -6.18% (95% CI -1.01, -11.63. p = 0.027) lower for the fourth highest, fifth highest and lowest ranked practice respectively after adjustment for confounders *(table 34).*

Compared to those in the highest ranked practice according to quality of care healthy ageing scores were -11.63% (95% CI -3.05, -22.14. p = 0.006) and -12.75% (95% CI -4.08, -23.37. p = 0.004) lower for the third highest and fifth highest ranked practice respectively after adjustment for confounders *(table 35).*

Those reporting widespread pain and a background of manual work had a significantly greater percentage reduction (there was an interaction) in their healthy ageing index score over 6 years than those with widespread pain but no history of manual work (Coef. -0.08; 95% CI -0.14, -0.02. p = 0.008) *(table 36).* Those reporting some pain and in the second most deprived education quintile also had a significantly greater percentage reduction (there was an interaction) in healthy ageing index score over 6 years than those with some pain but in the least deprived education quintile (Coef. -0.10; 95% CI -0.18, -0.02. p = 0.014) *(table 36).*

4.2. Comparison of results with published literature

4.2.1. Pain and healthy ageing by socio-demographic characteristics

At baseline, women were more likely than men to report widespread pain (61.03% *cf.* 38.97%; p = <0.001), and divorced and widowed respondents were more likely to report widespread pain, making up a greater proportion of the total number reporting widespread pain compared to all pain (7.59% *cf.* 6.53% and 12.61% *cf.* 10.88% respectively; p = 0.007). Although there was no significant difference in age (p = 0.30), living arrangements (p = 0.692), social networks (p = 0.5383) presence (p = 0.752) or frequency of contact with confidant (p = 0.464) between the pain groups *(table 1)*. The significant associations reported between poor social networks (Fukuda *et al.,* 2005) and absence of confidant (Michael *et al.,* 1999) and widespread musculoskeletal pain discussed in section 1.5 were not reflected in this sample.

Women had aged less well than males at baseline *(table 11)* and aged less well over 6 years (p = 0.006) *(table 24)*. This is not surprising; women generally report higher rates of pain in all sites and for all age groups (Urwin *et al.,* 1998; Thomas *et al.,* 2004a) (Section 1.1.3.2).

After adjustment for confounders (including diagnosis of chronic musculoskeletal condition) ageing had no effect on healthy ageing index scores at baseline (0.00%; 95% CI 0.00, 0.00). This reflects that noted in section 1.1.2., that whilst chronic pain is common amongst older adults it is not a normal part of ageing, as postulated by Gruenberg (1977), and physical or psychopathology is always involved (Harkins *et al.,* 1994). Furthermore our results support Christensen *and colleagues'* (2009) conclusion that ageing processes are modifiable.

4.2.2. Impact of pain on healthy ageing

Those with some pain and widespread pain had aged less healthily at baseline than those with no pain, having lower healthy ageing index scores (p < 0.001) *(table 6 & 11*). Similarly, the onset of some pain and widespread pain were associated with a graded reduction in healthy ageing across the six years of follow up (p < 0.001*) (table 24*).

Lower HAI scores with widespread pain, than some pain and no pain respectively are expected (discussed in section 1.1.5., summarised below) given that widespread musculoskeletal pain is associated with worse outcomes across multiple health domains than those with pain at fewer sites and those who are pain free (World Health Organization, 2003). It also reflects that pains consequences are variable, substantial and far-reaching. Pain has previously been reported to cause psychological distress, cognitive impairment (Lee, Pendleton *et al.,* 2010), physical disability, social withdrawal, reduced sexual function (Tajar, O'Neill *et al.,* 2011), falls (Blyth, Cumming *et al,.* 2007), self-neglect and suicidality (Juurlink, Herrmann *et al.,* 2004). Those with regional and widespread pain are at increased risk of cancer death (McBeth, Symmons *et al.,* 2009), prevention and treatment of chronic pain may significantly help in increasing the healthy lifespan (Leadley *et al.,* 2013), and new onset of chronic widespread pain is associated with poor mental and physical Health Related Quality of Life (Nicholl, Macfarlane *et al.,* 2009).

As reported in section 1.1.3.2., the severity of musculoskeletal pain symptoms, prevalence of associated disability (Walker-Bone, 2007) and degree of interference with normal activities (Thomas, Wilkie *et al.,* 2004) rise with age. This is reflected in the magnitude of reduction in the HAI with the onset of widespread pain in an older cohort across 6 years (-34.99%) (*table 24*), compared to the equivalent result in the baseline analysis (-17.30%) *(table 11*). A similar trend was apparent for the some pain group (-19.72% *cf.* -7.69%).

4.2.3. Impact of deprivation on healthy ageing

Those experiencing greater deprivation had aged less healthily at baseline. Median healthy ageing index scores were lower at baseline with greater deprivation across individual level deprivation ($p < 0.001$) *(table 7)*, area level deprivation ($p < 0.001$) *(table 8)*, access to care ($p < 0.001$) *(table 9)* and quality of care ($p < 0.001$) *(table 10)* variables. After adjustment for confounders all the individual deprivation variables except education were associated with lower healthy ageing scores across 6 years *(table 25)***.** There was a significant association between overall area level deprivation and unhealthy ageing across 6 years ($p < 0.001$) *(table 26),* which was echoed in the following constituent area level deprivation indicators; income ($p < 0.001$) *(table 27),* employment ($p < 0.001$) *(table 28),* health ($p < 0.001$) *(table 29)*, education ($p < 0.001$) *(table 30),* crime deprivation ($p < 0.001$) *(table 32)* and environment deprivation ($p = 0.001$) *(table 33).* Area level housing and services deprivation did not follow the general trend. Only the second least deprived area level housing quintile was associated with unhealthy ageing in the adjusted analysis compared to the least deprived quintile. The percentage reduction was -7.25% (CI -1.01, -13.88. $p = 0.026$) *(table 31).*

There was a significant association between access to care and unhealthy ageing ($p = 0.027$) *(table 34)*. The impact of quality was a little less clear, compared to those in the highest ranked practice according to quality of care healthy ageing scores were -11.63% (95% CI -3.05, -22.14. $p = 0.006$) and -12.75% (95% CI -4.08, -23.37. $p = 0.004$) lower for the third highest and fifth highest ranked practice respectively after adjustment for confounders *(table 35).*

In section 1.1.1., it was noted that the IASP pain definition viewed psychological factors as inherent to the pain experience, and consequently pain (and therefore probably healthy ageing) is likely influenced by cultural, economic, social, demographic and environmental factors (Merskey & Bogduk, 2012). Section 1.3.1. commented that if inequalities in health and economics hinder the ability of older people to engage in activities as per the activist theory of healthy ageing (Havighurst, 1961), this could lead to disengagement (Cumming & Henry, 1961) and poorer ageing. Wen *et al.,* (2006) postulated that perceptions which are linked to psychological processes may act as pathways linking objective features of the environment to health (section 1.6.7.3.), in keeping with Melzack's pain neuromatrix (1999) assertion that pain is produced in the CNS in response to stimuli from the body and or environment. Howe (2006) noted that the best explanation for the discrepancies between and within countries in later life morbidity and mortality was the role of environmental factors. Rowe and Kahn (1987) spoke of accumulated 'modifiable' environmental risks (1.3.2.1), Baltes and Baltes (1990) commented that the way strategies are realised depends on personal and societal circumstances faced as individual's age (1.3.3.1), Riley (1998) noted that success is reliant on the availability of structural opportunities or interventions in society (1.3.5), whereas O'Rand (2002) spoke of individual level and area level deprivation having reciprocal, reinforcing cycles contributing to cumulative disadvantage across the life course {a view endorsed by Ross *et al.,* (2013) and the Alameda County data (see section 1.6.2.)}.

4.2.3.1. Impact of individual level deprivation on healthy ageing

Section 1.1.5. surmised that those with more limited means are restricted in their potential responses to pain, and questioned which limitations or exposures lead to worse outcomes.

A greater proportion of those with widespread pain reported lower supervisory or routine occupational class compared to those with no pain (50.13% *cf.* 45.58%; p = 0.027), had received school age education only (86.45% *cf.* 81.34%; p = 0.020), had no access to car (15.87% *cf.* 11%; p = 0.002), had no access to public transport (8.30% *cf.* 3.02%; p < 0.001), no access to GP (9.81% *cf.* 5.21%; p = 0.002) and no access to work (23.96% *cf.* 13.2%; p < 0.001) *(table 2)*. Additionally, a greater proportion of those with some pain reported lower supervisory or routine occupational history compared to those with no pain (46.18% *cf.* 45.58%; p = 0.027). The same was true for all the other individual level deprivation variables noted to have a similar relationship with widespread pain, namely; school age education only (83.49% *cf.* 81.34%; p = 0.020), access to car (11.15% *cf.* 11%; p = 0.002), access to public transport (3.28% *cf.* 3.02%; p < 0.001), access to GP (7.19% *cf.* 5.21%; p = 0.002) and access to work (17.38% *cf.* 13.2%; p < 0.001) *(table 2)*. The difference in proportions was noticeably smaller between the some pain and no pain groups, compared to the widespread pain and no pain groups.

Reporting pain did not differ at baseline with access to chemist (p = 0.529), access to help with income (p = 0.501), or access to telephone (p = 0.948) *(table 2)*. These factors may not be relevant to pain reporting or access to these services may not be influenced by pain state in the study population, the latter being more probable.

Median healthy ageing index scores were lower at baseline with greater individual level deprivation (p < 0.001) *(table 7)*. This reflects the literature discussed in section 1.5., that lower socioeconomic conditions (Fukuda *et al.,* 2005) and lower education (Pruchno *et al.,* 2010) are associated with widespread musculoskeletal pain, also section 1.6.4., that nonprofessional occupations are associated with poorer osteoarthritis outcomes (Luong *et al.,* 2012) and Guralnik & Kaplan's (1989) report that less income lead to worse function.

However, after adjustment for confounders, education and manual work were no longer associated with a change in the baseline index. No access to car, or public transport, or GP, or work remained associated after adjustment for confounders with less healthy ageing at baseline *(table 12)*. After adjusting for confounders all the individual deprivation variables except education were associated with lower healthy ageing scores and consequently poorer ageing across 6 years *(table 25)*. Luong *et al.,* (2012) report that nonprofessional occupations are associated with poorer osteoarthritis outcomes was demonstrated by manual works association with poorer ageing over 6 years but not at baseline.

Educational attainment was not associated with less healthy ageing at baseline or over 6 years after adjustment for confounders; contrary to expectations given educational attainments reported association with; poorer osteoarthritis outcomes (Luong *et al.,* 2012), interfering pain in older people (Jordan *et al.,* 2008 & Dorner *et al.,* 2011), increase in total life expectancy and active life expectancy (Jack *et al.,* 1993), reduced mortality (Fischer, Karlsson *et al.,* 2013) and graded relationship with health outcomes {Section 1.6.5. (Marmot *et al.,* 1991; Pickett *et al.,* 2001; Huisman *et al.,* 2005)}. This does reflect that reported by Feinglass *et al.,* (2007) *(section 1.6.3.)* who noted that after adjustment for health status and behavioural risk factors lower levels of education were no longer associated with higher mortality in an American population.

Section 1.6.5. reported that individual level indicators (income, occupation, educational level {contrary to our results}) and neighborhood-level characteristics demonstrate a graded relationship with health outcomes (Marmot *et al.,* 1991; Pickett *et al.,* 2001; Huisman *et al.,* 2005). This was apparent in the median healthy ageing index scores at baseline stratified by individual level deprivation variables *(table 7)*, it was also apparent in the association between individual level deprivation variables and healthy ageing at baseline and 6 years (tables 12 & 25).

4.2.3.2. Impact of area level deprivation on healthy ageing

There was a significant association between overall area level deprivation and unhealthy ageing at baseline (p = 0.001) *(table 8).* Adjustment for confounders attenuated the association, however, the second most deprived and most deprived overall area level deprivation quintiles were still associated with lower HAI scores at baseline of -4.88% (95% CI -7.69, -1.98) and -7.69% (95% CI -11.31, -4.88) respectively *(table 13).*

There was a significant association between overall area level deprivation and unhealthy ageing across 6 years (p < 0.001) *(table 26).* Compared to the least deprived area, after adjustment for confounders healthy ageing scores were reduced as follows; for the mid-deprived (-6.18%; 95% CI -0.02, -11.63, p = 0.049), second most deprived (-15.03%; 95% CI -8.33, -22.14, p < 0.001) and most deprived (–18.53%; 95% CI -11.63, -25.86, p < 0.001) *(table 26).*

These findings reflect that noted in section 1.5., that inadequate income, neighbourhood deprivation and education (Jordan *et al.,* 2008; Shi *et al.,* 2010; Dorner *et al.,* 2011) are associated with interfering pain in older people, leading to poorer ageing, and that people with lower SES reported greater disability with pain (Dorner *et al.,* 2011). Similarly, in section 1.6.2., the Alameda County Study reported that mortality risks were significantly higher in neighborhoods with a low social environment, their descriptor for area level deprivation (after taking account of confounders) (Yen *et al.,* 1999), supported by Ross and colleagues' (2013) conclusion that mortality is higher with greater material and social deprivation, with evidence that these factors interact in both a protective and harmful manner. Likewise, from section 1.6.3; the prevalence of disability overall and need for 'constant care' was lower in British men and women in social classes I and II compared to the rest. Men in classes I and II could expect longer life free from disability, compared to those in classes III to V. Men in social classes I and II also had a shorter duration of disability. So higher socioeconomic groups in England can expect fewer years of disability despite longer overall life expectancy (Melzer *et al.,* 2000). Furthermore, in section 1.6.4.; Brekke reported that living in less affluent areas was associated with strong and widespread non-inflammatory musculoskeletal pain, with high levels of physical disability and mental distress and with low life satisfaction (Brekke *et al.,* 2002), Weden noted a strong association between neighbourhood quality and health (Weden *et al.,* 2008), whilst Dorner reported that those with lower SES gradually reported greater disability through pain (Dorner *et al.,* 2011). Lastly, section 1.6.5., reported that neighborhood-level characteristics demonstrate a graded relationship with health outcomes (Marmot *et al.,* 1991; Pickett *et al.,* 2001; Huisman *et al.,* 2005), clearly apparent in the association between area level deprivation and healthy ageing at baseline *(tables 13-17, 19)* and across 6 years *(tables 26, 27,30).*

4.2.3.2.1. Impact of income deprivation on healthy ageing

There was a significant association between area level income deprivation and unhealthy ageing at baseline (p = 0.001) *(table 8 & 14)* and across 6 years (p < 0.001) *(table 27).* These findings reflect; the higher physical function found in the Alameda County, California residents who had higher family income level (Guralnik & Kaplan, 1989), Jordan and colleagues' (2008) report that those with inadequate income are more likely to experience interfering pain (section 1.5), Ross and colleagues' (2013) finding that mortality risk increased with income deprivation and persisted after adjustment for individual factors, with better or worse outcomes for poor individuals living in richer or poorer areas respectively (section 1.6.2), and Feinglass and colleagues' (2007) report that household income disparities in middle age limit disability free life expectancy at older ages (section 1.6.3.).

4.2.3.2.2. Impact of employment deprivation on healthy ageing

There was a significant association between area level employment deprivation and unhealthy ageing at baseline ($p = 0.001$) *(tables 8 & 15)* and over 6 years ($p < 0.001$) *(table 28),* following the findings at an individual level for access to work *(tables 7, 12 & 25).* This suggests that low job opportunities in an area may contribute to unhealthy ageing in both those who are and are beyond working age opportunities for work. Similarly, Kibele and colleagues' (2013) noted that mortality was higher in districts with higher unemployment rates, after adjustment for individual level mortality determinants (section 2.8), and Ross and colleagues' (2013) reported similar findings with higher mortality in areas of lower employment independent of individual circumstances (section 1.6.2.).

4.2.3.2.3. Impact of area level health deprivation on healthy ageing

There was a significant association between area level health deprivation and unhealthy ageing ($p = 0.001$) at baseline *(table 8 & 16)* and over 6 years ($p < 0.001$) *(table 29).* This is not surprising when looking at the measures constituents (describes areas with higher rates of premature death or poor health or disability, section 2.5.2.2.3.).

Yen and colleagues' (1999) reporting of neighbourhood social environment characteristics being associated with higher risks for mortality independent of individual risk factors demonstrated the importance and impact of neighbourhood quality. Similarly, Macintyre and colleagues' (1993) conceptualisation of neighbourhood as a site for “multiple jeopardy/deprivation amplification” is also relevant, with individual deprivation being compounded by the attributes of deprived neighbourhoods. Allen and colleagues’ (2013) spoke of area characteristics making up social capital with better area characteristics protecting individuals from individual level deprivation (section 1.6.6.), which was reflected by Ross and colleagues’ (2013) findings termed ‘healthy immigrant neighbourhood effect’ (section 1.6.2.).

4.2.3.2.4. Impact of area level education deprivation on healthy ageing

There was a significant association between area level education deprivation and unhealthy ageing at baseline (p = 0.001) *(table 8 & 17)* and across 6 years (p < 0.001) *(table 30).* The areal level education deprivation measure (section 2.5.2.2.4.) captures the extent of deprivation in education, skills and training in the locality.

This contrasts with our finding that individual level educational attainment (school education only compared to further education) was not found to be associated with less healthy ageing at baseline or over 6 years after adjustment for confounders, contrary to expectations given educational attainments reported association with; poorer osteoarthritis outcomes (Luong *et al.,* 2012), interfering pain in older people (Jordan *et al.,* 2008 & Dorner *et al.,* 2011), increase in total life expectancy and active life expectancy (Jack *et al.,* 1993), and reduced mortality (Fischer, Karlsson *et al.,* 2013). This does reflect that reported by Feinglass *et al.,* (2007) *(section 1.6.3.)* who noted that after adjustment for health status and behavioural risk factors lower levels of education were no longer associated with higher mortality in an American population. However, Yen and colleagues' (1999) (section 1.6.2.) noted that when neighbourhood social environment characteristics were examined separately, independent of for example individual education they were associated with higher risk of mortality. This difference further supports the area based impacts outlined in section 1.6.6., specifically the work of Allen and colleagues' (2013) and Macintyre and colleagues' (1993), discussed above (section 4.2.3.2.3.) in relation to the area impact of health deprivation.

4.2.3.2.5. Impact of area level housing and services deprivation on healthy ageing

Area level housing and services deprivation exhibited fairly flat HAI scores across the five quintiles (p = 0.0096) *(table 8)*. After adjustment for confounders only the second most deprived quintile remained associated with a lower HAI score at baseline *(table 18)*. Over 6 years, after adjustment only the second least deprived area level housing quintile was associated with unhealthy ageing in the adjusted analysis compared to the least deprived quintile *(table 31)*.

This suggests that housing and services deprivation may play a less significant role in unhealthy ageing in this population. The barriers to housing and services domain (see 2.8.2.5.), is composed of indicators that may not vary widely in the study population, namely household overcrowding, homelessness and road distances to services (as respondents are from urban areas). It also reflects that in different populations various exposures may have different impact dependent on degree and existence of other factors, as proposed by Satariano (2013) in his ecological model of healthy ageing, as in arguably a population with greater variance in housing deprivation (The Alameda

County Study) mortality risk was significantly higher in areas of poorer housing (Yen *et al.,* 1999).

4.2.3.2.6. Impact of area level crime deprivation on healthy ageing

There was a significant association between area level crime deprivation and unhealthy ageing at baseline ($p = 0.001$) *(table 8 & 19)* and across 6 years ($p < 0.001$) *(table 32).* The crime domain represents the occurrence of personal and material victimisation at a small area level (section 2.8.2.6). Marmot (2006) noted that ill health could be caused by failing to meet the human needs of autonomy, empowerment and human freedom. Many studies note that lower perceived control results in poorer health outcomes (Chandola *et al.,* 2004; Griffin *et al.,* 2002), and in 1.6.1., in terms of social capital, Kawachi and colleagues (1997 & 1999) noted the association between high social capital and reduced mortality and better self-rated health respectively. This lead Lynch & Davey Smith (2002) to suggest that social capital may mediate the relationship between income inequality and health, and Perry *et al.,* (2008) suggested promoting community organisations and social support to reduce barriers to care. Interestingly, Akcomak & Weel (2008) noted that communities with higher social capital have lower crime rates and Cummins *et al.,* (2005) & Macintyre *et al.,* (1993) (section 1.6.6.) noted the potential impact of area crime level and health outcomes, by undermining social interaction and civic engagement and deprivation amplification respectively.

4.2.3.2.7. Impact of area level environment deprivation on healthy ageing

There was a significant association between area level environment deprivation and unhealthy ageing at baseline (p = 0.001) *(table 8 & 20)* and across 6 years (p = 0.001) *(table 33).* This domain measures the indoor living environment (with regards to quality of housing) and outdoor living environment, by air quality and road traffic accidents (section 2.5.2.2.7.).

The findings on individual and area based deprivations impact upon healthy ageing are in keeping with the literature discussed in section 1.6.2. Mortality is higher in poorer areas, independent of individual risk factors (Haan *et al.,* 1987; Yen *et al.,* 1999) and living in socially and materially deprived areas negatively affects survival beyond individual circumstances (Ross *et al.,* 2013), as hypothesized by O'Rand (2002). Strifler (2011) comments that the neglect of society level and environmental factors in operational definitions of successful ageing is an important and significant gap in the current literature, our results support this view.

4.2.3.3. Impact of access to care on healthy ageing

There was a significant association between poorer access to care (by ranked practice score, section 2.6.1.) and unhealthy ageing at baseline (p < 0.001) *(table 9 & 21)* and over 6 years (p = 0.027) (table 34). Similarly, no access to GP (from the ILD measures, section 2.5.1.1.) was associated with unhealthy ageing at baseline (table 12, -5.82%; 95% CI -9.52, -1.98) and across 6 years (table 25, -17.35%; 95% CI -9.42, -25.86).

Our results are in keeping with that highlighted in section 1.6.7.3., namely; Alonso and colleagues' (1997) report that elderly persons with unmet health care needs suffered higher risk of mortality, Porell & Miltiades (2001) conclusion that access to care made the most difference in delaying or slowing down functional decline among independent elderly persons, and Prentice & Pizer's (2007) report that longer waits for health care were associated with increased risk of mortality after controlling for individual health status and health care facilities.

Section 1.1.6.2. questioned if access was poor would outcomes be worse, they are. Multimorbidity is strongly related to age and deprivation in the UK. Those with multimorbidity have higher consultation rates and less continuity of care compared to those without multimorbidity, even though they are more likely to gain from it (Salisbury *et al.,* 2011). It is reasonable to conclude that better access in this population would lead to improved outcomes. As discussed in section 1.6.7.1., if the quality of care and/or access to care has an impact on the healthy ageing of older people with musculoskeletal pain (baseline data suggests it does, see table 23 interaction at baseline between widespread pain and fourth highest ranked practice according to access to care and with fifth highest ranked practice according to quality of care) it would provide justification for both increased primary care funding and looking in more detail at what about the care is effective in one practice over another, and how it can be replicated elsewhere, thereby improving healthy ageing in those with musculoskeletal pain.

Clearly, poorer access leads to poorer ageing, probably through a combination of causal pathways discussed in 1.2.1 (morbidity hypotheses). In summary, the expansion of morbidity hypothesis (Gruenberg, 1977) explains increasing life expectancy (subsequent to reduced mortality rates) by a delay in the progression from severe disease to death secondary to life-sustaining medical technologies, lack of access would therefore lead to increased mortality, with morbidity proceeding this and reflected by poorer ageing and lower HAI scores. The compression of morbidity hypothesis (Fries, 1980) also concentrates on one stage in the progression of chronic disease, namely the delay in appearance or onset, and is reliant upon the effectiveness of primary prevention for its plausibility (Howe, 2006), again undermined by poor access. Whereas Manton (1982) believed that changes in the severity and progression of chronic disease would match changes in mortality, so that disease progression would be stopped at an early stage, cumulating in more disease in the population, but disease with reduced consequences, namely reduced disability and death, again dependent on good access.

4.2.3.4. Impact of quality of care on healthy ageing

There was a significant association between quality of care and unhealthy ageing at baseline ($p < 0.001$) (table 10 & 22**).** However, after adjustment for confounders only the fifth highest ranked practice remained associated with a lower HAI score at baseline of -7.69% (95% CI -11.31, -2.96). Over 6 years, compared to those in the highest ranked practice according to quality of care healthy ageing scores were -11.63% (95% CI -3.05, -22.14. $p = 0.006$) and -12.75% (95% CI -4.08, -23.37. $p = 0.004$) lower for the third highest and fifth highest ranked practice respectively after adjustment for confounders *(table 35).*

Gulliford and colleagues' (2004) comment that the structural characteristics (quality and access elements) of practices might have a greater impact on health outcomes than the mere presence of a doctor is supported by our findings. Poorer access and poorer quality services lead to poorer ageing, probably through a combination of causal pathways discussed in 1.2.1 (morbidity hypotheses).

In 2007 the Carr Hill Formula was reviewed but the findings were never implemented. Another review was conducted in March 2012 to implement a Government pledge to increase funding for practices in the most deprived areas via a 'patient premium'. The changes were initially agreed in principle for 2013/14, then postponed to 2014/15, then 2015/16 (Lind, 2014), the current target is 04/2018 (Lind, 2016). A move towards more equitable funding for all GP practices, based on the number of patients they serve, with appropriate weighting for demographic factors that affect relative patient needs and practice workload is essential. The department of health plans to make changes to ensure that sufficient weight is given to deprivation factors (Hakin, 2012). Such funding is essential to provide access to quality care that can reduce health inequalities and promote healthier ageing (discussed 1.6.7.3).

4.2.4. Deprivations impact on the relationship between pain status and healthy ageing

There were significant baseline interactions (i.e. deprivation measure affected the relationship between pain status and healthy ageing score) between widespread pain and; not having access to a car (p = 0.001), having no access to public transport (p =

0.029), no access to work (p = 0.005), most deprived area crime level quintile (p = 0.047), fourth highest ranked practice according to access to care (p = 0.018) and fifth highest ranked practice according to quality of care (p = 0.033) {the fourth highest ranked practice according to access to care and the fifth highest ranked practice according to quality of care were the same practice} *(table 23).*

There were significant interactions across 6 years (i.e. deprivation measure affected the relationship between pain status and healthy ageing score, with unhealthy ageing being significantly greater when pain and deprivation occurred in these two examples, in comparison to no pain and no deprivation) between widespread pain and manual work (p = 0.008) and some pain and the second most deprived area education level deprivation (p = 0.014).

O'Rand (2002) *(section 1.6.2.)* postulated that pathways between neighbourhood socioeconomic status (SES), individual SES and health may have reciprocal, reinforcing cycles that contribute to cumulative disadvantage and cumulative advantage throughout the life course. Whereas, Sarkisian *et al.,* (2002) reported that people with low expectations place less importance on seeking health care and in 1.3.6., we questioned if those experiencing greater deprivation have lower expectations, and if their access to services is also poor would this compound their health behaviours, with the interaction leading to worse outcomes. The interactions noted at baseline between widespread pain and; not having access to a car, (p = 0.001), having no access to public transport (p = 0.029), no access to work (p = 0.005), most deprived area crime level quintile (p = 0.047), fourth highest ranked practice according to access to care (p = 0.018) and fifth highest ranked practice according to quality of care (p = 0.033), as well as interactions across 6 years between widespread pain and manual work (p = 0.008) and some pain and the second most deprived area education level deprivation (p = 0.014) may reflect this. It also supports Satariano's (2013) assertion that a global approach is required to healthy ageing research, with interactions noted with individual level deprivation, area level deprivation, and access and quality variables.

As noted in section 1.6.5., the association between low socioeconomic status and poorer health is well supported (Van Jaarsveld *et al.,* 2007). Individual level indicators (income, occupation, educational level) and neighborhood-level characteristics demonstrate a graded relationship with health outcomes (Marmot *et al.,* 1991; Pickett *et al.,* 2001; Huisman *et al.,* 2005), and this is clearly apparent in our data. Researchers had commented that it was unclear whether neighbourhood effects are independent of individual socioeconomic status (SES) (Macintyre & Ellaway, 1998; Reijneveld, 2001). Successive adjustment for individual level markers of SES had been shown to progressively reduce the magnitude of the association between neighborhood level SES and health (Davey *et al.,* 1998; Stafford & Marmot, 2003; Martikainen *et al.,* 2003). This prompted Van Jaarsveld *et al.,* (2007) to question whether there was a real independent neighborhood effect or if incomplete adjustment for individual SES explains the residual differences in health between residential areas. They concluded that there were at least partly independent influences on poor health of individual level and area level deprivation (Van Jaarsveld *et al.,* 2007). The interactions noted between widespread pain and; not having access to a car, (baseline, p = 0.001), having no access to public transport (baseline, p = 0.029), no access to work (baseline, p = 0.005), and manual work (across 6 years, p = 0.008), which are individual level effects; and between widespread pain and; most deprived area crime level quintile (baseline, p =

0.047), fourth highest ranked practice according to access to care (baseline, p = 0.018) and fifth highest ranked practice according to quality of care (baseline, p = 0.033), and some pain and the second most deprived area education level deprivation (across 6 years, p = 0.014), which are area level effects support Van Jaarsveld and colleagues' (2007) conclusion that there are independent ILD and ALD influences on healthy ageing in older people with musculoskeletal pain in our sample.

Bowling and Dieppe (section 1.3.6) argued that if high social functioning was accepted as part of ageing successfully then people should be encouraged and supported to build up their social networks and activities, with the provision of enabling community facilities (Bowling & Dieppe, 2005). As suspected, our results indicate that poorer environments and community services do translate to unhealthy ageing. Many domains of successful ageing are inter-related, and those with multiple social activities and better relationships have greater life satisfaction, improved health and function, greater autonomy and improved survival (Vaillant, 2002; Menec, 2003).

4.3. Methodological issues

Assessing the studies validity (degree to which items measure intended constructs) prior to data collection and analysis is essential. The process of developing and validating instruments is largely focused on reducing measurement error. Pre-testing questionnaires with knowledgeable others ensures that many methodological challenges are met (Grant & Davies, 1997) before piloting involving a small number of the sample population identifies remaining problems *e.g.* ambiguity, missed items, problematic response options and unclear instructions. Face validity and content validity are assessed and the questionnaire modified accordingly (Sim & Wright, 2000:72, 254). The Health Survey (from NorStOP which provided the HAI and ILD variables), GPPS (access variables) and 2001 census (IMD 2004 ALD variables) underwent rigorous development before application, discussed separately later. However, given that these data sources were used post inception it is important to know whether they measure the constructs or provide an adequate and usable measure of the construct under investigation. Information bias resulting from flaws in measuring exposure, covariate or outcome variables, leading to inaccurate data within comparison groups (Porta, 2008) is a threat to this studies reliability.

4.3.1. Strengths and limitations of the NorStOP data

The North Staffordshire Osteoarthritis Project (NorStOP) was a large population based study of older community dwelling individuals originally designed to capture data on the prognosis of hand, hip, knee and foot pain, and the impact of these syndromes on participation levels and health care use (Thomas *et al.,* 2004). The data collected was relevant, and collected prospectively allowing the temporal relationship between deprivation, access and quality of care upon healthy ageing in older people with musculoskeletal pain to be explored. The NorStOP recruited patients using a two stage mailing process. Follow up data for the cohort at 3 and 6 years was collected from general practice medical records and repeat mailed survey (Thomas *et al.,* 2004).

Sampling bias

Contact details of all adults aged 50 years and over were taken from the General Practices' list (section 2.3.1.1). Patients who are not registered or who have inaccurate details on the GP list may have more pain, or experience more ILD or ALD than those who are registered. Consequently, we may have underestimated the reduction in healthy ageing scores with the onset of pain, or with exposure to; more ILD or ALD, poorer access to care or quality of care. It is possible that those not registered are healthier, but given the cohort of interest is those 50 years and older and that access to care is free, it is likely that those more deprived outnumber these individuals, the net effect resulting in an underestimate of the impact of deprivation and quality of care upon healthy ageing in older people with musculoskeletal pain.

Response rates above 50% are considered acceptable for postal questionnaires (Mangione, 1998). The health questionnaire response rates were excellent; at baseline 71%, three years 81.4%, and six years 82.4% (*figure 8* flow diagram of participants, appendix). However, high response rates alone do not guarantee representativeness; a small proportion of non-responders differing systematically from responders will introduce bias. Examining the characteristics of non-responders and comparison with respondents is useful to ensure that their characteristics do not differ systematically, leading to a biased sample and poorly generalisable findings (Sim & Wright, 2000:267). The NorStOP reveals initial baseline selectivity at cohort recruitment among respondents to the baseline survey. Baseline participants had consulted more frequently about the topic of the study (Osteoarthritis and joint pain) and had received more and stronger analgesia prescriptions than the comparison population (Lacey *et al.,* 2013). This may be because patients with an interest in joint pain participated. Other studies have found that survey responders with the topic under investigation are more likely to consent to medical record access (Dunn *et al.,* 2004). Nevertheless, despite selective recruitment into a cohort study potentially resulting in a difference in the prevalence of baseline characteristics between the 'selected' cohort and the wider population from which it was derived, simulation studies suggest the validity of associations between baseline exposures and future outcomes is relatively unaffected by baseline selectivity (Pizzi *et al.,* 2011), which is important regarding the NorStOP data.

The 3-year gap between time points (questionnaires at baseline, 3 years and 6 years) may miss changes in subject pain status. NorStOP received 13986 responses to their baseline questionnaire and 4756 responded at 6 years (see *figure 8* flow diagram of participants, appendix). Non-participation in the questionnaire at follow-up is more likely in those reporting poorer health (Vega *et al.,* 2010) and cognitive impairment (Matthews *et al.,* 2004), this may lead to the severity of variables impact upon the HAI being missed or underappreciated.

The NorStOP data has been examined to assess if responders at follow up remained representative of responders at baseline, and if attrition biases estimates of longitudinal associations. Lacey and colleagues (2013) compared primary care consultation morbidities and prescription prevalence among 32,000 patients aged 50 or more who contributed to an anonymised general practice database (Consultations in Primary Care Archive – CiPCA) with those from patients aged 50 or more in the NorStOP cohort (2002-2008). Differences in consulting prevalence of non-musculoskeletal morbidities between NorStOP responders and CiPCA comparison population did not increase over the two follow up points (3 and 6 years) except for ischaemic heart disease. Differences observed at baseline for osteoarthritis related consultations were generally unchanged at the two follow up points (standardised prevalence ratios for OA 1.09-1.13 and joint pain 1.12-1.23). Age and gender adjusted associations were similar in CiPCA (adjusted Hazard Ratio: 1.40; 95% CI 1.34, 1.47) and NorStOP 6 year responders (1.32; 1.15, 1.51). There was little indication that responders at follow up represented any further selection bias to that present at baseline. They concluded that attrition in cohort studies does not inevitably indicate bias (Lacey *et al.,* 2013) and adults reported in this study can be considered as representative of adults aged 50 and over in the UK. Nevertheless, this study lost people who were ageing more unhealthily, had more pain and were poorer, it seems likely that if our results were biased it would be that the impact of deprivation and quality of care upon healthy ageing would be underestimated.

There was attrition and missing data throughout the 6 years. The sample for analysis included persons who responded at all three time points (0, 3 and 6 years). Participants with complete data represented 30.7% of the baseline population of 9611. Whilst this could affect the prevalence of pain and the distribution of healthy ageing, it is unlikely to affect the estimates of association between the two; the association between widespread pain and healthy ageing index scores were similar in those included in the analysis (n = 2949) and in those who dropped out (n = 5826). In addition, sensitivity analysis (a weighted analysis where differences in socio-demographic factors between those in the analysis and those not were accounted for in producing estimates) demonstrated that this had no effect on the results (Wilkie *et al.,* 2013).

Measurement bias

The Health Survey was initially mailed to a random sample of 1461 adults aged 50 years and over drawn from the registered population of one general practice belonging to the North Staffordshire Primary Care Research Consortium. Previously validated instruments were used to capture constructs (thus face and construct validity were known to be good). The psychometric properties (face, content and construct validity, responder burden, performance and repeatability) of the Keele Assessment of Participation were examined using qualitative and quantitative methods (Wilkie *et al.,* 2005). The researchers concluded that the instrument could provide estimates of person perceived participation restriction in population surveys (section 2.2.5). Piloting confirmed the instruments ability to be used in the local population and to provide valid information (minimising measurement error).

The measure of self-reported pain was based on a single question, and those answering 'yes' were asked to shade their painful areas on a full body manikin (front and back views). Based on their pain reports participants were categorised into one of three groups 'no pain', 'some pain' or 'widespread pain' using a method shown to be repeatable (Lewis *et al.,* 2002). These methods to determine the location and extent of pain are commonly used in population-based studies of pain, and have been shown to be valid and reliable (Margolis *et al.,* 1988 & Lacey *et al.,* 2005).

However, as mentioned in section 1.1.3.1., musculoskeletal pain can be caused by a variety of pathologies including malignancy (Walker-Bone, 2007), this was not accounted for in the original Health Survey *(see appendix, Health Survey, Part 10 –*

about your health), although baseline screening by GPs for exclusions will have mitigated any overestimate of the impact of pain (section 2.3.1.1.). Additionally, in section 1.1.2., we reported that primary care data offers a more accurate assessment of the burden of pain than secondary care data, but this may also underestimate the prevalence of pain, exemplified by chronic pain (pain persisting for more than 3 months) affecting more than 50% of older people living in the community (Ferrell, 1995), but more than 80% of nursing home residents (Helme & Gibson, 2001). Only patients who were well enough or motivated enough to respond to the health questionnaire supplied data, potentially underestimating the impact of pain.

Summary

The NorStOP (Thomas *et al.,* 2004) data was relevant, and collected prospectively with excellent response rates allowing the temporal relationship between deprivation, access and quality of care upon healthy ageing in older people with musculoskeletal pain to be explored. Baseline selectivity (Lacey *et al.,* 2013) may affect baseline characteristics prevalence, but the validity of associations between baseline exposures and future outcomes is relatively unaffected (Pizzi *et al.,* 2011). Use of the GP list, the need for respondents to be well enough to reply (Vega *et al.,* 2010; Matthews *et al.,* 2004), as well as attrition may mean the severity of variables impact upon the HAI were missed or underappreciated. Potentially the prevalence of pain and distribution of healthy ageing could be affected, but Lacey *et al.,* (2013) concluded that responders at follow up represented no further selection bias than that present at baseline, and that adults in the study could be considered representative of adults aged 50 and over in the UK.

NorStOP lost people who were ageing more unhealthily, had more pain and were poorer, any bias would likely result in the impact of deprivation, quality and access to care upon healthy ageing being underestimated, but the estimates of association between the two are unlikely to be affected (Wilkie *et al.,* 2013). Validated and repeatable instruments (Lewis *et al.,* 2002; Margolis *et al.,* 1988 & Lacey *et al.,* 2005) were used and the psychometric properties of the KAP were assessed (Wilkie *et al.,* 2005), with reassuring piloting results.

4.3.2. Strengths and limitations of the HAI

The concept of 'healthy ageing' captures multiple outcomes and the complexity and quality of increasing longevity (Bowling & Dieppe, 2005). The HAI (Wilkie *et al.,* 2013) moves forwards from the biomedical only approach of frailty, and incorporates biomedical, psychosocial and lay approaches of the healthy ageing concept, which capture items of relevance to older adults (as noted by Bowling and Dieppe 2005), and can evaluate outcomes in older populations (Wilkie *et al.,* 2013). The HAI is composed of 5 domains (physical function, biomedical, psychological, lay and perceived social participation) (Wilkie *et al.,* 2013) (section 2.6.3.1). Validated instruments were used in the HAI to measure the constructs (section 2.4.2.2. for descriptive information and background on each instrument). The HAI scores link with ageing and mortality contributes to evidence of construct validity (this would be expected given the relationship of health with ageing and mortality, correlations that fit expected patterns contribute to construct validity). Content validity appears good in relation to that discussed in section 1.3., (how well the items developed to operationalise a construct provide an adequate and representative sample of all the items that might measure the construct of interest - healthy ageing). Similar multi-dimensional models of successful ageing, using multidimensional indices that can be considered to capture the construct (Bowling & Iliffe, 2006), have been adopted and advanced the field e.g. successful ageing and frailty (Rockwood *et al.,* 2007 & 2010).

Thielke & Diehr (2012) and Nosraty *et al.,* (2012) claim that how healthy ageing is operationalised may lead to different findings. However, similar methods used in other ageing constructs (i.e. frailty) suggest that the composition of indices has little effect (Searle *et al.,* 2008). Although there is no gold standard for measuring healthy ageing, the constituents of the measures of healthy ageing in other studies (e.g. Doyle *et al.,* 2012) are the same constructs that are included in the measure used in the HAI study (Wilkie *et al.,* 2013).

However, the HAI was constructed using self-report data (which is susceptible to measurement error). Validated instruments were used to provide the majority (21 of the 33) points used in the index (section 2.4.2.1 & 2). Notably, for the biomedical domain 11 points were assigned using non-validated instruments, and in the lay domain, financial strain was assessed using a single item in the health survey (no evidence of reliability or validity), but only one point applied. Consequently, 12 of 33 points in the index raise minor concerns regarding reliability and validity. Self-reports were used because they reflect the individual's perception of how they appraise their health and how they may relate to the use of health and social care (Wilkie *et al.,* 2013).

The method employed for identifying medication use misses over the counter medication. This may underestimate the association between medication use and the HAI score. It may also underestimate the extent of attenuation between pain and healthy ageing score when adjusted for medication use, or the potential misclassification bias may have no effect. There may be other confounders (e.g. current financial status) which may be important but which were not included in this study.

The authors (Wilkie *et al.,* 2013) note that selecting items using factor analysis and subsequent testing of internal consistency would provide further support that the five constructs of the index were being measured. Further testing of the reliability and responsiveness would provide further information on the index's psychometric properties, thereby supporting the use of the index. Lastly, the three-year gap between time points may miss some of the changes in status.

However, the HAI novelty and strengths in measuring healthy ageing surpass its potential limitations.

4.3.3. Strength and limitations of the ILD and access variables from the health survey

For ILD, two measures were used from the NorStOP baseline questionnaire results and eight single item measures were used for access (Thomas *et al.,* 2004) (section 2.5.1.1). The single access items were not standardised questions from validated instruments and may lack construct validity but pre-pilot and pilot testing raised no concerns.

Ideally, life course studies would measure items such as socioeconomic status (SES) in real time (for example prospective or birth cohort studies), thereby reducing reliance on patient recall. However, such studies are expensive and time consuming. Consequently few cohorts with SES measurements across the life course exist (e.g. 1946, 1958 and 1970 UK birth cohort studies). Many influential studies relied upon participant recall using interview or postal surveys e.g. the British Regional Heart Study, the English Longitudinal Study of Ageing, the Whitehall II Study (Lacey *et al.,* 2012). Consequently, the limitations of patient recall are deemed acceptable.

Contact details were taken from the General Practices' list. As discussed previously (section 4.3.1.3.), patients who are not registered or who have inaccurate details on the GP list may experience more deprivation than those who are registered, they by definition have worse access. Consequently, we may have underestimated the reduction in healthy ageing scores with exposure to; more ILD or ALD, or poorer access to care.

The 3-year gap between time points (questionnaires at baseline, 3 years and 6 years) may miss changes in subject ILD or access variables, and concerns regarding attrition bias as discussed in section 4.3.1. *Sampling bias* apply.

Section 2.1. noted the disadvantages of secondary data analysis. Namely, as the study design and data collection is complete, the data may not facilitate a particular research question. However, these instruments do measure ILD and access, and there is enough congruence with the conceptual definition of these in this study. The data does potentially lack depth (the greater the breadth the harder it is to measure any one construct in depth). Also, because the variables are defined by a single survey item, or a subset of test items, there are reliability and validity concerns.

Summarising, the ILD and access variables from the health survey had reassuring piloting results, measure the constructs of interest, and the limitations of patient recall were deemed acceptable. As discussed (Section 4.3.1. *Sampling bias)* the use of GP contact details may have resulted in an underestimate of the reduction in healthy ageing scores with exposure to more ILD or access to care.

4.3.4. Strengths and limitations of the access variables from GPPS

The GP patient survey is the best available measure of access to primary care (The GP Patient Survey, 2008) that provides practice level data (section 2.6.1.). Strengths and weaknesses are discussed below.

4.3.4.1. Strengths of the access variables from GPPS

The GPPS was developed to reward GP practices in England for performance on patient access (NHS Information Centre, 2008). Ipsos MORI conducted face-to-face cognitive testing of the questions and adapted the survey based on prior years feedback, which improved its validity, reliability and responsiveness.

Random sampling was employed (patients were eligible for the GPPS if they were over 18 and registered with a GP), improving the chance of the sample being representative of the population from which it was drawn, therefore sample parameters are more likely to be generalizable to the population of interest, meaning the sample has better external validity (Bowling, 1997). How representative a sample is depends upon the extent to which it is both precise (free from random sampling error) and unbiased (free from systematic sampling error – systematic error in choosing the individuals to take part in the study, leading to a non-random sample) (Sim & Wright, 2000). In order to deliver similar levels of statistical reliability for each practice, issued sample sizes for the 2007/2008 GPPS varied for each practice according to practice size, and anticipated response rate based on response rates to the 2006/07 GP Patient Survey (one of the reasons for using the 2007/2008 survey). Service users were invited to provide feedback on their experiences of care in the preceding six months. This interval is typical for patient surveys and is believed to result in less recall bias than longer intervals, although there is evidence that patients might find it difficult to restrict their responses to the six month reference period (Harris-Kojetin *et al.,* 1999).

The GPPS was a good attempt to capture patients' views.

4.3.4.2. Limitations of the access variables from GPPS

When comparing Levesque and colleagues' (2013) access definition to the GPPS questions utilised (section 2.6.1.) it is apparent that the five questions selected are a narrow conceptualisation of access. *'Identifying healthcare needs'* is not merely about being able to get through on the phone, or get an appointment within 2 days, or an appointment at a convenient time, or with a particular doctor, or being satisfied about the hours the surgery was open. These questions are mainly about patient satisfaction. They do partially cover the opportunity *'to seek healthcare services'*, but what about vulnerable patient groups, *e.g.* those with literacy problems, cognitive impairment, disabled with access problems, housebound patients, otherwise disadvantaged or deprived groups? What are their opportunities to seek healthcare services like? Questions around these factors would help to satisfy the *'reach, to obtain or use healthcare services'* component, and provide a more accurate measure of the access different patients with differing needs truly experience.

The questions do ask about the opportunity to be seen, but this does not necessarily translate into an opportunity to *'identify healthcare needs',* that is dependent also on the quality of the service they receive. Likewise to *'have the need for services fulfilled'* is also partially quality driven. How able are patients to judge if they are given an opportunity to identify healthcare needs? Or if their healthcare needs are being met? When looking at the dimensions of accessibility; approachability, acceptability and availability are partially satisfied; accommodation, affordability and appropriateness are not assessed (a number of my patients for example will not attend practice or hospital appointments because they do not have the funds for transport). The survey questions do not investigate any of the corresponding abilities of populations, *'ability to perceive, ability to seek, ability to reach, ability to pay, and ability to engage'.*

Contact details were taken from the General Practices' list. As discussed (Section 4.3.1. *Sampling)*, patients who are not registered or who have inaccurate details on the GP list experience worse access. Consequently, we may have underestimated the reduction in healthy ageing scores with poorer access to care.

The GPPS data is composed of self reports, consequently; inaccurate recall, false information, completion by a person other than the intended respondent (Bowling, 1997), social desirability biases (Kimberlin & Winterstein, 2008), and item non-response can all undermine validity (Sim & Wright, 2000:77) (discussed section 4.3.1. *Measurement bias*). Response bias (section 2.2.2), where differences in the characteristics of respondents and non-respondents introduce systematic error (Bowling, 1997) is a threat to the GPPS data. The overall response rate in England to the Access survey was 41%, though the response rate between practices varied significantly, the average response rate for the 6 practices examined was 48%. The mean percentage response rate was higher with females and increasing age (The GP Patient Survey, 2008). Given that women report more pain and pain reporting increases with age this could exaggerate the perceived role of deprivation and quality of care upon healthy ageing in older people. However, previous research has indicated that the use of rigorous probability sampling methods (as adopted in the GPPS) is consistent with only a weak association between non-response rates and non-response bias (Elliott *et al.,* 2009; Groves, 2006; Groves & Peytcheva, 2008). Additionally, an analysis of GPPS data collected in 2009 indicated that practice level patient response rate was only weakly associated with variation in practice level score for questions related to patient access (Roland *et al.,* 2009). Finally, despite the concerns presented by the low response rate for the GPPS, no evidence of adverse association between response rate and non-response bias has been found for the GPPS (Warren *et al.,* 2015).

However, the GPPS data is not weighted, consequently two distortions in the data remain uncorrected, firstly; patients attending larger practices form a smaller part of the survey sample than they would in the population as a whole (because higher proportions of patients were sampled in smaller practices). Secondly, groups of patients who are more likely to respond to surveys (including women and older patients) will make up a larger proportion of the survey findings than they do in the population as a whole (GP Patient Survey National Report, 2008). There are systematic differences in how patients from different socio-demographic groups assess their care: younger patients, those belonging to ethnic minorities, those with higher socioeconomic status and those with poorer self-rated health report less positive experiences of healthcare (Lyratzopoulos *et al.,* 2012). This may mean that the GPPS underestimates difficulties with access. Furthermore, the potential for recall bias cannot be dismissed with regard to recall of the contact occurring, whether it occurred within the 6 month time period, and in reporting experience of the contact. For example, there is evidence that older patients might not accurately report use of health service resources over a relatively short time frame (Richards *et al.,* 2003). Also, only a single measurement in time was used based on responses to the GPPS between 07/01/2008 and 02/04/2008 (The GP Patient Survey, 2008), whereas, quality of access experienced by patients at the practices may have varied considerably over the 6 years and their lifetime. Additionally, despite the random sampling used by the GPPS, our study was interested in those aged 50 years or more. We don't know how old the respondents were to the GPPS, and the respondents were not the same as those for the Health Survey (Thomas *et al.,* 2004). Furthermore, the ecological fallacy is an important potential limitation of area-based measures (applies to GPPS, QOF and IMD). It results from the false assumption that inferences can be made about individual phenomena based on observations of groups (Morgenstern, 1982). Lastly, the GPPS did not ask about patients' English language ability or about educational attainment, both of which might influence experience of care and consequently responses (Elliott *et al.,* 2009).

Conclusions regarding the GPPS

The GPPS was developed to reward performance on patient access (NHS Information Centre, 2008) and random sampling provides good external validity. However, the GPPS measures a narrow conceptualisation of access, and is really more a measure of patient satisfaction. Arguably, the single item for access from the NorStOP Health Survey (Do you have good access to your doctor (GP), as and when you need it? Yes/no) provides a better measure of access. Nevertheless, despite its limitations, the GPPS does offer a measure of access that is novel and worth using. The National Audit Office and CQC are using GPPS items to monitor the performance of services. Policy makers have proposed changes in service provision on the basis of findings from the GPPS, and survey derived metrics are adopted within the key national metrics of UK healthcare provision (NHS outcomes framework, 2013). Therefore, we believe the findings presented here are relevant. Use of the General Practice list may have lead to underestimating the reduction in healthy ageing with poorer access to care and concerns regarding self-reports apply (section 4.3). Response bias seems acceptable (Elliot *et al.,* 2009; Groves, 2006; Groves & Peytcheva, 2008; Roland *et al.,* 2009; Warren *et al.,* 2015). As discussed the GPPS may underestimate difficulties with access (because it is not weighted). Recall bias is also a concern as older patients may not accurately report the use of health resources over a short time frame (Richards *et al.,* 2003). The net effect for our study being that the GPPS probably underestimates the impact of poor access on healthy ageing.

This study utilised the best measure of access available. There is precedent for this. For example, the Longitudinal Study in England and Wales (a follow-up of a 1% sample of the 1971 census linked to successive censuses and to vital statistics such as birth, death, and marriage registrations) has proved extremely useful in studying predictors of mortality (Drever & Whitehead, 1997; Fox & Goldblatt, 1982), but has been constrained by the questions asked, for various government purposes, at each census. Since the UK census did not have a question on income, but did have questions about housing tenure and access to private transport, much analysis of the relationship between deprivation and mortality (whether at an individual or aggregate level) used tenure and car access as major indicators of deprivation (Macintyre *et al.,* 2000). It was not that there was any a priori theorising about the role of housing tenure or car access in influencing health, rather that researchers used the data that was available (Macintyre *et al.,* 2002).

4.3.5. Strengths and limitations of the quality variable from QOF

4.3.5.1. Strengths of the quality variable from QOF

The QOF provided a measure of quality that satisfied our studies chosen definition of quality of care, which is that defined by NHS England 2014. The 2005/06 QOF information was the second year for which QOF information was available, with 8,409 practices in England submitting data at the end of March 2006, covering 99.6% of registered patients in England.

To what extent QOF scores indicate the quality of care delivered by practices in England is difficult to say. Individual indicators were carefully selected with an evidence base of literature to support their inclusion into QOF (Roland, 2004), and Ashworth and Armstrong (2006) argue that it is likely to provide a good snapshot of quality.

Numerous studies note that multiple deprivation was significantly inversely related to the number of quality points achieved (Wright *et al.,* 2006; Guthrie *et al.,* 2006; Sutton & McLean, 2006; Doran *et al.,* 2006; Ashworth *et al.,* 2007). Previously, Ashworth *et al.,* (2007) used the QOF indicators to explore the characteristics of primary care in deprived communities. They linked QOF data obtained for each practice in England in 2004-2005 and 2005-2006 with census derived social deprivation data (Index of Multiple Deprivation 2004 scores), national urbanicity scores and a database of practice characteristics. Comparisons were made between practices in the least and most deprived quintiles (total exceeded 8 thousand practices). The difference in mean total QOF score between practices in the least and most deprived quintiles was 65.5 points in 2004-05 (mean score all practices 959.9) and 30.4 in 2005-2006 (mean 1012.6). Relatively small differences in total QOF achievements between geographical areas of deprivation masked larger differences in the achievement of individual indicators between practices. Significantly in 2005/06 the QOF indicators displaying the largest differences between least and most deprived quintiles were: recall of patients not attending appointments for injectable neuroleptics (79 versus 58%, respectively), practices opening 45 hours or more per week (90 versus 74%), practices conducting more than or equal to 12 significant event audits in previous 3 years (93 versus 81%), proportion of epileptics who were seizure free for more than or equal 12 months (77 versus 65%) and proportion of patients taking lithium with serum lithium within therapeutic range (90 versus 78%). To what extent the recall of patients' indicator reflects that in poorer areas patients do not engage or that the practices do not recall them effectively is impossible to say. However, the reduced opening hours in more deprived areas demonstrates clear access inequity, which is a practice based choice, workload or funding is unlikely to be relevant. With regards to number of significant audits, this does measure whether a practice attained accepted professional standards but smaller practices and those with higher workloads (possibly secondary to increased deprivation and consequently need due to excess morbidity) may have found it harder to meet this indicator.

Ashworth *et al.,* (2007) noted that geographical differences were reduced in group and training practices. Notably, regarding access in the most deprived quintile, the list size per full time equivalent GP was 2284, in contrast to the least deprived quintile with a list size of 2063 (2005-2006 data). Three characteristics were independently associated with higher QOF scores: training practices, group practices and practices in less socially deprived areas. They comment that quality of care varies widely but measured variables only explain a small proportion of that variation. They surmised that other factors that may influence quality are linked to the values of the organisation, and attitudes of staff, and would be more amenable to exploration through qualitative studies. Focused interventions to improve the quality of care in deprived areas were suggested including; promoting longer opening hours (improving access), promoting training practices (as training practices consistently performed better than non-training counterparts in deprived areas and were under-represented in deprived areas – a quality aspect) (Ashworth *et al.,* 2007). Crucially they commented that certain types of practices are able to offer a higher standard of care in deprived areas and that well organised primary care can largely compensate for substantial social disadvantage (Ashworth *et al.,* 2007).

4.3.5.2. Limitations of the quality variable from QOF

98% of the UK population are registered with a General Practitioner (Bowling, 1997), however whether patients who are disadvantaged are more or less likely to be registered is unknown (although it is likely that disadvantaged patients are less likely to be registered). Furthermore, patients may not engage with services that they deem to be poor or that they struggle to access. If patients did not register, that would not lead to a lower QOF score and if they did not engage with the practice with regards to attending appointments or recall then they may be exception reported, which again would not impact on the QOF score, and lead to underestimating the impact of poor quality care in disadvantaged areas.

Primary care doctors were paid up to 25% more if they met QOF targets (Roland, 2004). Such remuneration might influence decision-making. Doctors could exclude patients from individual clinical indicators (exception reporting) for specified reasons including clinical inappropriateness, intolerance of medication, and patient dissent. An average of 5% of patients were excluded from individual QOF indicators by their GP, though the figure varied widely between indicators (Doran *et al.,* 2008). Research noted that QOF data could reflect true achievement within a practice, or could underestimate by under-recording or overestimating due to high levels of exception reporting (Ashworth *et al.,* 2007). Additionally, the QOF information was dependent on diagnosis and recording within practices' clinical information systems that could have accuracy issues (Health and Social Care Information Centre, 2012). Others noted that lower value might be placed on the importance of gathering QOF data in deprived areas (Saxena *et al.,* 2006).

The delivery of General Practice services will be related to population age, sex, ethnicity and deprivation characteristics that were not included in QOF data collection processes (The Information Centre, 2006). Indicators relating to patients' experiences of services could also be subject to problems of interpretation, as responses could be influenced by patient characteristics unrelated to the quality of care, such as age, gender, region of residence, self-reported health status, type of care and expectations (Healthcare Commission 2006)

QOF points do not reflect practice workload issues nor local infrastructure and circumstances (The Information Centre, 2006). Multiple deprivation is inversely related to the number of quality points achieved (Wright *et al.,* 2006; Guthrie *et al.,* 2006; Sutton & McLean, 2006; Doran *et al.,* 2006; Ashworth *et al.,* 2007), with less deprived areas achieving higher QOF scores (Ashworth & Armstrong, 2006), prompting McLean and colleagues' (2006) criticism that QOF perpetuated the inverse care law (Hart, 1971), with those with the greatest need receiving the least care because

QOF failed to reward the extra work required to achieve quality targets in deprived areas.

It may be harder to achieve QOF points in deprived localities, because deprived patients develop more morbidity and mortality or behave differently when accessing care. Or it could be that deprived areas have poor services providing poor care leading to worse outcomes. If QOF scores reflect poorer outcomes with greater deprivation (rather than differing quality of care) we may be measuring the same thing when looking at QOF scores and deprivation measures. Raleigh & Foot (2010) propose that the variation in QOF scores could be due to a number of reasons unrelated to quality of care, namely; data related issues (poor quality, reporting and coding artefacts, inadequate adjustment for case mix), differences in clinical practice, external factors (poor primary/community/social care services or effects of socioeconomic deprivation), random variation or regression to the mean, or some combination of the above. Furthermore, Ashworth & Armstrong comment that the quality of care varies widely between practices but measured variables only explain a small proportion of that variation. They surmised that other factors that may influence quality are linked to the values of the organisation, and attitudes of staff, and would be more amenable to exploration through qualitative studies (Ashworth & Armstrong, 2006). Additionally, only a single measurement in time was used based on QOF result on the 31/03/2006, whereas, the quality of care experienced by patients at the practices may have varied considerably over the 6 year follow up and their lifetime. Finally, the ecological fallacy is an important potential limitation (Morgenstern, 1982).

Conclusions regarding QOF

QOF ran into difficulties in the late 2000s partly due to indicators being introduced that had; little professional consensus (*e.g.* completing a symptom inventory for patients with depression), seemed to have a managerial rather than a clinical agenda (*e.g.* incentives designed to reduce emergency admissions), had poorly constructed formulas linking performance to pay (*e.g.* data from patient surveys), or prioritised aspects of care that were easy to measure potentially at the expense of care which is equally or more important (Roland & Olesen, 2016), in contrast to its original composition (Roland, 2004). Many clinical indicators are just indicators, they should prompt further investigation, but they are not directly comparable measures of performance. Incorrect interpretation risks well-performing providers being mistakenly classified as poor performers (Type I errors), or false assurance that poor performers are performing adequately (Type II errors) (Mannion & Goddard 2002). Ashworth & Armstrong (2006) argue it provides a good snapshot of quality.

Numerous studies note that multiple deprivation was significantly inversely related to the number of quality points achieved (Wright *et al.,* 2006; Guthrie *et al.,* 2006; Sutton & McLean, 2006; Doran *et al.,* 2006; Ashworth *et al.,* 2007). Some argue that it may be harder to achieve QOF points in deprived localities. However, in 2005/06 amongst the QOF indicators displaying the largest differences between least and most deprived quintiles were: practices opening 45 hours or more per week (90 versus 74%) and practices conducting more than or equal to 12 significant event audits in previous 3 years (93 versus 81%) (Ashworth *et al.,* 2007). The former reflects poor use of resources with regards to providing access and the second poor achievement of accepted professional standards (which may be linked to practice workload). Health care is multidimensional, complex and challenging to measure. The QOF was the best available measure of quality to apply to the practices and reasonably matched our definition of quality. It's validity, reliability and responsiveness is likely to be good, despite its limitations we feel it offers a reasonable measure of the quality of care available to the study population.

4.3.6. Strengths and limitations of the ALD variables from the English Index of Multiple Deprivation

4.3.6.1. Strengths of the ALD variables from the English Index of Multiple Deprivation

Consensus on the meaning of deprivation is lacking, but most accept it's a multidimensional problem. Consequently, representing these dimensions in a single measure and obtaining enough data sources is challenging (Carr-Hill & Chalmers-Dixon, 2005, section 5). Nevertheless, the breadth of data in the IMD is impressive, and the IMD's domains and indicators satisfy Townsend's (our accepted definition) conception of deprivation, with the exception of direct assessment of diet and clothing.

The 2001 census provides a detailed picture of the entire population from the 29/04/2001, collecting the same data at the same time enabling comparisons of different areas and populations with an impressive 98% response rate (ONS, 2010). A major advantage of the decennial census is the small area data, down to 100-125 households (output areas). Much of the non-census data incorporated into the IMD has not been collected with full postcodes and is reported for larger areas. Various modelling procedures were used to estimate ward level values for these components (Carr-Hill & Chalmers-Dixon, 2005, section 5).

Content validity (with review by expert panels), and overall validity (with piloting and adapting after the last index in 2000) and reliability is good.

4.3.6.2. Limitations of the ALD variables from the English Index of Multiple Deprivation

The IMD data is composed of self-reports with inherent challenges; inaccurate recall, false information, completion by a person other than the intended respondent (Bowling, 1997), social desirability biases (Kimberlin & Winterstein, 2008), and item non-response, which all undermine reliability (Sim & Wright, 2000:77) (discussed section 4.3.). Surveys of households omit those living in institutions or homeless; this potentially underestimates the impact of deprivation on healthy ageing. There is also potential for same source bias, which is when a third, unobserved factor, influences a respondent's reporting of the neighbourhood and their health (Weden, Carpiano *et al.,* 2008). The IMD data is primarily from 2001 whereas the Health Survey collected data from 2002/03 to 2008/09. The deprivation experienced by the respondents may have changed during this time.

The postcode sector (*e.g.* ST15 8BA, area = ST, district = 15, sector = 8, unit = BA) has an average population of 5,000. The census provides the area characteristics and is updated every 10 years. But, as postcodes are designed to deliver mail difficulties in relation to boundaries and postcode changes exist in some areas (Carstairs & Morris, 1991). The scores from postcode sectors with small populations (less than 2,000) are based on census counts that are particularly susceptible to random variation (McLoone, 1995). Also, much of the non-census data incorporated into the IMD has not been collected with full postcodes and is reported for larger areas. Areas are not homogenous, and populations containing a mixture of deprived and less deprived households are liable to have middle ranking scores (McLoone, 1995), reducing the ability to accurately delineate the impact of deprivation upon healthy ageing, this will be exacerbated in larger areas and groups. For example, Sloggett and Joshi estimate that (albeit before the IMD data was collected in 2001, however things are unlikely to have changed drastically) 55% of the most deprived individuals in England and Wales lived outside the 20% of areas that were most deprived (Sloggett & Joshi, 1994). Furthermore, the ecological fallacy is an important potential limitation of area-based measures (applies to GPPS and QOF also). It results from the false assumption that inferences can be made about individual phenomena based on observations of groups (Morgenstern, 1982).

The deprivation category may be associated with an individual's risk of an adverse health outcome through an individual's personal experience of deprivation, and/or the effect of living in a deprived area. It has been estimated that the deprivation effect on mortality is entirely explained by the presence of deprived individuals within those areas (Sloggett & Joshi, 1994). It remains possible however that area level effects, in addition to those expected from the concentration of individuals, may exist for certain health problems.

Several authors note that some indexes are less valid or reliable measures of deprivation amongst older people. The dependence of many census-based indexes on deprivation measures such as class and unemployment partially mask the circumstances of older people (O'Reilly, 2000; Jones & Cameron, 1984) and may jeopardise the estimation of the impact of deprivation on healthy ageing in older groups.

Ideally, a reliable individual measure of deprivation, which could be regularly updated would allow each of these effects to be accounted for at both the individual and the area levels and more reliably monitored over time. However, at present there is no readily available, validated measure that would be acceptable for general use. This would avoid problems of interpretation due to the ecological fallacy. However the analysis of health information at the individual level is always open to potentially problematic privacy and data protection issues. If the latter could be surmounted, or adequate guarantees provided, then health service data could be analysed both at the individual and area level (McLaren & Bain, 1998).

4.3.4. External validity and applicability to British primary care populations

The generalisability of the study may be limited by the study population's characteristics, being more deprived on health, education, and employment measures, but with fewer barriers to housing and services, than England as a whole (Wilkie *et al.,* 2013).

4.4. Implications

Healthy ageing decreases with pain and with deprivation in its many guises (ILD, ALD, poorer access or quality of care) demonstrating the need to address the causes of pain, improve the treatment of pain, reduce inequality encompassing individual and area based measures of deprivation, access and quality of care and allocate resources to areas of greatest need.

The baseline interactions between widespread pain and no access to car, public transport, work, or exposure to the most deprived area crime level, the fourth highest ranked practice according to access to care and the fifth highest ranked practice according to quality of care (which were the same practice) *(table 23)* translated into significant reductions in healthy ageing at baseline demonstrating the corrosive effect of extreme deprivation upon healthy ageing. The implications for the practice would depend on further investigation to identify whether it is another area based exposure causing poorer ageing or a characteristic unique to the care afforded by the practice.

Across 6 years ILD (except education)*,* ALD (excepting area level housing and services), and access to care were significantly associated with unhealthy ageing. Compared to those in the highest ranked practice according to quality of care healthy ageing scores were significantly lower for the third highest and fifth highest ranked practice respectively. There were significant interactions between widespread pain and a background of manual work, and some pain and in the second most deprived education quintile translating to significant reductions in healthy ageing across 6 years. People belonging to these categories are target groups for secondary and tertiary prevention. Importantly the mechanisms causing unhealthy ageing may differ, indicating various interventions and health promotion strategies are needed.

Clearly the results meet Kunst and Mackenbach's definition of health inequalities as *"differences in the prevalence or incidence of health problems between individual people of higher and lower socioeconomic status"* and illustrate the disproportionate burden of illness experienced by deprived populations associated with structural inequalities which reflect the unequal distribution of income and power (Kunst & Mackenbach, 1995) (section 1.5). The United Kingdom's publicly funded National Health Service is failing its aim to provide universal equitable healthcare.

Townsend defines poverty as: *"Individuals, families and groups can be said to be in poverty if they lack the resources to obtain the types of diet, participate in the activities and have the living conditions and amenities which are customary, or at least widely encouraged or approved in the societies to which they belong"* (Townsend, 1979; p31). Clearly this is a relative definition and whereas poverty is often used to refer mainly to the financial resources needed to meet an individuals needs and escape deprivation, people can be deprived because of a lack of many resources (described section 1.6.1), not merely monetary. Such deprivation can lead to unequal health outcomes (Marmot, 2006), and our results demonstrate this.

Rowe & Kahn (1997) challenged the view that ageing involves inevitable decline, rather, proposing that age related functional loss is the consequence of modifiable extrinsic factors. Their model remains influential and widely used (Bowling, 2007), and is supported by our findings. Riley (1998) comments (discussed in section 1.3.5.) that Rowe and Kahn's model focused mainly on individual factors, overlooking the influence of surrounding structural or contextual factors. This thesis illustrates the impact of deprivation, access and quality of care upon the healthy ageing of older people with musculoskeletal pain. Riley's Structural Lag Theory asserted that changes in lives and social structures are fundamentally interdependent; therefore success is reliant on the availability of structural opportunities or interventions in society. Such opportunities lag behind the added years of life experienced by many older adults (Riley *et al.,* 1994). Consequently, poorer environments would be expected to lead to inequalities in health outcomes with ageing, seen in our data. All the health models, be they mainly biomedical approaches (e.g. Rowe & Kahn, 1987), to psychosocial theories emphasizing life satisfaction or adaptation (e.g. Baltes & Baltes, 1990), to theories espousing environmental or cultural elements (e.g. Riley, 1998) struggle to deal with the multidimensionality of healthy ageing, with success or failure on a continuum rather than a simplistic binary assessment of success or failure. The models neglect the influence of broader social structures including allocation of resources and opportunities, cultural contexts, as well as societal norms and behavioural expectations (Ryff & Singer, 2009). The literature suggests additions to current models to improve their conceptualisation of ageing (Depp *et al.,* 2010; Bowling & Dieppe, 2005), however the role and impact of such variables remains poorly understood or quantified. This thesis used an existing healthy ageing index and examined the effect of deprivation and quality of care upon participant outcomes. Clearly, if you have pain you age quicker, if you experience socio-economic deprivation you age quicker (as indicated by the many measures in this study). The addition of ILD, ALD, access and quality of care variables to models conceptualising ageing is likely to be warranted (discussed 1.3.5.). An awareness of what it means to age well and how to measure healthy ageing is important to improve patients' quality of life, allowing society to benefit from the input of older adults and save health and social care resources. At risk groups can then be targeted for prevention and health promotion.

Given the continuing growth of the aged population (Silverstein, 2008), pain and its impact on the functioning and health requirements of older adults will become a greater concern (Badley & Crotty, 1995). The aging population is likely to result in a disproportionate increase in the number of people with chronic disabling disorders, occurring against a background of a decreasing or static number of young adults, with consequences for meeting healthcare and community support needs (Shi *et al.,* 2010). Clearly pain has a significant and growing public health impact. The House of Lords Select Committee concluded that the UK is "woefully underprepared" for the challenges of an ageing population, commenting that "longer lives can be a great benefit, but there has been a collective failure to address the implications and without urgent action this great boon could turn into a series of miserable crises" (Lords Select Committee, 2013) (section 1.1.6.1.). Interventions to promote healthier ageing and subsequently greater functional capacity and ability to work are vital to prevent the projected labour and skills shortages and consequent decreased output (Silverstein, 2008) (section 1.1.6.1).

Clearly, the Lords Select Committee (2013) is concerned that the UK is not prepared for the increasingly aged population and the Nuffield Trust and London School of Economics (2012) believes the NHS is not funded to meet the need. Greater tax revenues generated by longer working lives are seen as essential to meeting healthcare costs but the prevalence of musculoskeletal pain in older age and the associated disability caused means the attrition amongst older workers is likely to be high, undermining this approaches success (Hotopp, 2007). Interventions to promote healthier ageing and subsequently greater functional capacity and ability to work are essential to maintain the current levels of social and healthcare in older age (Silverstein, 2008). Discovering why older adults with pain have different outcomes with pain should be a priority, likewise reducing barriers to accessing high quality care, which is known to be effective and engenders healthier ageing, is essential (Gauthier & Gagliese, 2011) (section 1.1.6.3).

4.4.1. Further research

This thesis demonstrates that deprivation (individual and area based), poorer access and quality of care causes unhealthier ageing in older people with musculoskeletal pain, conforming with previous studies demonstrating that greater limitations predict worse health outcomes (Marmot, 2006) and demonstrating as discussed in section 1.3.2.1 that research on the risks associated with usual aging and strategies to modify them helps elucidate how a transition from usual to successful aging can be facilitated (Rowe & Kahn, 1987).

Further life course research could examine theories of how deprivation (whether at the level of the individual or area) leads to greater levels of unhealthy ageing, particularly among those that experience musculoskeletal pain. Bowling and Dieppe (2005) argue that interventions to promote successful ageing must target vulnerable groups early on (section 1.3.6.); they cite Vaillant's work as an example of middle aged variables predicting outcomes in old age. A 6 year follow up may be insufficient to identify the impact of some variables on healthy ageing or underestimate the impact of others, follow up of the original cohort may be informative {as per Guimarães (2007) section 1.6.7.3.}.

Future research involving qualitative approaches could investigate reasons for generally lower HAI scores from service users experiencing more ILD, ALD, or registered at practices with poorer access and quality scores. Section 1.6.6. described conceptualising neighbourhood effect as a site for "multiple jeopardy" or "deprivation amplification" (Macintyre *et al.,* 1993). This theory postulates that individual poverty is compounded by the attributes of the poor neighbourhood, which may include both material and social characteristics (underinvestment in services and public goods; exposure to noise and pollutants, crime, conflict, disarray; socialization effects on behavior and transmission of health compromising social norms; social isolation and isolation from economic opportunity). Socioeconomically disadvantaged areas could influence individuals social functioning by having poorer infrastructures and higher crime rates, which may undermine social interaction and civic engagement (Cummins *et al.,* 2005), and are deficient in social capital and unable to promote social integration and support (Wen et al., 2006). If poor areas undermine patients desire to access care (described by Brekke *et al.,* 2002), and poor areas have worse care provision (CQC, 2014), investigating the impact upon healthy ageing when poor people in poor areas also have poor access to care is warranted, perhaps by examining stratified care so that deprived populations receive a more targeted approach or different needs based interventions. As discussed in section 1.6.7.1., poor allocation of resources compounds the impact of inadequate funding, and the wide variation in the average number of GPs per 100,000 people, between 56.4 and 62.9 with more affluent areas having more doctors (NOA, 2010) is a concern, as is the lack of data on the proportion of consultations offered by locum GPs or practice nurses by area deprivation measures. It seems sensible to investigate the allocation of resources initially and then question if there are quality concerns secondly.

Godfrey (2000) highlighted the need for research into the precise mechanisms of successful ageing and how they are shaped by the socioeconomic circumstances of individuals. Other researchers note that there is a lack of research on the 'place effects on health' and how place of residence is associated with health outcomes (Green *et al.,* 2005; Macintyre *et al,.* 2002). Furthermore, Strifler (2011) comments that the neglect of society level and environmental factors in operational definitions of successful ageing is an important and significant gap in the current literature. Given the early environmental aspects of the models this omission is curious.

As noted in section 1.3.6., Sarkisian claims that people with low expectations place less importance on seeking health care (Sarkisian *et al.,* 2002). Do those experiencing greater deprivation have lower expectations, and if their access to services is also poor will this compound their health behaviours, with the interaction leading to worse outcomes? A wide variety of data exists demonstrating that those who are more deprived realise that their behaviours are deleterious to health (e.g., smoking and alcohol intake) but tend to persist in their activities, making additional services for these vulnerable groups more important, but also destined for limited success or abject failure as they do not address what may be the root cause i.e. something associated with deprivation. A life course approach may determine how this approach develops and inform attempts to intervene, thereby increasing healthy life expectancy. Such an approach is in keeping with the concerns noted by Hayflick (2000) (section 1.5), who encouraged garnering a better understanding of the ageing processes that underlie vulnerability to pathology, and Franco and colleagues' (2007) assertion that a better understanding of the mechanisms that provoke a vulnerability to age related disorders is required, as well as more funding investigating the mechanisms of ageing, aimed at healthy ageing and the socio-economic factors of ageing.

Investigating the extent to which any discrepancy between sociodemographic groups in respect of reports of care might be attributable to the clustering of servicer users belonging to sociodemographic groups reporting relatively lower scores within providers with lower overall scores would help inform the development and targeting of an intervention aimed at improving service users outcomes. Determining whether the issue is a poor area, poor person or poor practice issue and the interplay of these factors must be accomplished to allow interventions, as encouraged by Megan *et al.,* (2008) (section 1.5), who encouraged clarification of the relative importance and interactions between social capital and structural factors as predictors of healthcare experience and outcomes. This would allow testing of Bowling & Stafford's (2007) hypothesis that improving social capital (by increasing access to social resources, services and facilities) is one way of increasing support for people with consequent improvements in health (section 1.6.6). In section 1.6.8. we noted that providing satisfactory care is harder in more deprived areas (Gulliford *et al.,* 2004; Lind, 2014; Ashworth & Armstrong, 2006). Funding is not allocated according to need and patients in poorer areas are less likely to be referred (McBride *et al.,* 2010), less likely to be identified with cardiovascular disease, and less likely to be referred on for further care (Saxena *et al.,* 2007).

4.4.2. Clinical and practice implications

> *Exploring how socioeconomic position and perceived care impact on healthy ageing may offer area level interventions to reduce ageing inequality and improve population healthy ageing* (Acheson, 1998).

This thesis suggests that deprivation (individual and area based), and experiencing poorer access and quality of care reduces healthy ageing. It highlights the extent to which a combination of lifecourse factors (e.g. cumulative disadvantage) and structural barriers (e.g. poor quality environments) are likely to frustrate aspirations to improve healthy ageing in older people with musculoskeletal pain. The interactions between widespread pain and no access to car, no access to public transport, no access to work, the most deprived area crime level quintile, the fourth highest ranked practice by access and the fifth highest ranked practice by quality at baseline; and widespread pain and background of manual work, and some pain and the second most deprived education level deprivation quintile across 6 years, demonstrate significant further reductions compared to good access, quality and the least deprived group in healthy ageing for subjects in these groups.

The ageing population will increase demand on health services, long-term care and funding. Ideally, longevity should accompany quality of life and personal and social wellbeing. Of the 171,000 older people in Staffordshire only 26,000 (15%) are ‘frail elderly’, but account for 70% of health and care resource use (Staffordshire County Council, 2015). Public sector services must target the well persons, rather than continue to disproportionately invest in services for the frail, to promote healthy ageing as our communities grow older and our resources diminish, aiming for longer life with independence and a shorter period of ill health towards end of life. Consequently, services should preferentially target primary prevention, rather than secondary and finally tertiary prevention strategies. Older people must be enabled to remain independent for longer, providing positive contributions to their communities (both social and economic), but balancing this shift in care provision, services for the frail need to be appropriate to their needs (because eventually all will become frail) and of high quality (an example would be better end of life care at home or within a community service, namely hospice or care home, rather than hospital based care, which better suits patient preference, and when adequately provisioned provides higher quality care and is cheaper) (Staffordshire County Council, 2015).

It is essential to advance beyond the biomedical perspective of ageing, and the fallacy that deteriorating frail bodies require clinical solutions. Services should encourage active ageing, allowing people to realise their potential for physical, social and mental wellbeing throughout their life-course (WHO, 2002). The ‘WHO Life-Course

Approach to Healthy and Active Ageing', provides a suitable framework to employ when considering interventions, namely the right environments (housing and wider environment), healthy lifestyles, social inclusion and quality services (WHO, 2002).

Individual level and area level deprivation reduced healthy ageing. Subjects in poorer areas were further disadvantaged by both subjectively and objectively worse healthcare provision (more deprived areas tended to be served by practices with lower access and quality scores respectively, as noted by the CQC, 2014 (see Section 1.4.1.). Section 1.6.6. described neighbourhood as a site for "multiple jeopardy" or "deprivation amplification" (Macintyre *et al.,* 1993). The interactions between widespread pain and; the fourth highest ranked practice by access and the fifth highest ranked practice by quality at baseline (same practice) reflect the impact of this upon patients with musculoskeletal pain. Poorly performing practices need to be identified and supported, encouraged and when necessary and appropriate forced to improve their provision.

Furthermore, section 1.6.6. noted that area characteristics make up social capital (social networks and support at the level of the community). Social capital can be beneficial to those experiencing financial difficulty, protecting people from ILD (Allen, Inder *et al.,* 2013). It seems logical that those with pain would also benefit, potentially leading to healthier ageing. Bowling and Stafford's proposal that improving neighbourhood social capital (by increasing access to social resources, services and facilities, translating to opportunities for social and civic participation) is one way of increasing social networks/interaction/support available for people, with consequent improvements in health and function (Bowling, Stafford 2007), is compelling and trials of interventions aiming to build social capital in at risk groups are warranted. GP practices could be more active in their communities, utilising their strength as agents for change e.g. social prescribing initiatives (non medical referral options that can operate alongside treatments to improve health and well-being, e.g. gardening/walking/luncheon activities). The interactions between widespread pain and; no access to car and no access to public transport leading to significant reductions in healthy ageing suggests providing adequate transport to patients without it who experience widespread pain would improve ageing outcomes, for example by promoting volunteer transport services (our GP practice has done this).

Relevant partners need to design neighbourhoods that are safe and suitable for the changing needs of older people, to promote better health and social cohesion, thereby facilitating autonomy and independence (WHO, 2002). Cumming and Henry's Disengagement Theory (Section 1.3.1.) proposed that people gradually withdrew or disengaged from social roles in response to reduced capabilities, interest and societal disincentives to participation. Few organised activities for older adults and poor environments may perpetuate this in certain disadvantaged populations. Health and social service providers would benefit from better public transport links. Additionally, the interaction between widespread pain and crime demonstrates the importance of suitable neighbourhoods for vulnerable older patients.

As highlighted in section 1.6.8., clinicians' working in deprived areas treating patients with common physical disorders have a greater number of both physical and mental health disorders to manage simultaneously than do their colleagues in the most affluent areas (Barnett *et al.,* 2012). Providing satisfactory care is consequently harder in more deprived areas, compounded by less resources (Gulliford *et al.,* 2004; Lind, 2014).

Concerningly, Levene *et al.,* noted that lower practice payments were associated with increases in deprivation (Levene *et al.,* 2017). More equitable funding for all GP practices, based on the number of patients they serve, with appropriate weighting for demographic factors that affect relative patient needs and practice workload is essential (section 1.6.7.2). Such funding would provide access to quality care that can reduce health inequalities and promote healthier ageing (RCGP, 2015) (discussed section 1.6.7.3). Furthermore, Ashworth and Gulliford comment that QOF was initially heralded as the driver for quality improvement in primary care, but whilst it is thought to have contributed some clinically useful patient outcomes, it made little difference to overall mortality (Ryan *et al.,* 2016). They note that whichever system employed is likely to fail unless accompanied by adequate funding that takes account of the differing level of needs in various populations (Ashworth & Gulliford, 2017), and targets the at risk groups. Poor allocation and use of resources compounds the impact of inadequate funding. There are wide regional variations in the number of GP practitioners per 100,000 people, with access to GPs inequitably distributed between areas of high and low deprivation (Section 1.6.7.1.). This needs to be addressed to prevent patients who experience individual and/or area level deprivation to also be exposed to access and quality of service deprivation with consequently poorer ageing outcomes. Assessing the frequency of use by area deprivation and the impact of locum and nurse services on patient outcomes would also be interesting, because those with multimorbidity (who may be concentrated in deprived areas) who would most benefit from continuity of care from senior clinicians seem least likely to receive it (given that deprived areas have less GPs, and probably proportionally more locum and nurse use).

Clearly, socioeconomic status must be considered when planning health services because social and material deprivation causes increased consulting and morbidity (Baker *et al.,* 2002) as well as mortality (Ross *et al.,* 2013). However, material deprivation is only part of the puzzle. Ill health and unequal outcomes with deprivation (section 1.6), can also be caused by failing to meet the human needs of autonomy, empowerment and human freedom (Marmot, 2006). Providing improved services is simpler and more achievable than removing deprivation, but may not be effective if patients lack the means or the will {as per Brekke *et al.,* (2002) association between deprivation and low level involvement in healthcare} to access said services. Also, area based interventions are challenging. If an intervention focuses on the most deprived areas it will miss many deprived individuals. Likewise, many less deprived individuals live in very deprived areas. If an area-based intervention is not carefully applied any changes in behaviour may be greater for the less deprived individuals in the area (Sloggett & Joshi, 1994).

Healthcare should be provided on the basis of clinical need, regardless of personal characteristics (age, gender, ethnicity, disability, religion, sexual orientation, socio-economic status or geographical location) and it should aim to reduce differences in health status, access to services and outcomes across population sub-groups. Equality legislation mandates requirements for equity, and the Marmot Review has renewed the attention on health inequalities (Strategic Review of Health Inequalities in England 2009). England is at the forefront internationally of setting targets and public health policies to reduce health inequalities (Department of Health 2009b). However, health inequalities are widening. Marmot's review noted a 7-year difference in life expectancy between the poorest and richest members of society and a 17-year difference in disability free life (Marmot, 2010). The quality agenda does not include the measurement of inequalities and equity and consequently has limited impact on reducing inequalities in health. Furthermore, despite the General Practice Forward View outlining a commitment to better funding there is no clear evidence on how to allocate this funding (NHS England, GPFV, 2016) which makes reversing the inverse care law improbable (Tudor Hart, 1971). However, positively, The NHS Long Term Plan (2019) aims to support better care for patients outside hospitals in their local communities with particular emphasis on supporting people to age well. Also, the new GP services contract 2019/20 hopes to stabilise general practice and allow it to play a major role in Primary care networks (joint working between practices, community, mental health, social care, pharmacy, hospital and voluntary services) (NHS England, 2019) and integrated care communities (the ambition to join up health and care services in a given community, tailored to the needs of the local population, aiming to make better use of resources and provide more consistent services across that community). The Primary care networks and integrated care communities offer a vehicle to reduce inequalities in service provision.

4.5. Conclusion

Changes in physical abilities that are encountered with ageing are influenced by genetics and lifestyle as well as the environment in which individuals work and live (Buchman, Boyle *et al.,* 2007; Kenny, Yardley *et al.,* 2008). This thesis suggests that healthy ageing decreases with pain and with deprivation in its many guises (individual level deprivation, area level deprivation, poorer access or quality of care). Thereby demonstrating the need to; reduce the causes of pain, improve the treatment of pain, reduce inequality encompassing individual and area based measures of deprivation, access and quality of care and assess targeted interventions for the groups in greatest need to improve healthy ageing outcomes.

The interactions noted between pain and individual and area level deprivation, and access and quality of care variables demonstrates the corrosive effect of extreme deprivation upon healthy ageing. Further investigation to identify whether another unaccounted for area or individual based exposure is causing poorer ageing or if it is truly a characteristic unique to the care afforded by the practice is warranted. People belonging to the poorer ageing categories are target groups for secondary and tertiary prevention. Importantly the mechanisms causing unhealthy ageing may differ, and some changes may only become apparent over several decades (Gagliese, 2009), indicating further life course studies are warranted and various interventions and health promotion strategies are needed. Delivering more effective health care is a priority as well as addressing the causes of deprivation.

References

Acheson D. 1998. Independent inquiry into inequalities in health. London: The Stationery Office.

Akcomack S, ter Weel B. 2008. The Impact of Social Capital on Crime: Evidence from the Netherlands. Discussion Paper No. 3603. July 2008. Institute for the Study of Labor. Accessed 25/05/2018. http://ftp.iza.org/dp3603.pdf

Ashworth M, Armstrong D. 2006. The relationship between general practice characteristics and quality of care: a national survey of quality indicators used in the UK Quality and Outcomes Framework, 2004-5. BMC Family Practice, 7:68.

Ashworth M & Gulliford M. 2017. Editorials. Funding for general practice in the next decade: life after QOF. BJGP. January, volume 67, number 654, pages 4-5.

Ashworth M, Seed P, Armstrong D, Durbaba S, & Jones R. 2007. The relationship between social deprivation and the quality of primary care: a national survey using indicators from the UK Quality and Outcomes Framework. British Journal of General Practice; 57: 441-448.

Atchley RC. 1989. A Continuity Theory of Normal Aging. *The Gerontologist*, 29 (2): 183-190.

Airey A, & Erens B. 1999. The National Surveys of NHS Patients: General Practice 1998 Summary of Key Findings . England. Department of Health.

Allen J, Inder K, Harris M, Lewin T, Attia J. & Kelly B. 2013. Quality of life impact of cardiovascular and affective conditions among older residents from urban and rural communities. *Health Qual Life Outcomes,* 11(1), pp. 140.

Alonso J, Orfila F, Ruigómez A, Ferrer M, Antó JM. 1997. Unmet health care needs and mortality among Spanish elderly. *Am J Public Health*. March; 87(3): 365–370.

Arthritis Research UK. 2014. Disability and musculoskeletal problems. How often is disability caused by musculoskeletal problems? Available: http://www.arthritisresearchuk.org/arthritis-information/data-and-statistics/musculoskeletal-pain-and-disability/disability-and-musculoskeletal-problems.aspx Accessed 10/04/2014.

Badley E, & Crotty M. 1995. An international comparison of the estimated effect of the aging of the population on the major cause of disablement, musculoskeletal disorders. *J Rheumatol.* 22(10), pp. 1934-40.

Badley E, & Tennant A. 1992. Changing profile of joint disorders with age: findings from a postal survey of the population of Calderdale, West Yorkshire, United Kingdom. *Ann Rheum Dis,* (51), pp. 366-71.

Baker D, Mead N, & Campbell S. 2002. Inequalities in morbidity and consulting behaviour for socially vulnerable groups. *British Journal of General Practice,* 52, pp. 124-30.

Baltes PB, & Baltes MM. 1990. Psychological perspectives on successful aging: The model of selective optimization with compensation. In: Baltes PB, Baltes MM (eds): Successful aging: Perspectives from the behavioural sciences. Cambridge University Press, New York, 1-34).

Barnett K, Mercer S, Norbury M, Watt G, Wyke S, & Guthrien B. 2012. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. *The Lancet,* 380 (July 7), pp. 37-43.

Bassett R, Bourbonnais V, & McDowell I. 2007. Living long and keeping well: Elderly Canadians account for success in aging. *Canadian Journal on Aging*, 26(2), 113-126)

Bearon LB. 1996. Successful Aging: What does the "good life" look like? *Concepts in Gerontology*, Vol. 1, No. 3, Summer.

Bedson J, Martion OL, & Jordan KP. 2010. Determining Analgesic Prescribing Rates in Primary Care Using a Consensus Model of Prescribing from General Practice. Rheumatology 49(S1): 733, 2010.

Benzeval M, Green MJ, & Leyland AH. 2011. Do social inequalities in health widen or converge with age? Longitudinal evidence from three cohorts in the West of Scotland. *BMC Public Health*, 11: 947.

Bergner M, Bobbitt RA, Carter WB, & Gilson BS. 1981. The Sickness Impact Profile: Development and final revision of a health status measure. *Med Care* 1981, 19:787-805.

Berkman LF, & Syme SL. 1979. Social networks, host resistance, and mortality: a nine-year follow-up study of Alameda County residents. *Am J Epidemiol.,* 109(2), pp. 186-204.

Birrell F, Croft P, Cooper C, Hosie G, Macfarlane GJ, & Silman A. 2000. Radiographic change is common in new presenters in primary care with hip pain. Rheumatology 2000;39:772–5.

Blyth FM, Cumming R, Mitchell P, & Wang JJ. 2007. Pain and falls in older people. *European Journal of Pain,* 11(5), pp. 564-571.

Bordieu P. 1985. The forms of capital. In: Richardson J, ed, *Handbook of theory and research for the sociology of education.* Greenwood New York, pp. 241-358.

Boslaugh S. 2007. Secondary Data Sources for Public Health: A Practical Guide. Cambridge University Press.

Bourque LB & Fielder EP. 1995 *How to Conduct Self-Administered and Mail Surveys*. Thousand Oaks: Sage Publications.

Bowling A. 1997. Research Methods In Health: Investigating health and health services. Second edition. Buckingham, Open University Press.

Bowling A. 2007. Aspirations for older age in the 21st century: What is successful aging? *International Journal of Aging and Human Development*, 64(3), 263-297).

Bowling A. 2008. Enhancing later life: How older people perceive ageing? *Aging and Mental Health*. 12(3): 293-301.)

Bowling A, & Dieppe P. 2005. What is successful ageing and who should define it? *BMJ,* 331(7531), pp. 1548-51.

Bowling A, & Iliffe S. 2006. Which model of successful ageing should be used? Baseline findings from a British longitudinal survey of ageing. Age Ageing; 35: 607-14).

Bowling A, & Stafford M. 2007. How do objective and subjective assessments of neighbourhood influence social and physical functioning in older age? Findings from a British survey of ageing. *Social Science & Medicine,* 64, pp. 2553-2549.

Bowsher D, Rigge M, & Scoop L. 1991. Prevalence of chronic pain in the British population: a telephone survey of 1037 households. *Pain,* 4, pp. 223-30.

Brattberg G, Parker M, & Thorslund M. 1996. The prevalence of pain among the oldest old in Sweden. *Pain,* 67(1), pp. 29-34.

Brattberg G, Parker M, & Thorslund M. 1997. A longitudinal study of pain: reported pain from middle age to old age. *Clin J Pain*; 13:144–149.

Brekke M, Hjortdahl P, & Kvien TK. 2002. Severity of musculoskeletal pain: relations to socioeconomic inequality. *Social science & medicine (1982),* 54(2), pp. 221-228.

Brilleman SL, Pachana DA, & Dobson AJ. 2010. The impact of attrition on the representativeness of cohort studies of older people. BMC Med Res Methodol 10:71.

Brochet B, Michel P, Barberger-Gateau P, & Dartigues J. 1998. Population-based study of pain in elderly people: a descriptive survey. *Age and Ageing,* 27, pp. 279-284.

Brummel-Smith K. 2007. Optimal Aging, Part I: Demographics and Definitions. *Annals of Long-Term Care*; 15: 26 – 28).

Buchman A, Boyle P, Wilson R, Bienias J, & Bennet D. 2007. Physical activity and motor decline in older persons. *Muscle Nerve,* 35, pp. 354-362.

Burnham, K. P., and D. R. Anderson. 2002. Model selection and multimodel inference : a practical information-theoretic approach. Springer, New York.

Busse E, & Maddox G. 1985. The Duke Longitudinal Studies of Normal Aging: 1955–1980. New York: Springer.

Campbell D. 2014. Record A&E waits show NHS is cracking under pressure – doctors' chief. 12 December 2014. The Guardian.

Care Quality Commission. 2014. The state of health care and adult social care in England 2013/14. Pages 66-70. Williams Lea Group.

Carmona L, Ballina J, Gabriel R, Laffon A, on behalf of the EPISER Study Group. 2001. The burden of musculoskeletal diseases in the general population of Spain: results from a national survey. *Ann Rheum Dis*;60:1040–5.

Carr-Hill R, & Chalmers-Dixon P. 2005. Measuring inequalities by social categories. In: LIN J, ed. *The Public Health Observatory Handbook of Health Inequalities Measurement.* Oxford: South East England Public Health Observatory, pp. 11.

Carstairs V, & Morris R. 1991. Deprivation and health in Scotland. Aberdeen: Aberdeen University Press. 0080379796.

Caspi A, & Elden GH. 1986. Life satisfaction in old age: linking social psychology and history. *Psychol Aging.* 1:18-26.

Castro-Lionard K, Thomas-Antérion C, Crawford-Achour E, Rouch I, Trombert-Paviot B, Barthélémy J, Laurent B, Roche F, &Gonthier R. 2011. Can maintaining cognitive function at 65 years old predict successful ageing 6 years later? The PROOF study. *Age and Ageing,* 40(2), pp. 259-265.

Chandola T, Kuper H, Singh-Manoux A, Bartley M, & Marmot M. 2004. The effect of control at home on CHD events in the Whitehall II study: gender differences in psychosocial domestic pathways to social inequalities in CHD. *Soc Sci Med,* 58, pp. 1501-9.

Chisholm A, Reeves R, Graham C, & Bullen, N. 2004. *PCT Survey Results 2004.* Healthcare Commision.

Cho N, Kim I, Lim S, & Kim H. 2012. Prevalence of Widespread Pain and Its Influence on Quality of Life: Population Study in Korea. *Journal Korean Medical Science,* 27, pp. 16-21.

Christensen K, Doblhammer G, Rau R, &Vaupel JW. 2009. Ageing populations: the challenges ahead. Lancet. October 3; 374(9696): 1196–1208.

Cole B, Finch, E, Gowland C, & Mayo N. 1994. Physical Rehabilitation Outcome Measures. Canadian Physiotherapy Association, Toronto. In Sim & Wright, 2000, p135.

Crimmins EM, & Beltrán-Sánchez H. 2011. Mortality and Morbidity Trends: Is There Compression of Morbidity? *Journal of Gerontology: Social Sciences*, 2011, Jan; 66(1): 75-86.

Crimmins EM, & Saito Y. 2000. Change in the prevalence of diseases among older Americans: 1984–1994. *Journal of Demographic Research.* 2000;3(9).

Croft P, Blyth FM, & van der Windt, D (editors). 2010. Chronic Pain Epidemiology. From Aetiology to Public Health. Oxford University Press. ISBN 978–0–19–923576–6

Croft P, Lewis M, Papageorgiou AC, Thomas E, Jayson MV, Macfarlane GJ, & Silman AJ. 2001. Risk factors for neck pain: a longitudinal study in the general population. Pain 2001;93:317–25.

Crombie IK, & Davies HTO. 1996. Research in Health Care: Design, Conduct and Interpretation of Health Services Research. John Wiley, Cichester.

CSDH (Commission on Social Determinants of Health). 2008. Closing the gap in a generation: Health equity through action on the social determinants of health. Final Report of the Commission on Social Determinants of Health. Geneva: World Health Organization.

Cummins S, Curtis S, Diez-Roux AV, & Macintyre S. 2007. Understanding and representing 'place' in health research: A relational approach. *Social science & medicine,* 65(9), pp. 1825-1838.

Cumming E, & Henry WE. 1961. *Growing old: The process of disengagement.* New York: Basic Books, Inc.

Cummins S, Stafford M, Macintyre S, Marmot M, & Ellaway A. 2005. Neighbourhood environment and its association with self rated health: Evidence from Scotland and England. *Journal of Epidemiology and Community Health,* 59, pp. 207-213.

Czaja R, & Blair J. 1996. *Designing Surveys: A Guide to Decisions and Procedures.* Thousand Oaks: Pine Forge Press. Cited in Sim & Wright, 2000:75.

Davey SG, Hart C, Watt G, Hole D, & Hawthorne V. 1998. Individual social class, area-based deprivation, cardiovascular disease risk factors, and mortality: the Renfrew and Paisley Study. *J Epidemiol Community Health*;52:399e405.

Davey Smith G, Sterne JA, Fraser A, Tynelius P, Lawlor DA, & Rasmussen F. 2009. The association between BMI and mortality using offspring BMI as an indicator of own BMI: large intergenerational mortality study. BMJ. Dec 22;339:b5043

Deloitte. 2014. Primary care: Today and tomorrow. Improving general practice by working differently. The Deloitte Centre for Health Solutions.

Department of Health. 2003. *NHS patient survey programme: General practice 2002 results.* UK: Department of Health.

Department of Health. 2003a. Investing in general practice – the new General Medical Services contract. The Department of Health, 30 December 2003. http://webarchive.nationalarchives.gov.uk/+/www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4071966 (accessed 21/05/2014).

Department of Health. 2010. Progress in Improving Stroke Care. National Audit Office, 29 January 2010. www. nao.org.uk/publications/0910/stroke.aspx

Department of Health. 2010. The Operating Framework for the NHS in England 2011/12, Department of Health, 15 December 2010. http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPOlicyAndGuidance/DH_122738).

Department of Health. 2013. NHS outcomes framework 2014/15. DH. www.gov.uk/government/publications/ nhs-outcomes-framework-2014-to-2015.

Depp C, Vahia IV, & Jeste D. 2010. Successful aging: Focus on cognitive and emotional health. *Annual Review of Clinical Psychology*, 6(19), 19.1-19.24)

Dieppe P. 2013. Chronic Musculoskeletal Pain. *BMJ*;346:bmj.f3146

Di Gessa G, & Grundy E. 2014. The relationship between active ageing and health using longitudinal data from Denmark, France, Italy and England. *J Epidemiol Community Health.* Mar;68(3):261-7)

Donald I, & Foy C. 2004. A longitudinal study of joint pain in older people. *Rheumatology,* 43, pp. 1256-1260.

Doran T, Fullwood C, Gravelle H, Reeves D, Kontopantelis E, Hiroehand U, & Roland M. 2006. Pay-for-Performance Programs in Family Practices in the United Kingdom. New England Journal of Medicine;355:375–84.

Dorner TE, Muckenhuber J, Stronegger W, Ràsky E, Gustorff B, & Freidl, W. 2011. The impact of socio-economic status on pain and the perception of disability due to pain. European Journal of Pain, Volume 15, Issue 1, January, Pages 103–109.

Doyle YG, Mc Kee M, Sherriff M. 2012. A model of successful ageing in British populations. Eur J Public Health 22(1): 71–6. doi: 10.1093/eurpub/ckq132.

Dransfield S. 2014. A Tale of Two Britain's: Inequality in the UK. Oxfam GB. 17/03/2014.

Drever F, & Whitehead M. (Eds.). 1997. Health Inequalities. London: The Stationery Office.

Dunn KM, Jordan K, Lacey RJ, Shapley M, & Jinks C. 2004. Patterns of consent in epidemiologic research: evidence from over 25,000 responders. Am J Epidemiol 159(11): 1087–1094.

Dunn G, Pickles A, Tansella M, & Vazquez-Barquero JL. 1999. Two –phase epidemiological surveys in psychiatric research. Br J Psychiatry 174: 95-100.

DWP. 2007. Department for work and pensions. Disability Living Allowance - cases in payment Caseload (Thousands): Main Disabling Condition by Gender of claimant. http://83.244.183.180/100pc/dla/disabled/ccsex/a_carate_r_disabled_c_ccsex_nov07.html10/04/2014]. Accessed 21/05/2014.

Dytham C. 1999. Choosing and Using Statistics. A Biologist's Guide. Blackwell Science.

Ebrahim S. 1999. Disability in older people: a mass problem requiring mass solutions. *The Lancet,* 353(9169), pp. 1990-1992.

Elliott A, Smith B, Hannaford P, Smith W, & Chambers W. 2002. The course of chronic pain in the community: results of a 4-year follow-up study. *Pain*, pp. 299-307.

Elliott A, Smith B, Penny K, Smith W, & Chambers, W. 1999. The epidemiology of chronic pain in the community. *Lancet,* 354 (9186), pp. 1248-52.

Elliott MN, Haviland AM, Kanouse DE, et al. 2009. Adjusting for subgroup differences in extreme response tendency in ratings of health care: impact on disparity estimates. *Health Serv Res*;44:542-61.

Elliott MN, Zaslavsky AM, Goldstein E, et al. 2009. Effects of survey mode, patient mix, and nonresponse on CAHPS hospital survey scores. *Health Serv Res*;44:501-18.

Feinglass J, Lin S, Thompson J, Sudano J, Dunlop D, Song J, Baker DW. 2007. Baseline health, socioeconomic status, and 10-year mortality among older middle-aged Americans: findings from the Health and Retirement Study, 1992 2002. *J Gerontol B Psychol Sci Soc Sci.* 2007 Jul;62(4):S209-17.

Ferrell B. 1995. Pain Evaluation and Management. In: P. Katz, R. Lane and M. Mezey, eds, *Quality Care in Geriatric Settings.* New York: Springer.

Fischer M, Karlsson M, & Nilsson T. 2013. Effects of compulsory schooling on mortality: evidence from Sweden. *Int J Environ Res Public Health.,* 10(8), pp. 3596-618.

Foddy W. 1996. The in-depth testing of survey questions: a critical appraisal of methods. *Quality and Quantity* 1996 (30): 361-370. Cited in Sim & Wright, 2000:258.

Fox J, Goldblatt P. 1982. Longitudinal Study 1971–1975; England and Wales. Office of Population Censuses and Surveys. Series LS no 1. London: HMSO.

Freedman VA, Schoeni R, Martin LG, & Cornman J. 2007. Chronic conditions and the decline in late life disability. *Demography.* 44:459–477.

Fries JF. 1980. Aging, natural death, and the compression of morbidity. *New England Journal of Medicine*, 303(3), 1369-1370.

Fries JF. 2001. Aging, cumulative disability, and the compression of morbidity. *Compr Ther.* Winter;27(4):322-9.

Fries JF. 2003. Measuring and monitoring success in compressing morbidity. *Annals of Internal Medicine*; 139:455-459).

Franco OH, Kirkwood TBL, Powell JR, Catt M, Goodwin J, Ordovas JM, & van der Ouderaa F. 2007. Ten commandments for the future of ageing research in the UK: a vision for action. B*MC Geriatrics* 2007, 7:10

Fukuda Y, Nakamura K, & Takano T. 2005. Municipal health expectancy in Japan: decreased healthy longevity of older people in socioeconomically disadvantaged areas. *BMC Public Health.* Jun 14;5:65),

Gagliese L. 2009. Pain and Aging: The Emergence of a New Subfield of Pain Research. *The Journal of Pain,* 10(4), pp. 343-353.

Gauthier L, & Gagliese L. 2011. Chapter 12: Assessment of Pain in Older Persons. In: D. Turk and R. Melzack, eds, *Handbook of Pain Assessment.* Third Edition edn. The Guilford Press New York, pp. 242-259.

Godfrey M. 2009. Prevention: developing a framework for conceptualizing and evaluating outcomes of preventative services for older people. *Health and Social care in the Community*; (2), 89-99.

GP Patient Survey (Access) 2007/08 Technical Report. ISBN: 978-1-84636-224-7. Bulletin: 978-1-84636-224-7. Copyright © 2008, The NHS Information Centre for health and social care. All rights reserved. http://gp-survey-production.s3.amazonaws.com/archive/2008/June%202008%20Technical%20Annex.pdf Accessed May 2014.

GP Patient Survey (Access) National Report 2007/08 (England). ISBN: 978-1-84636-224-7 Bulletin: 978-1-84636-224-7
Copyright © 2008, The NHS Information Centre. All rights reserved. http://gp-survey-production.s3.amazonaws.com/archive/2008/unweighted/June%202008%20National%20Commentary%20Report.pdf Accessed May 2014.

Green S, Sixsmith J, Ivanoff SD, & Sixsmith A. 2005. Influence of occupation and home environment on the wellbeing of European elders. *International Journal of Therapy and Rehabilitation*, November 2005, Vol 12, No 11, pages 505-509.

Griffin J, Fuhrer R, Stansfeld S, & Marmot M. 2002. The importance of low control at work and home on depression and anxiety: do these effects vary by gender and social class? *Soc.Sci.Med.,* 54(5), pp. 783-98.

Groves RM. 2006. Nonresponse rates and nonresponse bias in household surveys. *Public Opin Quart* 2006;70:646-75.

Groves RM, Peytcheva E. 2008. The impact of nonreponse rates on nonresponse bias. *Public Opin Quart*;72:167-89.

Gruenberg EM. 1977. The failures of success. *Milbank Mem Fund Q Health Soc.* 1977 Winter;55(1):3-24.

Gu D, Zhang Z, Zeng Y. 2009. Access to Healthcare Services Makes a Difference in Healthy Longevity among Older Chinese Adults. *Soc Sci Med.* Jan; 68(2): 210-219.

Guimarães RM. 2007. Health Capital, Life Course and Ageing. *Gerontology*;53:96–101.

Gulliford MC. 2002. Availability of Primary Care Doctors and Population Health in England: Is There an Association? *Journal of Public Health Medicine* 24:252-4.

Gulliford MC, Jack RH, Adams G, Ukoumunne OC. 2004. Availability and Structure of Primary Care Services and Population Health and Health Care Indicators in England. *BMC Health Services Research* 4:12.

Guralnik JM, Kaplan GA. 1989. Predictors of healthy aging: prospective evidence from the Alameda County study. *Am J Public Health.* Jun; 79(6):703-8.

Guralnik JM, Land KC, Blazer D, Fillenbaum, and Branch LG. 1993. Educational Status and Active Life Expectancy among Older Blacks and Whites. *N Engl J Med*; 329:110-116.

Gureje O. 1998. Persistent pain and well-being: A World Health Organization study in primary care. *Journal of the American Medical Association,* 280, pp. 147-51.

Guthrie B, McLean G, & Sutton M. 2006. Workload and Reward in the Quality and Outcomes Framework on the 2004 General Practice Contract. British Journal of General Practice;56:836–41.

Haan M, Kaplan GA, Camacho T. 1987. Poverty and health prospective evidence from the Alameda County Study. *Am. J. Epidemiol*;125:989–998.

Hagen KB, Smedstad LM, Uhlig T, Kvien TK. 1999. The responsiveness of health status measures in patients with rheumatoid arthritis: comparison of disease-specific and generic instruments. J Rheumatol;26:1474–80.

Hakin B. 2012. General Medical Services Contract 2013/14 letter to PCT Chief Executives and SHA Chief Executives. Gateway Ref: 18276. 23 October 2012. http://www.pulsetoday.co.uk/Uploads/2012/10/23/y/y/i/Letter-on-GP-contracts.pdf Accessed May 2014.

Haley SM, McHorney CA, Ware JE Jr. Evaluation of the MOS SF-36 physical functioning scale (PF-10): I. Unidimensionality and reproducibility of the Rasch item scale. J Clin Epidemiol. 1994 Jun;47(6):671-84.

Hamer M, Bates CJ, & Mishra GD. 2011. Depression, physical function, and risk of mortality: National Diet and Nutrition Survey in adults older than 65 years. Am J Geriatr Psychiatry; 19(1):72-8.

Hardy SE, Studenski SA. 2008. Fatigue predicts mortality in older adults. J Am Geriatr Soc. Oct;56(10):1910-4.

Harkins SW, Price DD, & Bush FM. 1994. Geriatric pain. In: Wall PD, Melzack R (Eds). Textbook of Pain. New York: Churchill Livingstone, 1994, pp 769–787.

Harris-Kojetin LD, Fowler FJ Jr, Brown JA, et al. 1999. The use of cognitive testing to develop and evaluate CAHPS 1.0 core survey items. *Med Care*;37:MS10-21.

Hauer K, Lamb SE, Jorstad EC, Todd C, & Becker C. 2006. Systematic review of definitions and methods of measuring falls in randomised controlled fall prevention trials. Age Ageing;35:5-10

Hayflick, L. 2000. The future of ageing, commentary. *Nature* 408, 267-269 (9 November). |

Hayward RA, Rathod T, Roddy E, Muller S, Hider SL, & Mallen CD. 2013. The association of gout with socioeconomic status in primary care: a cross-sectional observational study. *Rheumatology,* 52(11), pp. 2004-2008.

Havighurst RJ. 1961. Successful aging. *Gerontologist*, 1, 8-13.

Havighurst RL, Neugarten B, & Tobin SS. 1968. Disengagement and patterns of aging. In: Neugarten, BL, ed. Middle age and aging: a reader in social psychology. Chicago. University of Chicago Press, 1968: 161-72.

Health and safety executive, 2014 (last update). Musculoskeletal Disorders (MSDs) in Great Britain. Summary. Available: http://www.hse.gov.uk/STATISTICS/causdis/musculoskeletal/index.htm Accessed 10/04/2014.

Health and Social Care Information Centre. 2012. QOF 2005/06 data notes. ISBN: 978-1-84636-224-7).

Healthcare Commission. 2003. *Key findings report: PCT Survey Results 2003* . England: Healthcare Commission.

Healthcare Commission. 2005. *PCT Survey Results 2005.* England: Healthcare Commission.

Healthcare Commission. 2006. *Variations in the Experiences of Patients using the NHS Services in England: Analysis of the Healthcare Commission's 2004/2005 surveys of patients*. London: Healthcare Commission. Available at: www.cqc.org.uk/publications.cfm?widCall

1=customDocManager.search_do_2&tcl_id=2&top_parent=4513&tax_child=4759&tax _ grand_child=4845&search_string= Accessed on 20 November 2014.

Helme R, & Gibson S. 2001. The Epidemiology of Pain in Older People. *Clinical Geriatric Medicine,* 17, pp. 417-431.

HM Treasury. 2010. Spending Review 2010. HM Treasury, 22 November. http://www.hm-treasury.gov.uk/spend_index.htm.

Hodge AM, English DR, Giles GG, & Flicker L. 2013. Social connectedness and predictors of successful ageing. *Maturitas.* Volume 75, Issue 4 , Pages 361-366, August 2013.

Hotopp U. 2007. The ageing workforce: A health issue. *Economics and Labour Market Review,* 1, pp. 30-35.

Howe K. 2006. Increasing life expectancy and the compression of morbidty: A critical review of the debate. Working paper 206. Oxford Institute of Ageing. July. http://www.ageing.ox.ac.uk/files/workingpaper_206.pdf).

Hox JJ, de Leeuw ED, Chang H. 2012. Nonresponse versus Measurement Error: Are Reluctant Respondents Worth Pursuing? Bulletin of Sociological Methodology. 113 (1): 5-19.

Huisman M, Kunst AE, Andersen O, Bopp M, Borgan JK, Borrell C, Costa G, Deboosere P, Desplanques G, Donkin A, et al. 2004. Socioeconomic inequalities in mortality among elderly people in 11 European populations. *J Epidemiol Community Health*. 2004;58:468–475. doi: 10.1136/jech.2003.010496.

Huisman M, Kunst A, Deeg D, Grigoletto F, Nusselder W, Mackenbach J. 2005. Educational inequalities in the prevalence and incidence of disability in Italy and the Netherlands were observed. *J Clin Epidemiol*;58:1058e65.

Ikeda N, Saito E, Kondo H et al. 2011. What has made the population of Japan Healthy? *The Lancet*, Volume 378, Issue 9796, Pages 1094 - 1105, 17 September.

Jenkins CD, Stanton BA, Niemcryk SJ, & Rose RM. 1988. A scale for the estimation of sleep problems in clinical research.*J Clin Epidemiol*;41:313–21.

Jinks C, Lewis M, Ong BN, & Croft P. 2001. A brief screening tool for knee pain in primary care. 1. Validity and reliability. Rheumatology 2001;40: 528–36.

Jones IL, & Cameron D. 1984. Social class analysis- an embarrassment to epidemiology. Community Med 1984;6:37-46. From section 5 (Carr-Hill & Chalmers-Dixon, 2005, section 5).

Jordan K, Hayward R, RobertS E, Edwards J, & Kadam U. 2013. The relationship of individual and neighbourhood deprivation with morbidity in older adults: an observational study. The European Journal of Public Health, October 21, 2013.

Jordan KM, Sawyer S, Coakley P, Smith HE, Cooper C, & Arden NK. 2004. The use of conventional and complementary treatments for knee osteoarthritis in the community. *Rheumatology (Oxford).* 2004 Mar;43(3):381-4. Epub Nov 17.

Jordan KP, Sim J, Moore M, Bernard M, & Richardson J. 2012. Distinctiveness of long-term pain that does not interfere with life: An observational cohort study. *Eur J Pain* 16, 1185-1194).

Jordan K, Thomas E, Peat G, Wilkie R, & Croft P. 2008. Social risks for disabling pain in older people: a prospective study of individual and area characteristics. *Pain,* 31(137(3)), pp. 652-61.

Juurlink DN, Herrmann N, Szalai JP, Kopp A, & Redelmeier DA. 2004. Medical illness and the risk of suicide in the elderly. *Archives Internal Medicine,* 14(164(11)), pp. 1179-84.

Kawachi I, Kennedy BP, & Glass R. 1999. Social capital and self-rated health: a contextual analysis. Am J Public Health. 1999;89:1187–1193.

Kawachi I, Kennedy BP, Lochner K, & Prothrow-Stith D. 1997. Social capital, income inequality, and mortality. Am J Public Health. 1997;87:1491–1498.

Kelley K, Clark B, Brown V, & Sitzia J. 2003. Good practice in the conduct and reporting of survey research. *Int J Qual Health Care*15 (3): 261-266.

Kendig H & Browning C. 1997. Positive ageing: facts and opportunities. *Medical Journal of Australia.* 167(8):409)

Kenny G, Yardley J, Martineau L, & Jay O. 2008. Physical work capacity in older adults: Implications for the ageing worker. *American Journal of Indusctrial Medicine,* 51, pp. 610-625.

Kerschner H & Pegues J. 1998. Productive ageing: A quality of life agenda. *Journal of the American Dietetic Association*; 98(12):1445-1448.

Kibele EUB. 2013. Individual and area level effects on mortality risk in Germany, both East and West, among Germans aged 65+. Int J Public Health.

Kimberlin CL, & Winterstein AG. 2008. Validity and reliability of measurement instruments used in research. Am J Health-Syst Pharm. 65:2276-84.

Kirkwood TB, & Austad SN. 2000. Why do we age? Nature, 408:233-238.

Kunst A, & Mackenbach J. 1995. *Measuring socio-economic inequalities in health.* Geneva: World Health Organisation.

Lacey RJ, Belcher J, & Croft PR. 2012. Validity of two simple measures for estimating life-course socio-economic position in cross-sectional postal survey data in an older population: results from the North Staffordshire Osteoarthritis Project (NorStOP). BMC Medical Research Methodology, 12:88.

Lacey RJ, Jordan KP, Croft PR. 2013. Does Attrition during Follow-Up of a Population Cohort Study Inevitably Lead to Biased Estimates of Health Status? PLOS ONE, December vol 8, issue 12.

Lacey RJ, Lewis M, Jordan K, Jinks C, & Sim J. 2005. Interrater reliability of scoring of pain drawings in a self-report health survey. Spine;30:E455–8.

Layte R & Jenkinson C. 1997. Social surveys. In: Assessment and Evaluation of Health and Medical Care (ed. Jenkinson, C.). Buckingham: Open University Press, pp. 47-63.

Leadley RM, Armstrong N, Reid KJ, Allen A, Misso KV, & Kleijnen J. 2013. Healthy Aging in Relation to Chronic Pain and Quality of Life in Europe. *Pain Pract.* 2013 Oct 21).

Lee DM, Pendleton N, Tajar A, O'Neill TW, O'Connor DB, Bartfai G, Boonen S, Casanueva FF, Finn JD, Forti G, Giwercman A, Han TS, Huhtaniemi IT, Kula K, Lean MEJ, Punab M, Silman AJ, Vanderschueren D, Moseley CM, Wu FCW, & McBeth J. 2010. Chronic widespread pain is associated with slower cognitive processing speed in middle-aged and older European men. *Pain,* 151(1), pp. 30-36.

Levene LS, Baker R, Wilson A, Walker N, Boomla K, & Bankart MJG. 2017. Population health needs as predictors of variations in NHS practice payments: a cross-sectional study of English general practices in 2013-2014 and 2014-2015. BJGP January, volume 67, number 654, page 15).

Levesque JF, Harris MF, Russell G. 2013. Patient-centred access to health care: conceptualising access at the interface of health systems and populations. *International Journal for Equity in Health* 2013, 12:18.

Lewis M, Jordan K, Lacey RJ, Jinks C, & Sim J. 2002. Inter-rater reliability assessment of the scoring of the body pain manikin. Rheumatology;41:52.

Lin K, Chen P, Twisk J, Lee H, & Chi L. 2010. Time-Varying Nature of Risk Factors for the Longitudinal Development of Disability in Older Adults with Arthritis. *J Epidemiol,* 20((6)), pp. 460-467.

Lind S. 2014. NHS England refuse to release details of Carr-Hill fromula review group. Pulse. 29 January 2014.

Lind S. 2016. GP Practices with 'atypical' population set to receive extra funding. Pulse. 16 August 2016.

Litwin H, & Sapir E. 2009. Perceived income adequacy among older adults in 12 countries: findings from the survey of health, ageing, and retirement in Europe. *Gerontologist.,* 49, pp. 397-406.

Lopez AD, Mathers CD, Ezzati M, Murray CJL, Jamison DT, eds. 2006. Global burden of disease and risk factors. New York, Oxford University Press.

Lords Select Committee. 2013. House of Lords Select Committee on Public Service and Demographic Change Report: Ready for ageing? Lords Select Committee. HL Paper 140. 14/03/2013.

Lovheim H, Sandman P, Kallin K, Karlsson S, & Gustafson Y. 2006. Poor staff awareness of analgesic treatment jeopardizes adequate pain control in the care of older people. *Age Ageing,* 35, pp. 257–261.

Luong ML, Cleveleand RJ, Nyrop KA, Callahan LF. 2012. Social determinants and osteoarthritis outcomes. *Aging health.* August 1; 8(4): 413–437.

Lynch J, Davey Smith G. 2002. Income inequality and health: the end of the story? Int J Epidemiol. 2002;31: 549–551.

Lyratzopoulos G, Elliott M, Barbiere JM, et al. 2012. Understanding ethnic and other socio-demographic differences in patient experience of primary care: evidence from the English General Practice Patient Survey *BMJ Qual Saf*;21:21-29.

Macfarlane GJ, Croft PR, Schollum J, & Silman AJ. 1996. Widespread pain: is an improved classification possible? J Rheumatol;23:1628–32.

Macfarlane GJ, Hunt IM, & Silman AJ. 2000. Role of mechanical and psychosocial factors in the onset of forearm pain: prospective population based study. Br Med J;321:676–9.

Macintyre S, & Ellaway A. 1998. Social and local variations in the use of urban neighbourhoods: a case study in Glasgow. *Health Place*;4: 91e4.

Macintyre S, Ellaway A, & Cummins S. 2002. Place effects on health: how can we conceptualise, operationalise and measure them? *Soc Sci Med.* Jul;55(1):125-39.

Macintyre S, Hiscock R, Kearns A, & Ellaway A. 2000. Housing tenure and health inequalities: a three-dimensional perspective on people, homes and neighbourhoods. In H. Graham(Ed.), Understanding Health Inequalities (pp 129–142). Buckingham: Open University Press.

Macintyre S, Maciver S, & Sooman A. 1993. Area, class and health: Should we be focusing on places or people? *J. Soc. Policy*;22:213–234).

Maniadakis N, & Gray A. 2000. The economic burden of back pain in the UK. *Pain,* 84(1), pp. 95-103.

Mannion R, & Goddard M. 2002. 'Performance measurement and improvement in health care'. *Applied Health Economics and Health Policy*, vol 1, pp 13–23. From Raleigh & Foot, 2010.

Manton KG. 1982. Changing concepts of morbidity and mortality in the elderly population. *Milbank Memorial Fund Quarterly/Health and Society*;60:183–244.

Margolis RB, Chibnall JT, & Tait RC. 1988. Test-retest reliability of the pain drawing instrument. Pain;33:49–51.

Marmot M. 2006. Health in an unequal world. *The Lancet,* 368, pp. 2081-2094.

Marmot MG, & Smith GD. 1989. Why are the Japanese living longer? *BMJ*; 299: 1547-1551.

Marmot MG, Smith GD, Stansfeld S, Patel C, North F, Head J, et al. 1991. Health inequalities among British civil servants: the Whitehall II study. *Lancet*;337:1387e93.

Martikainen P, Kauppinen TM, & Valkonen T. 2003. Effects of the characteristics of neighbourhoods and the characteristics of people on cause specific mortality: a register based follow up study of 252,000 men. *J Epidemiol Community Health*;57:210e7.

Martin R, Williams J, Hadjistavropoulos T, Hadjistavropoulos H, & Maclean M. 2005. A qualitative investigation of seniors' and caregivers' views on pain assessment and management. *The Canadian Journal of Nursing Resarch,* 37(2), pp. 142-64.

Matthews FE, Chatfield M, Freeman C, McCracken C, Brayne C, et al. 2004. Attrition and bias in the MRC cognitive function and ageing study: an epidemiological investigation. BMC Public Health;4: 12.

McBeth J, Lacey RJ, & Wilkie, R. 2014. Predictors of New-Onset Widespread Pain in Older Adults. Results From a Population-Based Prospective Cohort Study in the UK. Arthritis & Rheumatology. Vol. 66, No. 3, March, pp 757–767).

McBeth J, Macfarlane GJ, Benjamin S, Silman AJ. 2001. Features of somatization predict the onset of chronic widespread pain: results of a large population-based study. Arthritis Rheum 2001;44:751–3.

McBeth J, Symmons DP, Silman AJ, Allison T, Webb R, Brammah T, & Macfarlane GJ. 2009. Musculoskeletal pain is associated with a long-term increased risk of cancer and cardiovascular-related mortality. *Rheumatology,* 48(1), pp. 74-77.

McBride D, Hardoon S, Walters K, Gilmour S, & Raine R. 2010. Explaining variation in referral from primary to secondary care: cohort study. BMJ 2010; 341:c6267.

McHorney CA, Ware JE Jr, & Raczek AE. 1993. The MOS 36-item Short-Form health survey (SF-36). II. Psychometric and clinical tests of validity in measuring physical and mental health constructs. Med Care;31:247–63.

McLaren GL, & Bain MRS. 1998. Deprivation and health in Scotland : insights from NHS data. Edinburgh : ISD Scotland Publications.

Mclaughlin SJ, Connell CM, Heeringa SG, Li LW, & Roberts JS. 2010. Successful Aging in the United States: Prevalence Estimates From a National Sample of Older Adults. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences,* 65B(2), pp. 216-226.

McLoone P. 1995. Carstairs scores for Scottish postcode sectors from the 1991 census. Glasgow: Public Health Research Unit.

Meijer M, Rohl J, Bloomfield K, & Grittner U. 2012. Do neighbourhoods affect individual mortality? A systematic review and meta-amalysis of multilevel studies. Soc Sci Med 74: 1204-1212.

Mein G, Johal S, Grant RL, Seale C, Ashcroft R, & Tinker A. 2012. Predictors of two forms of attrition in longitudinal health study involving ageing participants: an analysis based on the Whitehall II study. BMC Medical Research Methodology. 12:164-164.

Melzack R. 1999. From the gate to the neuromatrix. *Pain, S6,* S121-S126.

Melzer D, McWilliams B, Brayne C Johnson T, & Bond J. 2000. Socioeconomic status and the expectation of disability in old age: estimates for England. *J Epidemiol Community Health*;54:286–292).

Menec VH. 2003. The relation between everyday activities and successful aging: a 6 year longitudinal study. *J Gerontol B Psychol Sci Soc Sci*; 58:S74-82.

Menz HB, Roddy E, Thomas E, & Croft PR. 2011. Impact of hallux valgus severity on general and foot-specific health-related quality of life. Arthritis Care Res (Hoboken) 63(3): 396–404.

Merskey H, & Bogduk N. 1994. Pain terminology updated from "Part III: Pain Terms, A Current List with Definitions and Notes on Usage" (pp 209-214). Classification of Chronic Pain, Second Edition, IASP Task Force on Taxonomy, edited by H. Merskey and N. Bogduk, IASP Press, Seattle, 1994. Available: https://www.iasp-pain.org/Education/Content.aspx?ItemNumber=169811/04/2014]. 22/05/2012-last update.

Michael YL, Colditz GA, Coaley E, & Kawachi I. 1999. Health behaviors, social networks, and healthy aging: cross-sectional evidence from the Nurses' Health Study. *Qual Life Res.* Dec;8(8):711-22.

Mobily P, Herr KA, Clark MK, & Wallace R. 1994. An Epidemiologic Analysis of Pain in the Elderly. The Iowa 65+ Rural Health Study. *J Aging Health May,* 6(2), pp. 139-154.

Mokkink LB, Terwee C, Patrick DL, Alonso J, Stratford PW, Knol DL, Bouter LM & de Vet HCW. 2010a. The COSMIN checklist for assessing the methodological quality of studies on measurement properties of health status measurement instruments: an international Delphi study. *Qual Life Res* (19):539-49.

Mokkink LB, Terwee C, Patrick DL, Alonso J, Stratford PW, Knol DL, Bouter LM & de Vet HCW. 2010b. The COSMIN study reached international consensus on taxonomy, terminology, and definitions of measurement properties for health-related patient-reported outcomes. *Journal of Clinical Epidemiology* (63):737-745.

Moore A, and Jorsh M. 2007. Chapter 10 Depression and pain. In: P. Crome, C. Main and F. Lally, eds, *Pain in Older People.* 1st edn. Oxford: Oxford University Press, pp. 121.

Morgenstern H. 1982. Uses of ecologic analysis in epidemiologic research. American Journal of Public Health Dec;72(12):1336-44.

Muntaner C. 2004. Social capital, social class, and the slow progress of psychosocial epidemiology. Int J Epidemiol;33:674–680.

NAO. 2010. Tackling inequalities in life expectancy in areas with the worst health and deprivation. Report by the Comptroller and Auditor General: HC 186 Session 2010-11. National Audit office, 2 July 2010. Available at: http://www.nao.org.uk/publications/1011/health_inequalities.aspx).

NAO. 2011. National Health Service Landscape Review, Report by the Comptroller and Auditor General, HC 708 Session 2010-11, National Audit Office, 20 January 2011. http://www.nao.org.uk/publications/1011/nhs_landscape_review.aspx).

Neogi T, Felson D, Niu J, Nevitt M, Lewis C, Aliabadi P, Sack B, Torner J, Bradley L, and Zhang Y. 2009. Association between radiographic features of knee osteoarthritis and pain: results from two cohort studies. *BMJ,* 339.

NHS Digital. Accessed 25/06/2017. https://digital.nhs.uk/article/1104/Read-Codes

NHS England. 2014. What do we mean by high quality care? High quality care for all, now and future generations. http://www.england.nhs.uk/about/imp-our-mission/high-quality-care. Accessed: 14/12/2014.
NHS England. 2019. Primary care networks. https://www.england.nhs.uk/gp/gpfv/redesign/primary-care-networks/

NHS England, GPFV. 2016. General Practice Forward View outlines a commitment to better funding. NHS England. General Practice Forward View. 2016. https://www.england.nhs.uk/wp-content/uploads/2016/04/gpfv.pdf).

NHS Information Authority. 2000. The Clinical Terms Version 3 (The Read Codes). Birmingham: NHS Information Authority, 2000.

NHS Information Centre. 2008. GP Patient Survey (Access). Summary Report 2007/2008 (England). The Health and Social Care Information Centre. http://www.hscic.gov.uk/catalogue/PUB05861/gp-pati-surv-07-08-nat-sum-rep-acc.pdf

NHS Information Centre. 2009. Trends in consultation rates in General Practice 1995-2008: Analysis of the QResearch database, NHS Information Centre, 2 September

2009. http://www.ic.nhs.uk/webfiles/publications/gp/Trends_in_Consultation_Rates_in General_Practice_1995_2008.pdf).

NHS Long Term Plan. 2019. https://www.longtermplan.nhs.uk

Nicholl BI, Macfarlane GJ, Davies KA, Morriss R, Dickens C, and McBeth J. 2009. Premorbid psychosocial factors are associated with poor health-related quality of life in subjects with new onset of chronic widespread pain – Results from the EPIFUND study. *Pain,* 141(1–2), pp. 119-126.

Nicholson A, Smith C, Mitchell A. Hu-Tech Ergonomics, 2006. Cost benefit studies that support tackling musculoskeletal disorders. Research report 491. Health & Safety Executive.

Noble M, Wright G, Dibben C, Smith GAN, McLennan D, Anttila C, Barnes H,Mokhtar C, Noble S, Avenell D, Gardner J, Covizzi I, Lloyd M. 2004. The English Indices of Deprivation 2004 (revised). Report to the Office of the Deputy Prime Minister. London: Neighbourhood Renewal Unit, 2004. http://webarchive.nationalarchives.gov.uk/20100410180038/http://www.communities.gov.uk/documents/communities/pdf/131209.pdf

Nosraty L, Sarkeala T, Hervonen A, & Jylhä M. 2012. Is there successful aging for nonagenarians? The vitality 90+ study. J Aging Re: 868797. doi: 10.1155/2012/868797)

Nuffield Trust. 2012. A decade of austerity? The funding pressures facing the NHS from 2010/11 to 2021/22. December 2012.

Nuffield Trust with PSSRU at the London School of Economics (LSE). 2012. Care for older people – Projected expenditure to 2022 on social care and continuing health care for England's older population, December 2012.

Nummela O, Sulander T, Helakorpi S, Haapola I, & Uutela A. 2011. Register based data indicated nonparticipation bias in a health study among aging people. J Clin Epidemiol 64(12): 1418-1425.

Office for National Statistics. Census 2001. 09/04/2010. Accuracy and quality. http://webarchive.nationalarchives.gov.uk/20100410180038/http://ons.gov.uk/census/index.html

Office for National Statistics. 2002. *National Statistics Socio-Economic Classification (NS-SEC 2002).* London: Stationery Office.

Okunribido O, & Wynn T. 2010. Ageing and work-related musculoskeletal disorders. A review of the current literature. *Health and Safety Executive Research Report,* RR799.

O'Rand AM. 2002. Cumulative advantage theory in life course research. *Annual Review of Gerontology and Geriatrics*, 22, 14-30.

O'Reilly D. 2000. Standard indicators of deprivation: do they disadvantage older people? Unpublished ms. From section 5 (Carr-Hill & Chalmers-Dixon, 2005, section 5).

Papageorgiou A, Croft PR, Ferry S, Jayson MI, & Silman AJ. 1995. Estimating the prevalence of low back pain in the general population. Evidence from the South Manchester Back Pain Survey. Spine 1995;20: 1889–93.

Patrick D, Peach H. 1989. Disablement in the community. Oxford University Press.

Peters TJ, Sanders C, Dieppe P, & Donovan J. 2005. Factors associated with change in pain and disability over time: a community-based prospective observational study of hip and knee osteoarthritis. *Br J Gen Pract*; 55:205-11.

Phelan EA, Anderson LA, Lacroix AZ, & Larson EB. 2004. Older adults' views of "successful aging" –How do they compare with researchers' definitions? *Journal of the American Geriatrics Society*, 52, 211-216.

Phongsavan P, Chey T, Bauman A, Brooks R, & Silove D. 2006. Social capital, socio-economic status and psychological distress among Australian adults. *Social science & medicine,* 63, pp. 2546-2561.

Pickett KE, & Pearl M. 2001. Multilevel analyses of neighbourhood socioeconomic context and health outcomes: a critical review. *J Epidemiol Community Health*;55:111e22.

Pizzi C, De Stavola B, Merletti F, Bellocco R, dos Santos Silva I, et al. 2011. Sample selection and validity of exposure-disease association estimates in cohort studies. J Epidemiol Community Health.

Porcheret M, Hughes R, Evans D, Jordan K, Whitehurst T. et al. 2004. Data quality of general practice electronic health records; the impact of a program of assessments, feedback, and training. J Am Med Inform Assoc 11 (1): 78-86.

Porell FW, & Miltiades HB. 2001. Access to care and functional status change among aged Medicare beneficiaries. *J Gerontol B Psychol Sci Soc Sci*; 56(2):S69-83.

Porta M. (Editor). 2008. A Dictionary of Epidemiology. 5th Edition, Oxford University Press.

Porter M. 12/12/2014. In: Campbell D. Record A&E waits show NHS is cracking under pressure – doctors' chief. 12 December 2014. The Guardian.

Prentice JC, Pizer SD. 2007. Delayed Access to Health Care and Mortality. *Health Serv Res.* Apr; 42(2):644-662.

Pruchno RA, Wilson-Genderson M, Rose M, & Cartwright F. 2010. Successful Aging: Early Influences and Contemporary Characteristics. *The Gerontologist,* 50(6), pp. 821-833.

Raleigh, VS. & Foot, C. 2010. Getting the measure of quality. Opportunities and challenges. The King's Fund. 2010. ISBN: 978 1 85717 590 5.

RCGP. 2006. Profile of UK practices. (http://www.rcgp.org.uk/pdf/ISS_INFO_02_MAY06.pdf).

RCGP Birmingham research unit. 2006-last update, Annual prevalence report . Available: http://www.arthritisresearchuk.org/arthritis-information/data-and-statistics/musculoskeletal-pain-and-disability/how-big-is-the-burden-on-general-practice.aspx#sthash.yFHreIrO.dpuf.

RCGP News. 2014. Funding for general practice set to plummet by fifth by 2017, while patient consultations to increase by 69m. 02/04/2014. http://www.rcgp.org.uk/news/2014/april/funding-for-general-practice-set-to-plummet-by-fifth-by-2017.aspx).

RCGP publication Health Inequalities (Royal College of General Practitioners. Health Inequalities. 2015. http://www.rcgp.org.uk/policy/rcgp-policy-areas/health -inequlities.aspx)

Rechel B, Doyle Y, Grundy E, McKee M. 2009. WHO Europe Policy brief 10. How can health systems respond to population ageing? http://www.euro.who.int/__data/assets/pdf_file/0004/64966/E92560.pdf).

Reijneveld SA. 2001. Explanations for differences in health outcomes between neighbourhoods of varying socioeconomic level. *J Epidemiol Community Health*; 55:847.

Renehan E, Dow B, Lin X, Blackbery I, Haapala I, Gaffy E, Cyarto E, Brasher K, & Hendy S. 2012. Healthy ageing literature review. Completed by the National Ageing Research Institute and Council on the Ageing for the Victorian Department of Health, Australia.

Richards SH, Coast J, & Peters TJ. 2003. Patient-reported use of health service resources compared with information from health providers. *Health Soc Care Comm*;11:510-8.

Riley MW. 1998. Successful aging. *Gerontologist*, 38(2), 151.

Riley MW, Kahn RL, & Foner A. 1994. Age and structural lag. New York, Wiley. In: page 124. Chapter 7. Understanding Health Aging: Key Components and Their Integration.

Rizzuto D, Orsini N, Qiu C, Wang H-X, & Fratiglioni L. 2012. Lifestyle, social factors, and survival after age 75: population based study. *BMJ*; 345: e5568).

Rockwood K, & Mitnitski A. 2007. Unconventional Views of Frailty. Frailty in relation to the accumulation of deficits. J Gerontol A Biol Sci Med Sci;62A:722-727.

Rockwood K, Rockwood MR, & Mitnitski A. 2010. Physiological redundancy in older adults in relation to the change in the slope of a frailty index. J Am Geriatr Soc, 58(2):318-23).

Rogers RG. 1995. Sociodemographic characteristics of long-lived and healthy individuals. *Population and Development Review*, 21(1), 33-58).

Roland M. 2004. Linking physicians' pay to the quality of care – a major experiment in the United Kingdom. N Engl J Med, 351: 1448-1454.

Roland M, Elliott M, Lyratzopoulos G, et al. 2009. Reliability of patient responses in pay for performance schemes: analysis of national General Practitioner Patient Survey data in England. *BMJ*;339:b3851.

Roland M, & Olesen F. 2016. Analysis. Can pay for performance improve the quality of primary care? *BMJ*;354:i4058.

Ross M, Carswell A, Hing M, Hollingworth G, & Dalziel W. 2001. Seniors' decision making about pain management. *Journal of Advanced Nursing,* 35(3), pp. 442-51.

Ross N, Oliver L, and Villeneuve P. 2013. The contribution of neighbourhood material and social deprivation to survival: a 22-year follow-up of more than 500,000 Canadians. *Int J Environ Res Public Health.,* 10(4), pp. 1378-91.

Rowe JW & Kahn RL. 1987. Human aging: Usual and successful. *Science.* 237, 143-149.

Rowe J & Khan R. 1997. Successful aging. *The Gerontologist.* 37(4):433-440.

Ryan A, Krinsky S, Kontopantelis E, & Doran T. 2016. Long-term evidence for the effect of pay-for-performance in primary care on mortality in the UK: a population study. Lancet; 388(10041):268-274.

Ryff CD. 1989. Beyond Ponce de Leon and life satisfaction: new directions in quest of successful aging. *Int J Behav Dev*; 12: 35-55.

Ryff CD, Singer B. 2009. Understanding healthy aging: key components and their integration. In: Bengtson VL, Gans D, Putney NM, & Silverstein M (Eds.), Handbook of theories of aging, 2nd ed. Springer Publishing Company, New York, 117-144.

Sacco RL, Benjamin EJ, Broderick JP et al. Public health burden of stroke. Stroke 1997;28:1507–17. stroke.ahajournals.org/content/28/7/1507.full

Salisbury C, Johnson L, Purdy S, Valderas JM, Montgomery, AA. 2011. Epidemiology and impact of multimorbidity in primary care: a retrospective cohort study. Br J Gen Pract; DOI: 10.3399/bjgp11X548929).

Sarkisian CA, Hays RD, & Mangione CM. 2002. Do older adults expect to age successfully? The associations between expectations regarding aging and beliefs regarding healthcare seeking among older adults. *J Am Geriatr Soc*; 50: 1837 – 43.

Satariano WA. 2013. Healthy Aging in the US. Healthy aging in sociocultural context. Routledge advances in sociology 81. New York: Routledge pp 14 -21.

Saxena S, Car J, Eldred D, Soljak M, & Majeed A. 2007. Practice size, caseload, deprivation and quality of care of patients with coronary heart disease, hypertension and stroke in primary care: national cross-sectional study. BMC Health Services Research 2007, 7:96.

Saxena S, George J, Barber J, Fitzpatrick J, Majeed A. 2006. Association of population and practice factors with potentially avoidable admission rates for chronic diseases in London: cross sectional analysis.
J R Soc Med. Feb; 99(2):81-9.

Schafer M, & Ferraro K. 2012. Childhood Misfortune as a Threat to Successful Aging: Avoiding Disease. *Gerontologist,* 52(1), pp. 111–120.

Scudds R, & Østbye T. 2001. Pain and pain-related interference with function in older Canadians: the Canadian study of health and aging. *Disabil Rehabil,* 23, pp. 654–664.

Searle SD, Mitnitski A, Gahbauer EA, Gill TM, & Rockwood K. 2008. A standard procedure for creating a frailty index. BMC Geriatr 8: 24. doi: 10.1186/1471-2318-8-24.

Seeman TE, Charpentier PA, Berkman LF, Tinetti ME, Guralnik JM, Albert M et al. 1994. Predicting changes in physical performance in a high functioning elderly cohort. MacArthur studies of successful ageing. *J Gernontol*; 49: M97-108.

Shi Y, Hooten M, Roberts R, & Warner D. 2010. Modifiable risk factors for incidence of pain in older adults. *PAIN.* Volume 151, Issue 2, November, Pages 366–371.

Shi L, & Starfield B. 2000. Primary Care, Income Inequality, and Self-Rated Health in the United States: A Mixed Level Analysis. *International Journal of Health Services* 30: 541-55.

Shoemaker P, Eichholz M, & Skewes E. 2002. Item Nonresponse: Distinguishing between don’t know and refuse. International Journal of public Opinion Research. 14(2):193-201.

Silverstein M. 2008. Meeting the challenges of an aging workforce. *American Journal of Industrial Medicine,* 51, pp. 269-280.

Sim J, & Arnel P. 1993. Measurement validity in physical therapy research. Physical Therapy, 73, 102-115.

Sim S. & Wright C. 2000. *Research in Health Care. Concepts, Designs and Methods.* Cheltenham: Nelson Thornes.

Singer JD, & Willet JB. 2003. Applied Longitudinal Data Analysis. Modelling Change and Even Occurrence. Oxford University Press.

Sloggett A. & Joshi H. 1994. Higher mortality in deprived areas: community or personal disadvantage? BMJ Dec 3;309(6967):1470-4.

Stafford M, & Marmot M. 2003. Neighbourhood deprivation and health: does it affect us all equally? *Int J Epidemiol*;32:357e66.

Staffordshire County Council. 2015. Healthy Ageing in Staffordshire: Adding Life to Years and Years to Life. The Annual Report of the Director of Public Health for Staffordshire 2014/15. https://www.staffordshire.gov.uk/health/PublicHealth/Annual-Reports/DPH-Annual-Report-2014.pdf

Stern N, Dethier J, & Rogers H. 2004. *Growth and empowerment: making development happen.* Cambridge Mass: MIT Press.

Strawbridge WJ, Wallhagen MI, & Cohen RD. 2002. Successful aging and well-being. Self-rated compared with Rowe and Kahn. *Gerontologist*; 42: 727-33).

Sudman S, & Bradburn NM. 1982. Asking Questions: A Practical Guide to Questionnaire Design. Jossey Bass Publishers, San Francisco. From Sim & Wright.

Sutton M, & McLean G. 2006. Determinants of Primary Medical Care Quality Measured under the New UK Contract: Cross Sectional Study. British Medical Journal;332:389–90

Szklo M, & Nieto FJ. 2014. Epidemiology. Beyond the Basics. Third Edition.

Tajar A, O'Neill TW, Lee DM, O'Connor DB, Corona G, Finn JD, Bartfai G, Boonen S, Casanueva FF, Forti G, Giwercman A, Han TS, Huhtaniemi IT, Kula K, Lean MEJ, Pendleton N, Punab M, Purandare N, Silman AJ, Vanderschueren D, Wu FCW, & McBeth J. 2011. The Effect of Musculoskeletal Pain on Sexual Function in Middle-aged and Elderly European Men: Results from the European Male Ageing Study. *The Journal of rheumatology,* 38(2), pp. 370-377.

The healthcare commission, 2008. *PCT Survey Results 2008* . England: The Healthcare Commission.

The Information Centre, 2006. National Quality and Outcomes Framework Statistics for England 2005/06. The Information Centre. 2006. ISBN 1-84636-078-1.

The Information Centre. 2006. Online GP practice results database: Search. Quality and Outcomes Framework 2005/06 for GP practices. http://qof.hscic.gov.uk/0506/search.asp

The Information Centre. 2012. QOF 2005/06 data notes. The Health and Social Care Information Centre. http://www.hscic.gov.uk/catalogue/PUB01950/qof-eng-05-06-data-note-rep.pdf

Thielke S, & Diehr P. 2012. Transitions among Health States Using 12 Measures of Successful Aging in Men and Women: Results from the Cardiovascular Health Study. J Aging Res 2012: 243263. doi: 10.1155/2012/243263

Thinggaard M, Jacobsen R, Jeune B, Martinussen T, & Christensen K. 2010. Is the relationship between BMI and mortality increasingly U-shaped with advancing age? A 10 year follow-up of persons aged 70-95 years. J Gerontol A Biol Sci Med Sci 65(5):526-31

Thomas E, Dunn K, & Jinks C. 2007. Chapter 1 The epidemiology of pain. In: P. Crome, C. Main and F. Lally, eds, *Pain in Older People.* 1st edn. Oxford: Oxford University Press, pp. 1.

Thomas E, Mottram S, Peat G, Wilkie R. & Croft P. 2007. The effect of age on the onset of pain interference in a general population of older adults: prospective findings from the North Staffordshire Osteoarthritis Project (NorStOP). *Pain,* 129((1-2)), pp. 21-7.

Thomas E, Peat G, Harris L, Wilkie R, &Croft PR. 2004a. The prevalence of pain and pain interference in a general population of older adults: cross-sectional findings from the North Staffordshire Osteoarthritis Project (NorStOP). *Pain,* 110(1–2), pp. 361-368.

Thomas E, Wilkie R, Peat G, Hill S, Dziedzic K, & Croft P. 2004. The North Staffordshire Osteoarthritis Project - NorStOP: Prospective, 3-year study of the epidemiology and management of clinical osteoarthritis in a general population of older adults. BMC Musculoskelet Disord. 2004 Jan 13;5:2.

Townsend P. 1979. Poverty in the United Kingdom. Harmondsworth: Penguin.

Townsend P. 1987. 'Deprivation'. *Journal of Social Policy*, 16(2): 125-146.

Townsend P, Whitehead M, & Davidson N. 1992. Inequalities in health: The Black Report and the Health Divide. New edn. London: Penguin Books.

Tracey I, and Bushnell MC. 2009. How Neuroimaging Studies Have Challenged Us to Rethink: Is Chronic Pain a Disease? *The Journal of Pain,* 10(11), pp. 1113-1120.

Tudor Hart J. 1971. The inverse care law. Lancet 1971; I: 405-412.

Turk D, & Melzack R. 2011. The Measurement of Pain and the Assessment of People Experiencing Pain. In: D. Turk and R. Melzack, eds, *Handbook of Pain Assessment.* 3rd edn. London: The Guildford Press, pp. 3.

Uchino BN, Cacioppo JT, Kiecolt-Glaser JK. 1996. The Relationship Between Social Support and Physiological Processes: A Review With Emphasis on Underlying Mechanisms and Implications for Health. Psychological Bulletin. Vol. 119, No. 3, 488-531.

UCL Institute of Health Equity. 2010. 'Fair Society Healthy Lives'. The Marmot Review. 2010. http://www.instituteofhealthequity.org/projects/fair-society-healthy-lives-the-marmot-review

Urwin M, Symmons D, Allison T, Brammah T, Busby H, Roxby M, Simmons A, & Williams G. 1998. Estimating the burden of musculoskeletal disorders in the community: the comparative prevalence of symptoms at different anatomical sites, and the relation to social deprivation. *Ann Rheum Dis*;57:649–655).

Vaillant GE. 2002. Aging well: surprising guideposts to a happier life from the Landmark Harvard study of adult development. Boston: Little Brown.

Van Dijk G, Veenhof C, Spreeuwenberg P, Coene N, Burger B, Van Schaardenburg D, Van den Ende C, Lankhorst G. & Dekker J. 2010. Prognosis of limitations in activities in osteoarthritis of the hip or knee: a 3-year cohort study. *Arch Phys Med Rehabil,* 91((1)), pp. 58-66.

Van Jaarsveld HM, Miles A, & Wardle J. 2007. Pathways from deprivation to health differed between individual and neighbourhood based indices. *Journal of Clinical Epidemiology.* 60; 712-19.

Vartanian, & Thomas P. 2011. Secondary Data Analysis, Oxford University Press, New York. Page 216.

Vega S, Benito-León J, Bermejo-Pareja F, Medrano MJ, Vega-Valderrama LM et al. 2010. Several factors influenced attrition in a population-based elderly cohort: neurological disorders in Central Spain Study. J Clin Epidemiol 63(2): 215–222.

Walker-Bone K. 2007. Musculoskeletal pain. In: P. Crome, C. Main and F. Lally, eds, *Pain in Older People.* 1st edn. Oxford: Oxford University Press, pp. 53-65.

Ware J, Kosinski M, & Keller SD. 1996. A 12 – Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. Medical care. 34(3):220-233.

Ware JE, & Sherbourne CD. 1992. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care. Jun;30(6):473-83.

Warren, F. C., Abel, G., Lyratzopoulos, G., Elliott, M. N., Richards, S., Barry, H. E., ... Campbell, J. L. 2015. Characteristics of service users and provider organisations associated with experience of out-of-hours general practitioner care in England: population-based cross-sectional postal questionnaire svey. BMJ, 350, [h2040]. DOI: 10.1136/bmj.h2040

Webb P, Bain C. 2011. Essential Epidemiology: An Introduction for Students and Health Professionals. Second Edition. Cambridge University Press.

Weden MM, Carpiano RM, & Robert SA. 2008. Subjective and objective neighborhood characteristics and adult health. *Social science & medicine,* 66(6), pp. 1256-1270.

Wen M, Hawkley L, &Cacioppo J. 2006. Objective and perceived neighborhood environment, individual SES and psychosocial factors, and self-rated health: an analysis of older adults in Cook County, Illinois. *Social science & medicine,* 63, pp. 2575-2590.

Wilkie R, Peat G, Thomas E, Hooper H, & Croft PR. 2005. The Keele Assessment of Participation: a new instrument to measure participation restriction in population studies. Combined qualitative and quantitative examination of its psychometric properties. *Qual Life Res* 2005;14:1889–99.

Wilkie R, Tajar A, & McBeth J. 2013. The Onset of Widespread Musculoskeletal Pain Is Associated with a Decrease in Healthy Ageing in Older People: A Population-Based Prospective Study. *PLOS ONE,* 8(3), pp. 1-10.

Wolfe F, Smythe HA, Yunus MB, Bennett RM, Bombardier C, Goldenberg DL, et al. 1990. The American College of Rheumatology 1990 criteria for the classification of fibromyalgia: report of the Multicenter Criteria Committee. Arthritis Rheum 1990;33:160–72.

World Health Organisation. 2002. *Active ageing. A policy framework.* Geneva: WHO.

World Health Organization. 2003. The burden of musculoskeletal conditions at the start of the new millennium: report of a WHO Scientific group. *WHO Technical Report Series: 919,* Geneva, World Health Organization.

World Health Organisation. 2014. About WHO: Definition of Health. https://apps.who.int/aboutwho/en/definition.html) accessed 2014.

World Health Organization Regional Office for Europe. 2014. Healthy ageing. Accessed 14/04/2014. http://www.euro.who.int/en/health-topics/Life-stages/healthy-ageing/healthy-ageing).

Wright J, Martin D, & Cockings S. 2006. Overall Quality of Outcomes Framework scores lower in practices in deprived areas. Br J Gen Pract. Apr 1, 2006; 56(525): 277–279.

Yen IH, & Kaplan GA. 1999. Neighborhood social environment and risk of death: multilevel evidence from the Alameda County Study. *Am J Epidemiol.* May 15;149(10):898-907.

Young H, & Cochrane B. 2004. Healthy aging for older women. *Nursing Clinics of North America*, Mar, vol. 39, no. 1, p. 131-143.

Zigmond AS, & Snaith RP. 1983. The hospital anxiety and depression scale. *Acta Psychiatr Scand*;67:361–70.

Appendix

Figure 1

“In the past 4 weeks have you had pain that has lasted for one day or longer in any part of your body?”

Age group	Females	Males
50 - 59	69%	66%
60 - 69	69%	68%
70 - 79	64%	61%
80+	66%	57%

Source: Thomas E, Peat G, Harris L, Wilkie R, Croft PR. The prevalence of pain and pain interference in a general population of older adults: cross-sectional findings from the North Staffordshire Osteoarthritis Project (NorStOP). Pain 2004; 110 (1-2): 361-8. See more at: http://www.arthritisresearchuk.org/arthritis-information/data-and-statistics/musculoskeletal-pain-and-disability/how-common-is-pain.aspx#sthash.gvylVmyz.dpuf

Figure 2

“Pain or discomfort that persisted continuously or intermittently for longer than 3 months”

Age group	Back pain	Arthritis
25 - 34	12%	1%
35 - 44	17%	5%
45 - 54	18%	12%
55 - 64	19%	20%
65 - 74	15%	26%
≥75	15%	28%

Total population	16%	15.8%

Source: Elliott AM, Smith BH, Penny KI, Smith WC, Chambers WA. The epidemiology of chronic pain in the community. Lancet 1999; 354 (9186):1248-52. See more at: http://www.arthritisresearchuk.org/arthritis-information/data-and-statistics/musculoskeletal-pain-and-disability/how-common-is-pain.aspx#sthash.gvylVmyz.dpuf

Figure 3

"During the past 4 weeks, how much did pain interfere with your normal work (including housework)?"

Age group	Females	Males
50 - 59	32%	33%
60 - 69	38%	39%
70 - 79	43%	37%
80+	50%	41%

Source: Thomas E, Peat G, Harris L, Wilkie R, Croft PR. The prevalence of pain and pain interference in a general population of older adults: cross-sectional findings from the North Staffordshire Osteoarthritis Project (NorStOP). Pain 2004; 110(1-2):361-8. See more at: http://www.arthritisresearchuk.org/arthritis-information/data-and-statistics/musculoskeletal-pain-and-disability/how-common-is-pain.aspx#sthash.gvylVmyz.dpuf

Figure 4

The contribution of arthritis to the UK burden of disability compared to other disorders

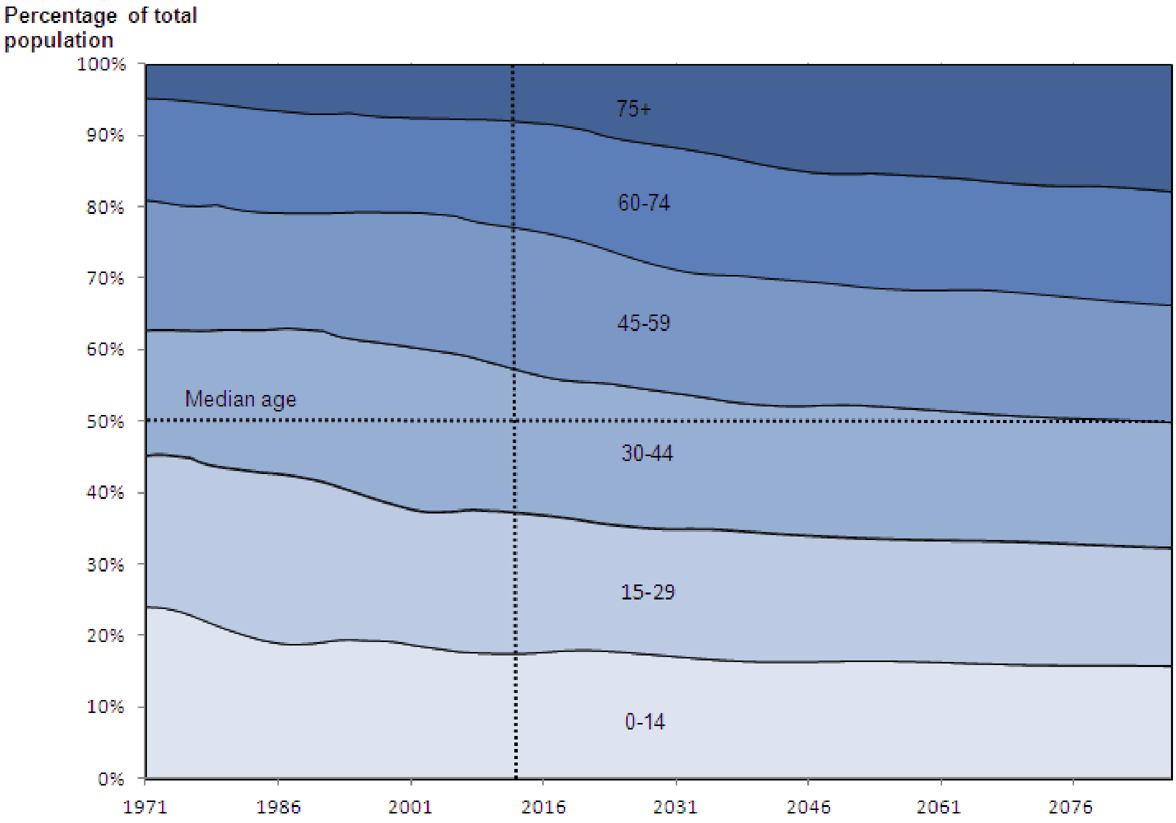
Condition	Receiving DLA	Percentage
Arthritis	514,410	18%
Mental health causes	482,630	16%
Learning difficulties	280,230	10%
Back ailments	222,850	8%

Muscle/bone/joint disease	219,410	7%
Heart disease	134,290	5%
Stroke related	93,390	3%
Chest disease	84,460	3%

Department for work and pensions. Disability Living Allowance - cases in payment caseload (thousands): main disabling condition by gender of claimant. http://83.244.183.180/100pc/dla/disabled/ccsex/a_carate_r_disabled_c_ccsex_nov07.html - See more at: http://www.arthritisresearchuk.org/arthritis-information/data-and-statistics/musculoskeletal-pain-and-disability/disability-and-musculoskeletal-problems.aspx#sthash.OQiJQsaZ.dpuf

Figure 5

Percentage age distribution, United Kingdom, mid-1971 to mid-2087



Source ONS 2014

Figure 6

How many adults consult their GP with musculoskeletal problems each year?

Group	Percentage consulting	UK estimate (millions)
Males	17%	4.1
Females	23%	6.0
All	20%	10.1

Royal College of General Practitioners - Birmingham Research Unit. Annual prevalence report 2006. See more at: http://www.arthritisresearchuk.org/arthritis-information/data-and-statistics/musculoskeletal-pain-and-disability/how-big-is-the-burden-on-general-practice.aspx#sthash.yFHreIrO.dpuf

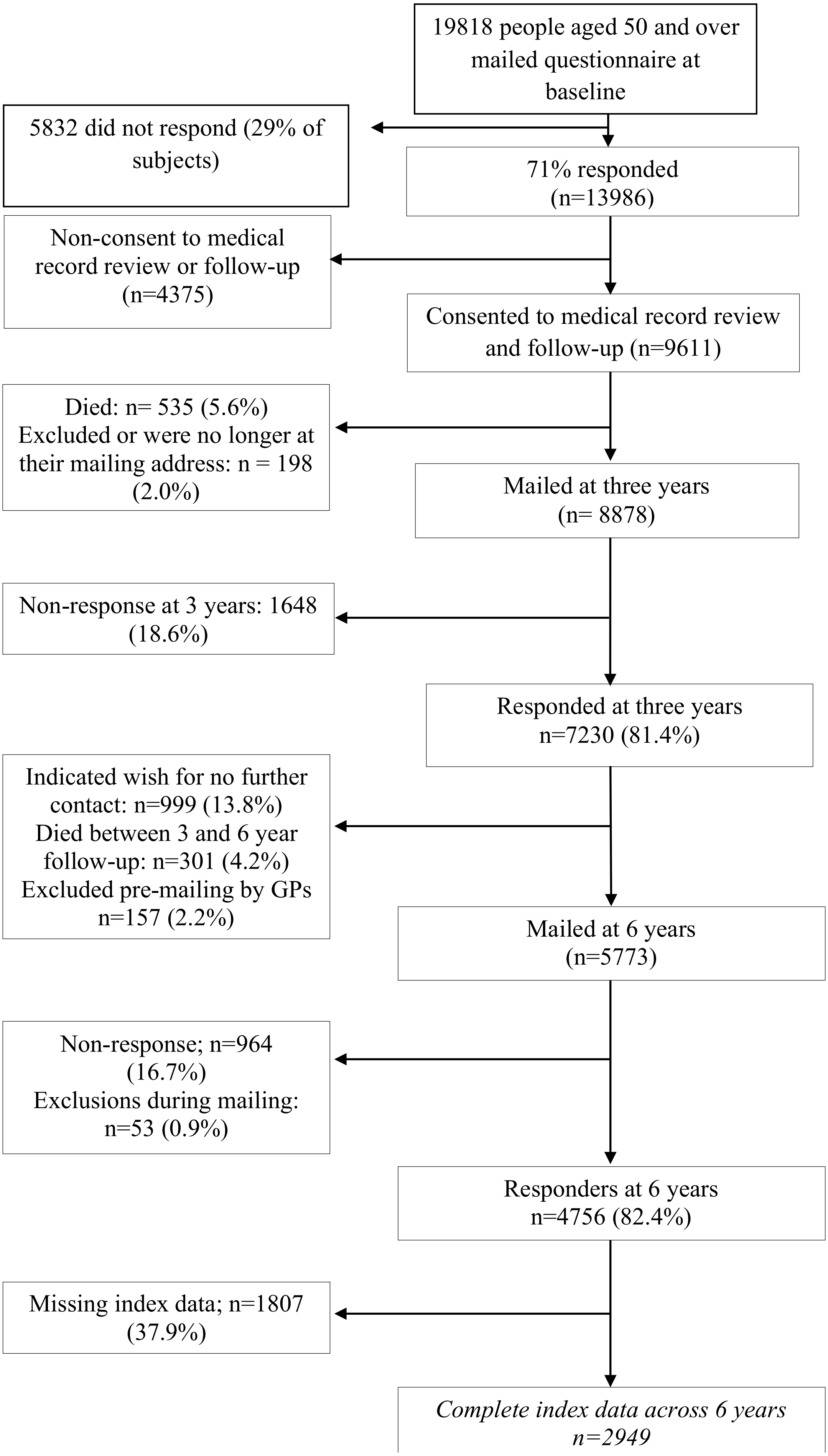
Figure 7

The influence of age on annual GP consultation rates for musculoskeletal problems.

Group (age)	Percentage consulting	UK estimate (millions)
Males		
15 - 24	8%	0.3
25 - 44	13%	1.1
45 - 64	20%	1.5
65 - 74	27%	0.6
75+	30%	0.5
Females		
15 - 24	11%	0.4
25 - 44	17%	1.5
45 - 64	28%	2.1
65 - 74	35%	0.9
75+	36%	1.0

Royal College of General Practitioners - Birmingham Research Unit. Annual prevalence report 2006. See more at: http://www.arthritisresearchuk.org/arthritis-information/data-and-statistics/musculoskeletal-pain-and-disability/how-big-is-the-burden-on-general-practice.aspx#sthash.yFHreIrO.dpuf

Figure 8. Flow diagram of participants



Practice GP Patient Participation Survey 2007/2008 & QOF 2005/06 results and ranking

	Practice and England average						
	M83014	*M83082*	*M83004*	M83071	M83034	M83056	England average
GPPS 2007/2008							
% satisfied with telephone access	72 (4) (95% CI 66, 78)	67 (5) (95% CI 60, 74)	47 (6) (95% CI 39, 55)	92 (1) (95% CI 88, 96)	80 (3) (95% CI 74, 86)	86 (2) (95% CI 81, 100)	87
% able to get GP appointment in 48 hours	89 (2) (95% CI 84, 94)	85 (3) (95% CI 79, 91)	74 (6) (95% CI 65, 83)	96 (1) (95% CI 93, 99)	79 (5) (95% CI 72, 86)	80 (4) (95% CI 73, 87)	87
% able to book 2+ days ahead if wanted	46 (6) (95% CI 36, 56)	72 (4) (95% CI 63, 81)	73 (3) (95% CI 64, 82)	69 (5) (95% CI 60, 78)	87 (2) (95% CI 81, 93)	89 (1) (95% CI 84, 94)	77
% able to book appointment with specific GP	86 (5) (95% CI 77, 95)	93 (3) (95% CI 88, 98)	86 (5) (95% CI 79, 93)	87 (4) (95% CI 81, 93)	97 (1) (95% CI 94, 100)	94 (2) (95% CI 90, 98)	88
% satisfied with opening hours	84 (3)	84 (3)	89 (1)	89 (1)	83 (4)	88 (2)	82
Cumulative score (higher worse)	20	18	21	12	15	11	
Rank (higher worse)	5	4	6	2	3	1	
Survey forms distributed	764	572	554	550	586	534	
Completed forms received	306	251	272	285	284	298	
Response rate	40%	44%	49%	52%	48%	56%	
QOF score 2005/2006							
Total achievement (max 1050)	1046 (99.62%)	1031.92 (98.28%)	985.17 (93.83%)	1050 (100%)	1044.26 (99.45%)	1046.44 (99.66%)	1043 (99.33%)
Clinical domain (max 550)	550 (100%)	540.96 (98.36%)	498.58 (90.65%)	550 (100%)	546.94 (99.44%)	547.02 (99.46%)	545 (99.09%)
Rank (higher worse)	3	5	6	1	4	2	

Sources: The GP Patient Survey 2008 & http://qof.hscic.gov.uk/0506/search.asp

Characteristics of questionnaire respondents and non-respondents

	Sample population (n = 2949)	Died (n = 836)	Missing data (n = 1807)	Attrition (n = 4019)	Total (n = 13986, but only 9611 consented to review and follow up giving data)	p - value
Median age in years (IQR)^{K}	61.72 (7.95)	73.99 (9.59)	65.27 (8.81)	65.52 (10.24)	66.48 (10.32)	<0.001
Female ^{C}	1615 (54.76%)	350 (41.87%)	1029 (56.95)	2185 54.37%)	5179 (53.89%)	<0.001
Male ^{C}	1334 (45.24%)	486 (58.13%)	778 (43.05%)	1834 (45.63%)	4432 (46.11%)	
ILD						
Occupational class (ISC) group ^{C}						
Managerial/ professional	735 (25.86%)	152 (19.87%)	332 (19.16%)	632 (17.03%)	1841 (20.46%)	<0.001
Intermediate /self employed	770 (27.09%)	234 (30.59%)	445 (26.47%)	891 (24.00)	2340 (26%)	
Lower supervisory/ routine	1337 (47.04%)	379 (49.54%)	914 (54.37%)	2189 (58.97%)	4819 (53.54%)	
Education ^{C}						
School age education	2444 (83.64%)	743 (91.73%)	1511 (86.69%)	3500 (89.08)	8198 (87.18%)	<0.001
Further education	478 (16.36%)	67 (8.27%)	232 (13.31%)	429 (10.92%)	1206 (12.82%)	
Living arrangements ^{C}						
Alone	509 (17.69%)	278 (35.37%)	425 (24.82%)	945 (24.71%)	2157 (23.45%)	<0.001
Not living alone	2368 (82.31%)	508 (64.63%)	1287 (75.18%)	2880 (75.29%)	7043 (76.55%)	
ALD						
Social isolation/networks ^{K}						
Socially integrated (high)	694 (27.98%)	110 (16.69%)	351 (24.70%)	634 (19.99%)	1789 (23.14%)	<0.001
Moderately integrated (med/high)	355 (14.31%)	66 (10.02%)	185 (13.02%)	367 (11.57%)	973 (12.58%)	
Moderately isolated (med)	993 (40.04%)	281 (42.64%)	621 (43.70%)	1385 (43.66)	3280 (42.42%)	
Socially isolated (low)	438 (17.66%)	202 (30.65%)	264 (18.58%)	786 (24.78)	1690 (21.86%)	
Presence of confidant ^{C}						
Yes	2702 (92.57%)	740 (91.47%)	1589 (90.34%)	3541 (90.08%)	8572 (91.02%)	0.003
No	217 (7.43%)	69 (8.53%)	170 (9.66%)	390 (9.92%)	846 (8.98%)	
Frequency of contact with confidante ^{K}						
Daily	1606 (59.28%)	442 (58.93%)	854 (53.21%)	2088 (58.47%)	4990 (57.79%)	<0.001
Weekly	891 (32.89%)	242 (32.27%)	584 (36.39%)	1192 (33.38%)	2909 (33.69%)	
Monthly	125 (4.61%)	35	90 (5.61%)	148	398 (4.61%)	

		(4.67%)		(4.14%)		
Few times a year	70 (2.58%)	21 (2.80%)	59 (3.68%)	104 (2.91%)	254 (2.94%)	
<1 year	17 (0.63%)	10 (1.33%)	18 (1.12%)	39 (1.09%)	84 (0.97%)	
Access to material goods and services						
Access to car ^{C}						
Yes	2560 (87.64%)	579 (71.39%)	1428 (80.72%)	3084 (78.27%)	7651 (81.04%)	<0.001
No	361 (12.36%)	232 (28.61%)	341 (19.28%)	856 (21.73%)	1790 (18.96%)	
Access to public transport ^{C}						
Yes	2782 (95.47%)	612 (75.84%)	1609 (91.37)	3495 (89.07%)	8498 (90.35%)	<0.001
No	132 (4.53%)	195 (24.16%)	152(8.63%)	429 (10.93%)	908 (9.65%)	
Access to telephone ^{C}						
Yes	2913 (99.69%)	807 (99.38%)	1761 (99.49)	3900 (98.86%)	9381 (99.28%)	<0.001
No	9 (0.31%)	5 (0.62%)	9 (0.51%)	45 (1.14%)	68 (0.72%)	
Access to GP ^{C}						
Yes	2705 (92.70%)	774 (95.32%)	1633 (92.78%)	3633 (92.28%)	8745 (92.77%)	0.025
No	213 (7.30%)	38 (4.68%)	127 (7.22%)	304 (7.72%)	682 (7.23%)	
Access to chemist ^{C}						
Yes	2909 (99.56%)	795 (98.15%)	1760 (99.44%)	3882 (98.50%)	9346 (98.97%)	<0.001
No	13 (0.44%)	15 (1.85%)	10 (0.56%)	59 (1.50%)	97 (1.03%)	
Access to help with income ^{C}						
Yes	2225 (76.57%)	590 (73.11%)	1297 (73.90%)	2785 (71.41%)	6897 (73.62%)	<0.001
No	681 (23.43%)	217 (26.89%)	458 (26.10%)	1115 (28.59%)	2471 (26.38%)	
Access to work ^{C}						
Yes	2384 (82.09%)	378 (47.73%)	1228 (70.62%)	2413 (62.51%)	6403 (68.89%)	<0.001
No	520 (17.91%)	414 (52.27%)	511 (29.38%)	1447 (37.49%)	2892 (31.11%)	
Marital status ^{C}						
Married	2192 (74.56%)	471 (57.37%)	1214 (68.51%)	2657 (66.91%)	6534 (68.75%)	<0.001
Separated	28 (0.95%)	5 (0.61%)	15 (0.85%)	45 (1.13%)	93 (0.98%)	
Divorced	192 (6.53%)	32 (3.90%)	129 (7.28%)	258 (6.50%)	611 (6.43%)	
Widowed	320 (10.88%)	264 (32.16%)	311 (17.55%)	714 (17.98%)	1609 (16.93%)	
Cohabiting	61 (2.07%)	8 (0.97%)	22 (1.24%)	82 (2.06%)	173 (1.82%)	
Single	147 (5.00%)	41 (4.99%)	81 (4.57%)	215 (5.41%)	484 (5.09%)	
Neighbourhood deprivation (IMD 2004) by quintiles ^{K}						
Most deprived (1)	407 (13.81%)	163 (19.50%)	316 (17.49%)	836 (20.81%)	1722 (17.92%)	<0.001
Second	469	175	343	775	1762 (18.34%)	

most deprived (2)	(15.91%)	(20.93%)	(18.98%)	(19.29%)		
Mid-deprived (3)	586 (19.88%)	163 (19.50%)	374 (20.70%)	862 (21.46%)	1985 (20.66%)	
Second least deprived (4)	694 (23.54%)	170 (20.33%)	380 (21.03%)	758 (18.87%)	2002 (20.84%)	
Least deprived (5)	792 (26.87%)	165 (19.74%)	394 (21.80%)	786 (19.57%)	2137 (22.24%)	
Health Deprivation and Disability Domain (IMD 2004) by quintiles [K]						
Most deprived (1)	433 (14.69%)	169 (20.22%)	332 (18.37%)	852 (21.21%)	1786 (18.59%)	<0.001
Second most deprived (2)	440 (14.93%)	167 (19.98%)	329 (18.21%)	766 (19.07%)	1702 (17.71%)	
Mid-deprived (3)	612 (20.76%)	156 (18.66%)	345 (19.09%)	842 (20.96%)	1955 (20.35%)	
Second least deprived (4)	690 (23.41%)	184 (22.01%)	422 (23.35%)	766 (19.07%)	2062 (21.46%)	
Least deprived (5)	773 (26.22%)	160 (19.14%)	379 (20.97%)	791 (19.69%)	2103 (21.89%)	
General Practice Patient Survey (ranked 0 best score, to 5 worst) [K]						
0	770 (26.11%)	202 (24.16%)	374 (20.70%)	722 (17.96%)	2068 (21.52%)	0.0069
1	286 (9.70%)	69 (8.25%)	223 (12.34%)	399 (9.93%)	977 (10.17%)	
2	434 (14.72%)	160 (19.14%)	342 (18.93%)	844 (21.00%)	1780 (18.52%)	
3	341 (11.56%)	95 (11.36%)	299 (16.55%)	694 (17.27%)	1429 (14.87%)	
4	346 (11.73%)	98 (11.72%)	197 (10.90%)	400 (9.95%)	1041 (10.83%)	
5	772 (26.18%)	212 (25.36%)	372 (20.59%)	960 (23.89%)	2316 (24.10%)	
Quality Outcomes Framework Score (ranked 0 best score, to 5 worst) [K]						
0	286 (9.70%)	69 (8.25%)	223 (12.34%)	399 (9.93%)	977 (10.17%)	<0.001
1	770 (26.11%)	202 (24.16%)	374 (20.70%)	722 (17.96%)	2068 (21.52%)	
2	346 (11.73%)	98 (11.72%)	197 (10.90%)	400 (9.95%)	1041 (10.83%)	
3	434 (14.72%)	160 (19.14%)	342 (18.93%)	844 (21.00%)	1780 (18.52%)	
4	341 (11.56%)	95 (11.36%)	299 (16.55%)	694 (17.27%)	1429 (14.87%)	
5	772 (26.18%)	212 (25.36%)	372 (20.59%)	960 (23.89%)	2316 (24.10%)	

Above illustrates that those in the sample population (n=2949) were of higher social class, more educated, less likely to live alone, more socially integrated, more likely to have confidant /more frequent contact with confidant, more access to care/public transport/access to work, more affluent by IMD in comparison to attrition group. Also 2 practices had significant attrition.

Search strategy

AMED search

The Allied and Complementary Medicine Database (AMED) is a unique bibliographic database produced by the Health Care Information Service of the British Library. It covers a selection of journals in complementary medicine, palliative care, and several professions allied to medicine. The database covers the years from 1985 to present and is updated monthly. This database is supplied by Ovid.

Search history: 1. AMED; "depriv*".ti,ab; 295 results 2. AMED; "inequ*".ti,ab; 233 results 4. AMED; "social class*".ti,ab; 84 results 5. AMED; "socioeconomic".ti,ab; 465 results 6. AMED; "occupational class*".ti,ab; 14 results 7. AMED; "occupational group*".ti,ab; 52 results 8. AMED; "education*".ti,ab; 11323 results 9. AMED; "social capital".ti,ab; 25 results 10. AMED; "social network*".ti,ab; 227 results 11. AMED; "social demograph*".ti,ab; 15 results 12. AMED; "social isolat*".ti,ab; 144 results 13. AMED; "social support".ti,ab; 1092 results 14. AMED; "income".ti,ab; 703 results 15. AMED; "living arrangement*".ti,ab; 92 results 17. AMED; "access*".ti,ab; 4149 results 18. AMED; "health insurance".ti,ab; 270 results 19. AMED; QUALITY OF HEALTH CARE/; 2817 results 20. AMED; "general practice patient survey".ti,ab; 0 results 21. AMED; "GP patient survey".ti,ab; 0 results 22. AMED; "quality outcomes framework".ti,ab; 1 results 23. AMED; "QOF".ti,ab; 0 results 24. AMED; 1 OR 2 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23; 19980 results 25. AMED; "healthy ageing".ti,ab; 17 results 26. AMED; "successful ageing".ti,ab; 12 results 27. AMED; 25 OR 26; 29 results 28. AMED; "pain".ti,ab; 23165 results 29. AMED; "nocicepti*".ti,ab; 391 results 30. AMED; "analgesi*".ti,ab; 2111 results 31. AMED; "hyperalgesi*".ti,ab; 143 results 32. AMED; "allodyni*".ti,ab; 70 results 33. AMED; "musculoskeletal".ti,ab; 3101 results 34. AMED; "arthritis".ti,ab; 2885 results 35. AMED; "osteoarthritis".ti,ab; 2213 results 36. AMED; "OA".ti,ab; 649 results 37. AMED; 28 OR 29 OR 30 OR 31 OR 32 OR 33 OR 34 OR 35 OR 36; 28982 results 38. AMED; 24 AND 27; 3 results

Deprivation and ageing 3 hits
Deprivation and pain 2217 hits
Deprivation and pain and ageing 0 hits

BNI search

The British Nursing Index (BNI) is a bibliographic database that indexes articles from the most popular English language nursing journals published primarily in the UK. BNI is a comprehensive index covering all aspects of nursing, midwifery and community healthcare from 1985 to the present, and is updated monthly. This database is supplied by ProQuest.

Search history: BNI; "depriv*".ti,ab; 645 results 43. BNI; "inequ*".ti,ab; 1041 results 44. BNI; "social class*".ti,ab; 121 results 45. BNI; "socioeconomic".ti,ab; 923 results 46. BNI; "occupational class*".ti,ab; 10 results 47. BNI; "occupational group*".ti,ab; 20 results 48. BNI; "education*".ti,ab; 18590 results 49. BNI; "social capital".ti,ab; 73 results 50. BNI; "social network*".ti,ab; 342 results 51. BNI; "social demograph*".ti,ab; 6 results 52. BNI; "social isolat*".ti,ab; 142 results 53. BNI; "social support".ti,ab;

1273 results 54. BNI; "income".ti,ab; 1034 results 55. BNI; "living arrangement*".ti,ab; 43 results 56. BNI; "access*".ti,ab; 4620 results 57. BNI; "health insurance".ti,ab; 188 results 58. BNI; QUALITY OF HEALTH CARE/; 0 results 59. BNI; "general practice patient survey".ti,ab; 2 results 60. BNI; "GP patient survey".ti,ab; 2 results 61. BNI; "quality outcomes framework".ti,ab; 8 results 62. BNI; "QOF".ti,ab; 67 results 63. BNI; 42 OR 43 OR 44 OR 45 OR 46 OR 47 OR 48 OR 49 OR 50 OR 51 OR 52 OR 53 OR 54 OR 55 OR 56 OR 57 OR 58 OR 59 OR 60 OR 61 OR 62; 26809 results 64. BNI; "healthy ageing".ti,ab; 34 results 65. BNI; "successful ageing".ti,ab; 23 results 66. BNI; 64 OR 65; 56 results 67. BNI; "pain".ti,ab; 7255 results 68. BNI; "nocicepti*".ti,ab; 21 results 69. BNI; "analgesi*".ti,ab; 979 results 70. BNI; "hyperalgesi*".ti,ab; 11 results 71. BNI; "allodyni*".ti,ab; 7 results 72. BNI; "musculoskeletal".ti,ab; 306 results 73. BNI; "arthritis".ti,ab; 695 results 74. BNI; "osteoarthritis".ti,ab; 291 results 75. BNI; "OA".ti,ab; 40 results 76. BNI; 67 OR 68 OR 69 OR 70 OR 71 OR 72 OR 73 OR 74 OR 75; 8513 results 77. BNI; 63 AND 66; 10 results 78. BNI; 63 AND 76; 826 results 79. BNI; 78 [Limit to: (Languages English)]; 826 results 80. BNI; 63 AND 66 AND 76; 1 results

Deprivation and ageing 10 hits
Deprivation and pain 826 hits
Deprivation and ageing and pain 1 hit

CINAHL search

Cinahl covers all aspects of nursing and allied health disciplines. Seventeen allied health disciplines are covered: cardiopulmonary technology, dental hygiene, emergency services, medical/laboratory technology, the medical assisting, athletic training, occupational therapy, optometry, physical therapy and rehabilitation, the physician's assistant, radiologic technology, respiratory therapy, social service in health care, speech-language pathology, nutrition and dietetics, audiology and surgical technology.

Journals from biomedicine, alternative therapy, health sciences, librarianship, health promotion/education, and consumer health are also scanned for relevant articles. Cited references from nursing and allied health journals have been included as Cinahl has received permission - starting in 1994. Cinahl's annually updated thesaurus is adapted from the US National Library of Medicine's Medical Subject Headings (MeSH). There are over 4000 unique nursing and allied health subject headings.

Search history: 1. CINAHL; "depriv*".ti,ab; 4544 results 2. CINAHL; "ineq*".ti,ab; 6362 results 3. CINAHL; "occupational class*".ti,ab; 160 results 4. CINAHL; "occupational group*".ti,ab; 449 results 6. CINAHL; "social class*".ti,ab; 1512 results 7. CINAHL; "socioeconomic".ti,ab; 11624 results 8. CINAHL; "social capital".ti,ab; 965 results 9. CINAHL; "social network*".ti,ab; 3280 results 10. CINAHL; "social demograph*".ti,ab; 191 results 11. CINAHL; "social isolat*".ti,ab; 1224 results 12. CINAHL; "social support".ti,ab; 10730 results 13. CINAHL; "income".ti,ab; 17803 results 14. CINAHL; "living arrangement*".ti,ab; 617 results 16. CINAHL; "health insurance".ti,ab; 5775 results 17. CINAHL; "quality of health care".ti,ab; 975 results 18. CINAHL; "general practice patient survey".ti,ab; 5 results 19. CINAHL; "GP patient survey".ti,ab; 2 results 20. CINAHL; "quality outcomes framework".ti,ab; 8 results 21. CINAHL; "QOF".ti,ab; 297 results 23. CINAHL; "healthy ageing".ti,ab; 167 results 24. CINAHL; "successful ageing".ti,ab; 61 results 25. CINAHL; 23 OR 24; 223 results 26. CINAHL; "pain".ti,ab; 89957 results 27. CINAHL; "nocicepti*".ti,ab; 1307 results 28. CINAHL; "analgesi*".ti,ab; 11346 results 29. CINAHL; "hyperalgesi*".ti,ab; 857 results 30. CINAHL; "allodyni*".ti,ab; 609 results 31. CINAHL; "musculoskeletal".ti,ab; 9050 results 32. CINAHL; "arthritis".ti,ab; 14883 results 33. CINAHL; "osteoarthritis".ti,ab; 7222 results 34. CINAHL; "OA".ti,ab; 2367 results 35. CINAHL; 26 OR 27 OR 28 OR 29 OR 30 OR 31 OR 32 OR 33 OR 34; 116682 results 36. CINAHL; "access*".ti,ab; 52971 results 37. CINAHL; 1 OR 2 OR 3 OR 4 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 36; 103744 results 38. CINAHL; 25 AND 37; 19 results 39. CINAHL; 35 AND 37; 4070 results 40. CINAHL; 25

AND 35 AND 37; 0 results

Deprivation and ageing 19 hits
Deprivation and pain 4070 hits
Deprivation and ageing and pain 0 hits

EMBASE search

The EMBASE database is a member of the EMBASE family that consists of three separate databases: the Excerpta Medica Database (EMBASE), EMBASE Drugs and Pharmacology (EMDP), and EMBASE Psychiatry (EMPS). Formally, EMDP, and EMPS are considered to be subsets of EMBASE. This field guide, although very similar in content to those of EMDP and EMPS, provides scope of information specific to the EMBASE database.

The Excerpta Medica database (EMBASE) produced by Elsevier, is a major biomedical and pharmaceutical database indexing over 3,500 international journals in the following fields: drug research, pharmacology, pharmaceutics, toxicology, clinical and experimental human medicine, health policy and management, public health, occupational health, environmental health, drug dependence and abuse, psychiatry, forensic medicine, and biomedical engineering/instrumentation. There is selective coverage for nursing, dentistry, veterinary medicine, psychology, and alternative medicine. EMBASE is one of the most widely used biomedical and pharmaceutical databases because of its currency and in-depth indexing. Frequent updates allow access to the latest medical and pharmacological trends. Approximately 375,000 records are added yearly.

EMBASE; "depriv*".ti,ab; 71234 results 42. EMBASE; "ineq*".ti,ab; 21349 results 43. EMBASE; "occupational class*".ti,ab; 639 results 44. EMBASE; "occupational group*".ti,ab; 2818 results 45. EMBASE; "social class*".ti,ab; 8416 results 46. EMBASE; "socioeconomic".ti,ab; 57489 results 47. EMBASE; "social capital".ti,ab; 1779 results 48. EMBASE; "social network*".ti,ab; 9144 results 49. EMBASE; "social demograph*".ti,ab; 1079 results 50. EMBASE; "social isolat*".ti,ab; 5053 results 51. EMBASE; "social support".ti,ab; 26463 results 52. EMBASE; "income".ti,ab; 67733 results 53. EMBASE; "living arrangement*".ti,ab; 1656 results 54. EMBASE; "health insurance".ti,ab; 27592 results 55. EMBASE; "quality of health care".ti,ab; 5408 results 56. EMBASE; "general practice patient survey".ti,ab; 6 results 57. EMBASE; "GP patient survey".ti,ab; 13 results 58. EMBASE; "quality outcomes framework".ti,ab; 48 results 59. EMBASE; "QOF".ti,ab; 369 results 60. EMBASE; "healthy ageing".ti,ab; 670 results 61. EMBASE; "successful ageing".ti,ab; 231 results 62. EMBASE; 60 OR 61; 887 results 63. EMBASE; "pain".ti,ab; 543960 results 64. EMBASE; "nocicepti*".ti,ab; 27846 results 65. EMBASE; "analgesi*".ti,ab; 115747 results 66. EMBASE; "hyperalgesi*".ti,ab; 12382 results 67. EMBASE; "allodyni*".ti,ab; 7279 results 68. EMBASE; "musculoskeletal".ti,ab; 35922 results 69. EMBASE; "arthritis".ti,ab; 165391 results 70. EMBASE; "osteoarthritis".ti,ab; 48449 results 71. EMBASE; "OA".ti,ab; 26641 results 72. EMBASE; 63 OR 64 OR 65 OR 66 OR 67 OR 68 OR 69 OR 70 OR 71; 816018 results 73. EMBASE; "access*".ti,ab; 359808 results 74. EMBASE; 41 OR 42 OR 43 OR 44 OR 45 OR 46 OR 47 OR 48 OR 49 OR 50 OR 51 OR 52 OR 53 OR 54 OR 55 OR 56 OR 57 OR 58 OR 59 OR 73; 612523 results 75. EMBASE; 62 AND 74; 83 results 76. EMBASE; 72 AND 74; 22885 results 77. EMBASE; 62 AND 72 AND 74; 6 results

Deprivation and ageing 83 hits
Deprivation and pain 22885 hits
Deprivation and ageing and pain 6 hits

HMIC Search

The Health Management Information Consortium (HMIC) database is a compilation of data from two sources, the Department of Health's Library and Information Services and King's Fund Information and Library Service. Brief summaries about the types of data that these two sources contribute to HMIC are included below.

DH Data is the database of the Department of Health's Library and Information Services and contains in excess of 174,000 records relating to health and social care management information. Coverage includes official publications, journal articles and grey literature on: health service policy, management and administration, with an emphasis on the British National Health Service; the quality of health services including hospitals, nursing, primary care and public health; the planning, design, construction and maintenance of health service buildings; occupational health; control and regulation of medicines; medical equipment and supplies; and social care and personal social services. The majority of records are from 1983 onwards, although coverage of departmental materials dates back to 1919. Over a quarter of the records have abstracts.

The King's Fund Information and Library Service database holds records of the material in the library of the King's Fund Information and Library Service, an independent health charity working to develop and improve the management of health and social care services. This library is open to the public. Its database contains over 70,000 records (1979 to date), mostly with a UK focus, on health management and services, social care, service development, and NHS organisation and administration. Records include books, pamphlets, government reports, abstracts of journal articles, and a wide range of grey literature.

Search history: HMIC; "depriv*".ti,ab; 3218 results 79. HMIC; "ineq*".ti,ab; 5749 results 80. HMIC; "occupational class*".ti,ab; 132 results 81. HMIC; "occupational group*".ti,ab; 274 results 82. HMIC; "social class*".ti,ab; 1166 results 83. HMIC; "socioeconomic".ti,ab; 2761 results 84. HMIC; "social capital".ti,ab; 299 results 85. HMIC; "social network*".ti,ab; 542 results 86. HMIC; "social demograph*".ti,ab; 25 results 87. HMIC; "social isolat*".ti,ab; 209 results 88. HMIC; "social support".ti,ab; 1020 results 89. HMIC; "income".ti,ab; 4592 results 90. HMIC; "living arrangement*".ti,ab; 142 results 91. HMIC; "health insurance".ti,ab; 1287 results 92. HMIC; "quality of health care".ti,ab; 822 results 93. HMIC; "general practice patient survey".ti,ab; 13 results 94. HMIC; "GP patient survey".ti,ab; 52 results 95. HMIC; "quality outcomes framework".ti,ab; 18 results 96. HMIC; "QOF".ti,ab; 219 results 97. HMIC; "healthy ageing".ti,ab; 81 results 98. HMIC; "successful ageing".ti,ab; 25 results 99. HMIC; 97 OR 98; 102 results 100. HMIC; "pain".ti,ab; 2824 results 101. HMIC; "nocicepti*".ti,ab; 5 results 102. HMIC; "analgesi*".ti,ab; 367 results 103. HMIC; "hyperalgesi*".ti,ab; 1 results 104. HMIC; "allodyni*".ti,ab; 0 results 105. HMIC; "musculoskeletal".ti,ab; 446 results 106. HMIC; "arthritis".ti,ab; 460 results 107. HMIC; "osteoarthritis".ti,ab; 166 results 108. HMIC; "OA".ti,ab; 59 results 109. HMIC; 100 OR 101 OR 102 OR 103 OR 104 OR 105 OR 106 OR 107 OR 108; 3828 results 110. HMIC; "access*".ti,ab; 15056 results 111. HMIC; 78 OR 79 OR 80 OR 81 OR 82 OR 83 OR 84 OR 85 OR 86 OR 87 OR 88 OR 89 OR 90 OR 91 OR 92 OR 93 OR 94 OR 95 OR 96 OR 110; 30872 results 112. HMIC; 99 AND 111; 25 results 113. HMIC; 109 AND 111; 459 results 114. HMIC; 99 AND 109 AND 111; 3 results

Deprivation and ageing 25 hits
Deprivation and pain 459 hits
Deprivation and ageing and pain 3 hits

MEDLINE search

MEDLINE™ is the United States National Library of Medicine's (NLM™) premier bibliographic database providing information from the following fields:

Medicine Veterinary medicine
Nursing
Allied health
Dentistry
Pre-clinical sciences

The MEDLINE database is the electronic counterpart of Index Medicus™, Index to Dental Literature, and the International Nursing Index.
MEDLINE is the primary source of global information from international literature on biomedicine, including the following topics as they relate to biomedicine and health care:

Biology Plant and animal science
Environmental science
Biophysics
Marine biology
Chemistry

NLM uses a controlled vocabulary of biomedical terms to index articles, to catalog books and other holdings, and to facilitate searching within MEDLINE. MEDLINE's controlled-vocabulary thesaurus contains Medical Subject Headings (MeSH™) to describe the subject of each journal article in the database. MeSH terms provide a consistent way of retrieving information that uses different terminology for the same concept. Within MEDLINE's thesaurus, MeSH terms display hierarchically by category, with more specific terms arranged beneath broader terms. This hierarchical structure also provides an effective way for searchers to browse MeSH in order to find descriptors appropriate to their searches.

NLH Medline search uses the Ovid dataset MESZ Ovid MEDLINE™ 1946 to Present, which is updated weekly.

115. MEDLINE; "depriv*".ti,ab; 61617 results 116. MEDLINE; "ineq*".ti,ab; 19519 results 117. MEDLINE; "occupational class*".ti,ab; 597 results 118. MEDLINE; "occupational group*".ti,ab; 2439 results 119. MEDLINE; "social class*".ti,ab; 8246 results 120. MEDLINE; "socioeconomic".ti,ab; 49922 results 121. MEDLINE; "social capital".ti,ab; 1571 results 122. MEDLINE; "social network*".ti,ab; 7555 results 123. MEDLINE; "social demograph*".ti,ab; 779 results 124. MEDLINE; "social isolat*".ti,ab; 3857 results 125. MEDLINE; "social support".ti,ab; 21113 results 126. MEDLINE; "income".ti,ab; 58020 results 127. MEDLINE; "living arrangement*".ti,ab; 1479 results 128. MEDLINE; "health insurance".ti,ab; 21363 results 129. MEDLINE; "quality of health care".ti,ab; 4111 results 130. MEDLINE; "general practice patient survey".ti,ab; 7 results 131. MEDLINE; "GP patient survey".ti,ab; 12 results 132. MEDLINE; "quality outcomes framework".ti,ab; 18 results 133. MEDLINE; "QOF".ti,ab; 211 results 134. MEDLINE; "healthy ageing".ti,ab; 517 results 135. MEDLINE; "successful ageing".ti,ab; 166 results 136. MEDLINE; 134 OR 135; 671 results 137. MEDLINE; "pain".ti,ab; 394039 results 138. MEDLINE; "nocicepti*".ti,ab; 22498 results 139. MEDLINE; "analgesi*".ti,ab; 86791 results 140. MEDLINE; "hyperalgesi*".ti,ab; 9546 results 141. MEDLINE; "allodyni*".ti,ab; 5265 results 142. MEDLINE; "musculoskeletal".ti,ab; 27170 results 143. MEDLINE; "arthritis".ti,ab; 124254 results 144. MEDLINE; "osteoarthritis".ti,ab; 34914 results 145. MEDLINE; "OA".ti,ab; 18531 results 146. MEDLINE; 137 OR 138 OR 139 OR 140 OR 141 OR 142 OR 143 OR 144 OR 145; 604746

results 147. MEDLINE; "access*".ti,ab; 288515 results 148. MEDLINE; 115 OR 116 OR 117 OR 118 OR 119 OR 120 OR 121 OR 122 OR 123 OR 124 OR 125 OR 126 OR 127 OR 128 OR 129 OR 130 OR 131 OR 132 OR 133 OR 147; 503705 results 149. MEDLINE; 136 AND 148; 65 results 150. MEDLINE; 146 AND 148; 14858 results 151. MEDLINE; 136 AND 146 AND 148; 3 results

Deprivation and ageing 65 hits
Deprivation and pain 14858 hits
Deprivation and ageing and pain 3 hits

PsycINFO search

The PsycINFO database provides extensive international coverage of the literature on psychology and allied fields.

PsycINFO covers psychological practice and research as well as the related clinical, social and biological disciplines.

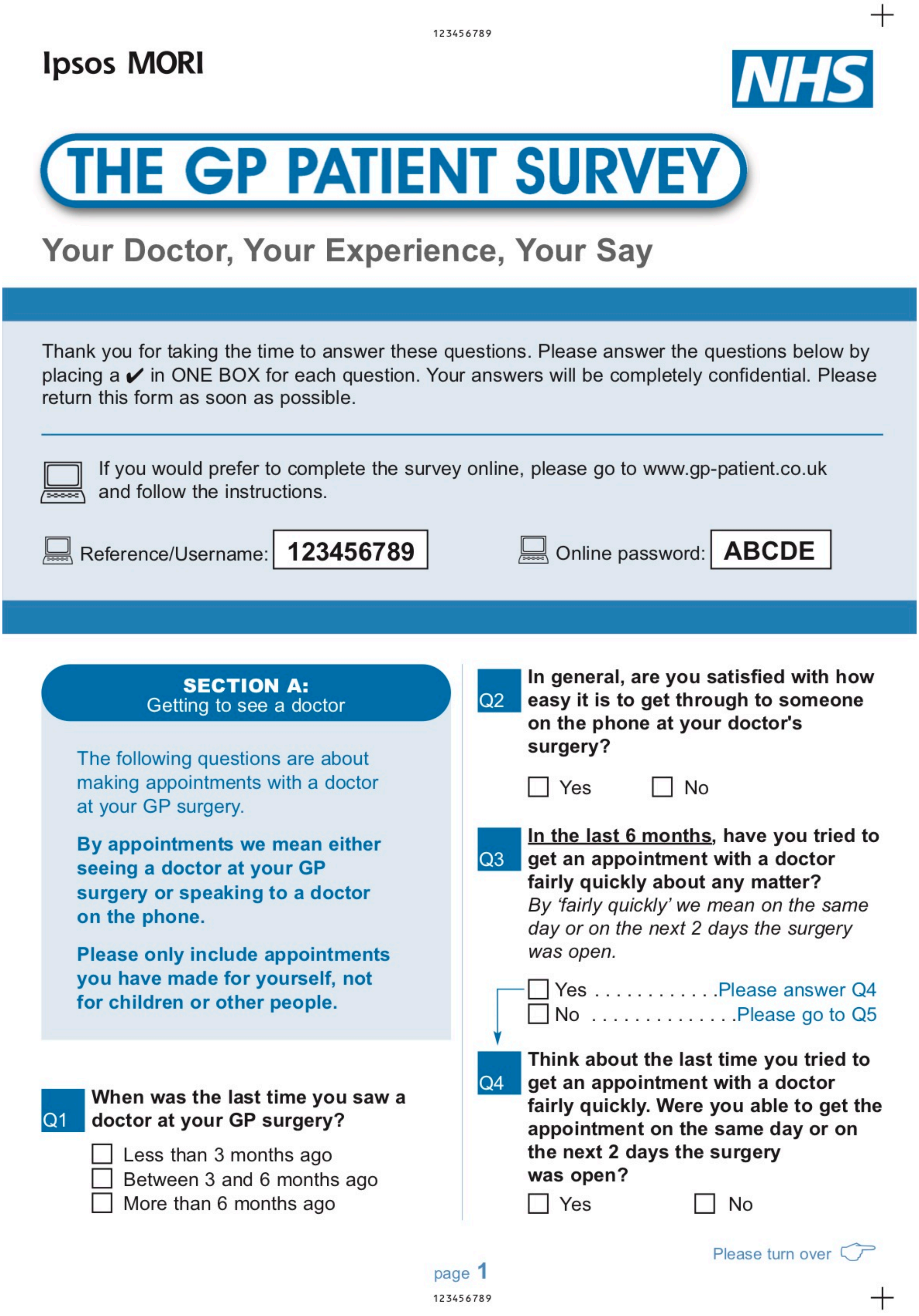
This includes information on drug and behavioural therapy, treatment of disease, drug addiction, developmental psychology, and educational psychology, as well as the psychological aspects of such areas as linguistics, social processes, pharmacology, physiology, nursing, education, anthropology, business and law. Subject searching is facilitated by means of PsycINFO's Psychological Index Terms and PSYC includes an online thesaurus, which allows easy access to these terms.

The major emphasis of the database is on original research, while case studies, literature reviews, surveys and discussions are also covered. Detailed abstracts are provided for all documents in the database, except dissertations.

152. PsycINFO; "depriv*".ti,ab; 24191 results 153. PsycINFO; "ineq*".ti,ab; 14866 results 154. PsycINFO; "occupational class*".ti,ab; 436 results 155. PsycINFO; "occupational group*".ti,ab; 1448 results 156. PsycINFO; "social class*".ti,ab; 8981 results 157. PsycINFO; "socioeconomic".ti,ab; 29788 results 158. PsycINFO; "social capital".ti,ab; 4182 results 159. PsycINFO; "social network*".ti,ab; 12971 results 160. PsycINFO; "social demograph*".ti,ab; 518 results 161. PsycINFO; "social isolat*".ti,ab; 4566 results 162. PsycINFO; "social support".ti,ab; 30838 results 163. PsycINFO; "income".ti,ab; 35776 results 164. PsycINFO; "living arrangement*".ti,ab; 1879 results 165. PsycINFO; "health insurance".ti,ab; 4271 results 166. PsycINFO; "quality of health care".ti,ab; 937 results 167. PsycINFO; "general practice patient survey".ti,ab; 1 results 168. PsycINFO; "GP patient survey".ti,ab; 2 results 169. PsycINFO; "quality outcomes framework".ti,ab; 5 results 170. PsycINFO; "QOF".ti,ab; 26 results 171. PsycINFO; "healthy ageing".ti,ab; 177 results 172. PsycINFO; "successful ageing".ti,ab; 108 results 173. PsycINFO; 171 OR 172; 280 results 174. PsycINFO; "pain".ti,ab; 62712 results 175. PsycINFO; "nocicepti*".ti,ab; 6473 results 176. PsycINFO; "analgesi*".ti,ab; 10790 results 177. PsycINFO; "hyperalgesi*".ti,ab; 2893 results 178. PsycINFO; "allodyni*".ti,ab; 1762 results 179. PsycINFO; "musculoskeletal".ti,ab; 3249 results 180. PsycINFO; "arthritis".ti,ab; 3805 results 181. PsycINFO; "osteoarthritis".ti,ab; 1103 results 182. PsycINFO; "OA".ti,ab; 706 results 183. PsycINFO; 174 OR 175 OR 176 OR 177 OR 178 OR 179 OR 180 OR 181 OR 182; 74147 results 184. PsycINFO; "access*".ti,ab; 84414 results 185. PsycINFO; 152 OR 153 OR 154 OR 155 OR 156 OR 157 OR 158 OR 159 OR 160 OR 161 OR 162 OR 163 OR 164 OR 165 OR 166 OR 167 OR 168 OR 169 OR 170 OR 184; 231638 results 186. PsycINFO; 173 AND 185; 49 results 187. PsycINFO; 183 AND 185; 3737 results 188. PsycINFO; 173 AND 183 AND 185; 2 results

Deprivation and ageing 49 hits
Deprivation and pain 3337 hits
Deprivation and pain and ageing 2 hits

The GP Patient Survey 2008



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THE GP PATIENT SURVEY

Your Doctor, Your Experience, Your Say

Thank you for taking the time to answer these questions. Please answer the questions below by placing a ✔ in ONE BOX for each question. Your answers will be completely confidential. Please return this form as soon as possible.

If you would prefer to complete the survey online, please go to www.gp-patient.co.uk and follow the instructions.

Reference/Username: 123456789

Online password: ABCDE

SECTION A:
Getting to see a doctor

The following questions are about making appointments with a doctor at your GP surgery.

By appointments we mean either seeing a doctor at your GP surgery or speaking to a doctor on the phone.

Please only include appointments you have made for yourself, not for children or other people.

Q1 **When was the last time you saw a doctor at your GP surgery?**

☐ Less than 3 months ago
☐ Between 3 and 6 months ago
☐ More than 6 months ago

Q2 **In general, are you satisfied with how easy it is to get through to someone on the phone at your doctor's surgery?**

☐ Yes ☐ No

Q3 **__In the last 6 months__, have you tried to get an appointment with a doctor fairly quickly about any matter?**
By 'fairly quickly' we mean on the same day or on the next 2 days the surgery was open.

☐ Yes . . . . .Please answer Q4
☐ No . . . . .Please go to Q5

Q4 **Think about the last time you tried to get an appointment with a doctor fairly quickly. Were you able to get the appointment on the same day or on the next 2 days the surgery was open?**

☐ Yes ☐ No

Please turn over ☞

page 1

123456789

Thinking about less urgent appointments...

Q5 **In the last 6 months, have you wanted to book ahead for an appointment with a doctor?**

By 'booking ahead' we mean booking an appointment more than 2 full days in advance.

☐ Yes . . . . .Please answer Q6
☐ No . . . . .Please go to Q7

Q6 **Last time you wanted to, were you able to get an appointment with a doctor more than 2 full days in advance?**

☐ Yes ☐ No

Q7 **In the last 6 months, have you ever wanted to make an appointment with a particular doctor at your GP surgery?**

☐ Yes . . . . .Please answer Q8
☐ No . . . . .Please go to Q9

Q8 **Last time you wanted to, were you able to make an appointment with a particular doctor - even if it meant waiting longer?**

☐ Yes ☐ No

Now a question about your GP surgery's opening hours

Q9 **Over the last 6 months or so, were you satisfied with the hours your GP surgery was open?**

☐ Yes, I was satisfied with the opening hours . . . . . . .Please go to Section B
☐ No, I was dissatisfied with the opening hours .. .Please answer Q10

Q10 **I was dissatisfied because...**

Please tick the ONE box closest to your views.

☐ ...the surgery was not open early enough in the morning
☐ ...the surgery was not open around lunchtime
☐ ...the surgery was not open late enough in the evening
☐ ...the surgery was not open on a Saturday
☐ ...the surgery was not open on a Sunday
☐ ...of some other reason

SECTION B:
Referrals to hospital

We are also interested in your experiences when your doctor refers you to see certain types of specialists at a hospital. The next few questions are about this.

Please Note **When answering questions 11 and 12 please do not include referrals for cancer, urgent heart conditions, stroke, mental health or maternity services.**

Q11 **In the last 6 months, has your doctor referred you to see a specialist?**

By specialist we mean someone like a hospital doctor who you would see for treatment or further examination.

☐ Yes . . . . .Please answer Q12
☐ No . . . . .Please go to Section C

Q12 **Think about the last time your doctor referred you to see a specialist. Did your doctor talk with you about a choice of hospital for your appointment?**

☐ Yes ☐ No

SECTION C:
Some questions about you

The following questions will help us to see how experiences vary between different groups of the population.

Q13 Are you male or female?

☐ Male ☐ Female

Q14 How old are you?

☐ Under 18
☐ 18-19
☐ 20-24
☐ 25-34
☐ 35-44
☐ 45-54
☐ 55-59
☐ 60-64
☐ 65-74
☐ 75-84
☐ 85 or over

Q15 How many appointments have you made with a doctor at your GP surgery in the last 12 months?

☐ None
☐ 1
☐ 2
☐ 3
☐ 4
☐ 5
☐ 6
☐ 7-10
☐ 11-15
☐ 16-25
☐ 26 or more

Q16 Are you a parent or a legal guardian for any children aged under 16 currently living in your household?

☐ Yes ☐ No

Q17 Which of these best describes what you are doing at present?

If more than one of these applies to you, please tick the main ONE.

☐ Full-time paid work (30 hours plus per week) ☐ Part-time paid work (under 30 hours per week)	Please answer Q18
☐ Full-time education at school, college or university ☐ Unemployed ☐ Permanently sick/disabled ☐ Fully retired from work ☐ Looking after the home ☐ Doing something else	Please go to Q21

Q18 In general, how long does your journey take from home to work (door to door)?

☐ Less than 10 minutes
☐ 10-30 minutes
☐ 31 minutes - 1 hour
☐ More than 1 hour
☐ Live on site

Q19 Which of the following most reflects your typical working hours?

If more than one of these applies to you, please tick the main ONE.

☐ Weekday office hours (we mean starting around 8 or 9am and finishing around 5 or 6pm) ☐ Weekday mornings ☐ Weekday afternoons/evenings	Please answer Q20
☐ Overnights ☐ Weekends	Please go to Q21
☐ Other work pattern ☐ Working hours vary	Please answer Q20

Q20 If you need to see a doctor at your GP surgery during your typical working hours, can you take time away from your work to do this?

☐ Yes ☐ No

Please turn over ☞

The following questions will help us to see how experiences vary between different groups of the population.

Q21 Do you have any of the following long-standing conditions?

Include problems which are due to old age.
Please tick all boxes which apply.

- ☐ Deafness or severe hearing impairment
- ☐ Blindness or severe visual impairment
- ☐ A condition that substantially limits one or more basic physical activities such as walking, climbing stairs, lifting or carrying
- ☐ A learning difficulty
- ☐ A long-standing psychological or emotional condition
- ☐ Other, including any long-standing illness

Please answer Q22

- ☐ No, I do not have a long-standing condition

Please go to Q23

Q22 Does your long-standing health problem or disability mean you have substantial difficulties doing day-to-day activities?

Include problems which are due to old age.

☐ Yes ☐ No

Q23 Do you have carer responsibilities for anyone in your household with a long-standing health problem or disability?

☐ Yes ☐ No

Q24 What is your ethnic group?

Choose one section from A to E, then select the appropriate option to indicate your ethnic group.

A. White

☐ British ☐ Irish
☐ Any other White background
(Please write in) ______

B. Mixed

☐ White and Black Caribbean
☐ White and Black African
☐ White and Asian
☐ Any other Mixed background
(Please write in) ______

C. Asian or Asian British

☐ Indian ☐ Pakistani
☐ Bangladeshi
☐ Any other Asian background
(Please write in) ______

D. Black or Black British

☐ Caribbean ☐ African
☐ Any other Black background
(Please write in) ______

E. Chinese or other ethnic group

☐ Chinese
☐ Any other
(Please write in) ______

Please return the questionnaire in the envelope provided or send it in an envelope marked only FREEPOST GP PATIENT SURVEY (No stamp is needed).

Thank you for taking the time to answer these questions.

Barcode placement only. Do not print

☐

Health Survey

Instructions for this questionnaire

The aim of this questionnaire is to find out about the general health of local people and about how many people suffer from joint pain. The answers you give in the questionnaire will be treated in the **strictest confidence**.

Section A

This section is made up of questions about your health, the activities you do, and some of the ways in which people do things in everyday life.
Please answer each set of questions as the instructions tell you to.

Part 1 - Your health

We are interested in your general health**.**
Please answer every question. Some questions may look similar to others but each one is different. We would like you to answer each one. Please take the time to read and answer each question carefully by placing a cross in the box of your choice. Please cross one box only on each line.

1. In general would you say your health is:
   (Please put a cross in one box only)

Excellent **Very good** **Good** **Fair** **Poor**

☐ ☐ ☐ ☐ ☐

2. The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?
(Please put a cross in one box on each line)

	Yes, limited a lot	**Yes, limited a little**	**No, not limited at all**
a. **Moderate activities**, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	☐	☐	☐
b. Climbing **several** flights of stairs	☐	☐	☐

3. During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

(Please put a cross in one box on each line)	**Yes**	**No**
a. **Accomplished less** than you would like	☐	☐

b. Were limited in the **kind** of work or other activities you could do ☐ ☐

4. During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?
   (Please put a cross in one box on each line)

	Yes	**No**
a. **Accomplished less** than you would like	☐	☐
b. Didn't do work or other activities as **carefully** as usual	☐	☐

5. During the **past 4 weeks**, how much did **pain** interfere with your normal work (including both work outside the home and housework)?
   (Please put a cross in one box only)

Not at all	**A little bit**	**Moderately**	**Quite a bit**	**Extremely**
☐	☐	☐	☐	☐

6. These questions are about how you feel and how things have been with you during the **past 4 weeks**. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the **past 4 weeks**….

(Please put a cross in one box on each line)

	All of the time	**Most of the time**	**A good bit of the time**	**Some of the time**	**A little of the time**	**None of the time**
a. Have you felt calm and peaceful?	☐	☐	☐	☐	☐	☐
b. Did you have a lot of energy?	☐	☐	☐	☐	☐	☐
c. Have you felt downhearted and blue?	☐	☐	☐	☐	☐	☐

7. During the **past 4 weeks**, how much of the time have your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)? ***(Please put a cross in one box on each line)***

All of the time	**Most of the time**	**Some of the time**	**A little of the time**	**None of the time**
☐	☐	☐	☐	☐

Part 2 – Taking Part

We are interested in some of the things that are necessary for you to live your life in the way you choose. We are particularly interested in how often these things are achieved in the way you would like.

When answering the questions, please think about the **past four weeks**. It does not matter if you require the help of other people or from gadgets and machines. We would simply like to know if the activity **IS** achieved to the extent that you want it to be.

Please read each statement below and put a cross in the box, which comes closest to how much you agree with the statement. Please put a cross in one box only for each line.

1. During the past 4 weeks, I have moved around in my home, **as and when I have wanted.**

All	Most of	Some of	A little	None of
the time	the time	the time	of the time	the time
☐	☐	☐	☐	☐

2. During the past 4 weeks, I have moved around outside my home, **as and when I have wanted.**

All	Most of	Some of	A little	None of

the time the time the time of the time
the time

☐ ☐ ☐ ☐ ☐

3. During the past 4 weeks, my self-care needs (examples are washing, toileting, dressing, feeding, maintaining health) have been met, **as and when I have wanted.**

All Most of Some of A little
None of

the time the time the time of the time
the time

☐ ☐ ☐ ☐ ☐

4. During the past 4 weeks, my home has been looked after, **as and when I have wanted.**

All Most of Some of A little
None of

the time the time the time of the time
the time

☐ ☐ ☐ ☐ ☐

5. During the past 4 weeks, my things (belongings) have been looked after, **as and when I have wanted.**

All Most of Some of A little
None of

the time	the time	the time	of the time	the time
☐	☐	☐	☐	☐

6. Do you have any relatives, or other people, who depend on you?

Yes…. ☐ No… ☐

If yes, during the past 4 weeks, were these people looked after,

as and when you wanted?

All the time	Most of the time	Some of the time	A little of the time	None of the time
☐	☐	☐	☐	☐

7. During the past 4 weeks, I have met and spoken to other people **as and when I have wanted.**

All the time	Most of the time	Some of the time	A little of the time	None of the time
☐	☐	☐	☐	☐

8. During the past 4 weeks, I, or someone else on my behalf, have managed my money, **as I have wanted.**

All	Most of	Some of	A little	None of

the time	the time	the time	of the time	the time
☐	☐	☐	☐	☐

9. Do you choose to take part in paid or voluntary work?

Yes…. ☐ No…. ☐

If yes, during the past 4 weeks, have you taken part in paid or voluntary work, **as and when you have wanted?**

All	Most of	Some of	A little	None of
the time	the time	the time	of the time	the time
☐	☐	☐	☐	☐

10. Do you choose to take part in education or training courses?

Yes…. ☐ No…. ☐

If yes, during the past 4 weeks, have you taken part in education or training, **as and when you have wanted?**

All the time	Most of the time	Some of the time	A little of the time	None of the time
☐	☐	☐	☐	☐

11. Do you choose to take part in social activities?
(Examples of social activities are community and religious activities,
meeting up with friends, going to clubs)

Yes…. ☐ No… ☐

If yes, during the past 4 weeks, have you taken part in social activities,

as and when you have wanted?

All the time	Most of the time	Some of the time	A little of the time	None of the time
☐	☐	☐	☐	☐

Part 3 - How often

We would like to know about how often you do things during your normal daily routine.

Look at the following list. **Thinking about the past 4 weeks**, please consider how often did you do each thing, and put a cross in one box on each line.

	All days	Most days	Some days	Few days	No days
a. Go out for a walk..................	☐	☐	☐	☐	☐
b. Go out of the house and go somewhere...........................	☐	☐	☐	☐	☐
c. Go out to work........................	☐	☐	☐	☐	☐
d. Spend most or all of the day in bed or in a chair.................	☐	☐	☐	☐	☐
e. Go shopping..........................	☐	☐	☐	☐	☐
f. Take a bus or drive a car.........	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐

g. Go in a car as a passenger....

h. Go to a club, church ☐ ☐ ☐ ☐ ☐

or social event........................

☐ ☐ ☐ ☐ ☐

i. Play a sport..............................

j. Go on an education or ☐ ☐ ☐ ☐ ☐

training course.........................

☐ ☐ ☐ ☐ ☐

k. Do a hobby.............................

☐ ☐ ☐ ☐ ☐

l. Take a bath..............................

m. Do home maintenance ☐ ☐ ☐ ☐ ☐

activities..................................

All Most Some Few

No

days days days

days days

☐ ☐ ☐ ☐ ☐

n. Wash clothes..........................

o. Cook and clean....................... ☐ ☐ ☐ ☐ ☐

p. Look after others..................... ☐ ☐ ☐ ☐ ☐

Below is a list of physical activities that you may have done in the **past 4 weeks**.

Please put a cross in one box on each line.

How often have you done…….

Every

Once

Every other Twice a

week Not

day day a week or less

at all

q. Heavy housework (e.g. spring cleaning, moving furniture, scrubbing floors by hand) ☐ ☐ ☐ ☐ ☐

r. Heavy gardening (e.g. digging, tree felling) ☐ ☐ ☐ ☐ ☐

s. Heavy DIY work at home (e.g. decorating, plastering)	☐	☐	☐	☐	☐
t. Walks of at least a quarter of a mile (5-10 minutes continuous walking)	☐	☐	☐	☐	☐
u. Walks of two miles or more (at least 40 minutes continuous walking)	☐	☐	☐	☐	☐

Part 4 - How you do things

We would like to know if you have changed the way you do your normal daily activities and if you require the help of other people or special devices.

Please answer each question and put a cross in one box for each one.

1. Thinking back over the **past 4 weeks,** have you had to reduce the amount of time or change how you have done most activities because of your health?

All Most Some Few
No

days days days days
days

☐ ☐ ☐ ☐ ☐

2. During the **past 4 weeks** have you required the assistance of others or aids (examples are a walking stick or a wheelchair) to move around your home?

☐

Yes…. No….

☐

3. During the **past 4 weeks**, have you required the assistance of others or aids (examples are walking sticks and wheelchairs) to go to places outside of your home? ☐

   Yes….   No…. ☐

4. During the **past 4 weeks** have you required the assistance of others to look after yourself? ☐

   Yes…. ☐   No….

5. During the **past 4 weeks**, have you r☐ired the assistance of others to look after your home? ☐

   Yes....   No…. ☐

6. Compared to **12 months ago**, have you reduced the time or changed how you have done any of your activities?

   Yes, a lot ☐   Yes, a little ☐   No, not at all ☐

<u>Part 5 -Friends and family</u>

We are interested in the contact you may have with your friends and family.

Please answer each question and put a cross in one box for each line.

1. How many living children do you have?

None 1 to 2 3 to 5
6 or more

☐ ☐ ☐ ☐

2. How many of your children do you see at least once a month ?

None 1 to 2 3 to 5
6 or more

☐ ☐ ☐ ☐

3. Apart from your children, how many relatives do you have whom you feel close to?

None 1 to 2 3 to 5 6 to 9
10 or more

☐ ☐ ☐ ☐ ☐

4. How many close relatives do you see at least once a month?

None 1 to 2 3 to 5 6 to 9
10 or more

☐ ☐ ☐ ☐ ☐

5. How many friends do you have?

None 1 to 2 3 to 5 6 to 9
10 or more

☐ ☐ ☐ ☐ ☐

6. How many of these friends do you see at least once a month?

None 1 to 2 3 to 5 6 to 9
10 or more

☐ ☐ ☐ ☐ ☐

7. Is there anyone special you know that you feel very close to, someone you feel you can share confidences and feelings with?

Yes…. ☐ No…. ☐

If yes, how often do you see or talk with this person?

(Please put a cross in one box on each line)

Once

Daily Weekly Monthly Several times
a year

a year
or less

☐ ☐ ☐ ☐ ☐

Part 6 - Access

We would like you to tell us how easy it is to get hold of or gain access to things that you need in daily life.

Please answer with a cross in one box for each question.

1. Do you have access to a car when you personally need it?

   Yes…. ☐ No…. ☐

2. Do you have access to public transport?

   Yes…. No…. ☐

3. Do you have access to a telephone?

   Yes…. No…. ☐

4. Do you have good access to your doctor (GP), as and when you need it?

   Yes…. No…. ☐

☐

5. Do you have access to a chemist?

Yes…. ☐ No…. ☐

6. Do you have access to a bank?

Yes…. ☐ No…. ☐

☐

7. Do you have access to advice or help with your income (for example,
relatives or the benefits system)?

Yes…. ☐ No…. ☐

8. If you wanted to take part in an education course, is there the opportunity ☐

Yes…. No…. ☐

9. If you wanted to do paid or voluntary work, is there the opportunity?

Yes…. ☐ No… ☐

Part 7 - How you feel

The next set of questions are about how you feel at the moment. Please read each item and put a cross next to the reply that comes closest to how you have been feeling **in the past week.** Don't take too long over your replies; your immediate reaction to each item will usually be more accurate than a long thought out response.

1. I feel tense or wound up:

Most of the time	A lot of the time	From time to time, occasionally	Not at all
☐	☐	☐	☐

2. I still enjoy the things I used to enjoy:

Definitely as much	Not quite as much	Only a little	Hardly at all

☐ ☐ ☐ ☐

3. I get a sort of frightened feeling as if something awful is about to happen:

Very definitely Yes, but not A little, but it
Not at all

and quite badly too badly doesn’t worry me

☐ ☐ ☐ ☐

4. I can laugh and see the funny side of things:

As much as I Not quite so Definitely not
Not at all

always could much now so much now

☐ ☐ ☐ ☐

5. Worrying thoughts go through my mind:

A great deal A lot of Not too
Very

of the time the time often
little

☐ ☐ ☐ ☐

6. I feel cheerful:

Never Not often Sometimes
Most of

the time

☐ ☐ ☐ ☐

7. I can sit at ease and feel relaxed:

Definitely Usually Not often
Not at all

☐ ☐ ☐ ☐

8. I feel as if I am slowed down:

Nearly all

of the time Very often Sometimes
Not at all

☐ ☐ ☐ ☐

9. I get a sort of frightened feeling like butterflies in my stomach:

Not at all Occasionally Quite often
Very often

☐ ☐ ☐ ☐

10. I have lost interest in my appearance:

Definitely I don’t take I may not take I
take just as as much care quite as much
much care

as I should care
as ever

☐ ☐ ☐ ☐

11. I feel restless as if I have to be on the move:

Very much Quite a Not very
Not at

indeed lot much
all

☐ ☐ ☐ ☐

12. I look forward with enjoyment to things:

As much as	Rather less	Definitely less	Hardly at all
I ever did	than I used to	than I used to	
☐	☐	☐	☐

13. I get sudden feelings of panic:

Very often	Quite often	Not very	Not at all
indeed		often	
☐	☐	☐	☐

14. I can enjoy a good book or radio or TV programme:

Often	Sometimes	Not often	Very seldom
☐	☐	☐	☐

Part 8- Your views

Section 1

We are interested in your views of health and life. Please indicate how much you agree or disagree with the following statements about health issues by putting a cross in one box for each one.

(Please put a cross in one box on each line)

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
a. There is a lot which I can do to control my health....	☐	☐	☐	☐	☐
b. What I do will affect whether my health gets better or worse.................	☐	☐	☐	☐	☐
c. Treatments are effective in controlling illness..........	☐	☐	☐	☐	☐
d. My health is very unpredictable...................	☐	☐	☐	☐	☐

e. Illness makes me feel afraid...............................	☐	☐	☐	☐	☐
f. The course of my life depends on me.................	☐	☐	☐	☐	☐
g. I have the power to influence what happens in my life...........................	☐	☐	☐	☐	☐
h. Osteoarthritis is a serious condition..............	☐	☐	☐	☐	☐
i. Problems with your joints are a normal part of growing old......................	☐	☐	☐	☐	☐
j. Doctors can do a lot to help people with joint problems..........................	☐	☐	☐	☐	☐

Neither

Strongly agree nor

Strongly

disagree Disagree disagree Agree

agree

k. Joint problems always get worse over time..........	☐	☐	☐	☐	☐
l. Treatments are effective in controlling pain.............	☐	☐	☐	☐	☐
m. If a pain lasts for a week or more, you may have a serious illness..............	☐	☐	☐	☐	☐
n. I do not expect doctors to be able to do much about pain................................	☐	☐	☐	☐	☐
o. The thought of pain makes me afraid..............	☐	☐	☐	☐	☐

Section 2

Now, we would like to know what your views are on **what causes illness**. Please indicate your agreement or disagreement with each of the following as a possible cause of illness.

Please put a cross in one box on each line.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
a. Stress or worry.................	☐	☐	☐	☐	☐
b. Hereditary – it runs in the family..............	☐	☐	☐	☐	☐
c. A germ or virus................	☐	☐	☐	☐	☐
d. A diet or eating habit........	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
e. Chance or bad luck..........	☐	☐	☐	☐	☐
f. Poor medical care in the	☐	☐	☐	☐	☐

past.................................

g. Pollution in the environment....................	☐	☐	☐	☐	☐
h. Someone's own behaviour.........................	☐	☐	☐	☐	☐
i. Someone's mental attitude e.g. thinking about life negatively.........................	☐	☐	☐	☐	☐
j. Family problems or worries.............................	☐	☐	☐	☐	☐
k. Overwork.........................	☐	☐	☐	☐	☐
l. Someone's emotional state (e.g. feeling down, lonely, anxious, empty).....	☐	☐	☐	☐	☐
m. Ageing............................	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐

n. Alcohol............................

☐ ☐ ☐ ☐ ☐

o. Smoking..........................

☐ ☐ ☐ ☐ ☐

p. Accident or injury............

☐ ☐ ☐ ☐ ☐

q. Someone’s personality....

☐ ☐ ☐ ☐ ☐

r. Altered immunity...............

(the body is unable to fight illness)

Section 3

We are also interested in how you think illness can be controlled and how you may use your doctor (GP).

Please answer by putting a cross in one box for each question.

1. In your opinion, is it a matter of luck whether you are well or ill, or is it something which can be controlled? ***(Please put a cross in one box only)***

All Mostly Bit of Mostly under
Almost

luck luck both control
all under

control

☐ ☐ ☐ ☐ ☐

2. How often do you visit the doctor (GP) for yourself?
(Please put a cross in one box only)

Very Often Occasionally Seldom
Hardly

often
ever

☐ ☐ ☐ ☐ ☐

3. When you are ill, do you usually go straight away to the doctor, or do you wait to see if you get better?***(Please put a cross in one box only)***

a. Go straight to the doctor………………………. ☐

b. Wait a day or two to see if it gets better……... ☐

c. Wait several days to see if it gets better…….. ☐

d. Put it off as long as possible………………….. ☐

Part 9 - About you

Here are some general questions about yourself.

Please follow the instructions and answer ALL of the following questions.

1. What is your date of birth? ☐☐ / ☐☐ / ☐☐

(For example - If you were born on the 5th June 1936, this would be entered as 05/06/36)

2. Are you:

Female… ☐ Male…. ☐

3. What is your current marital status? ***(Please put a cross in one box only)***

Married ……….. ☐ Widowed……… ☐

Separated …….. ☐ Cohabiting……. ☐

Divorced ………. ☐ Single………… ☐

4. Do you live alone?

Yes...... ☐ No..... ☐

5. What is your current employment status?***(Please put a cross in one box only)***

Employed …………………………………… ☐

Not working due to ill-health or disability … ☐

Retired ………………………………………☐

Unemployed/seeking work …………………☐

Housewife ……………………………………☐

Other …………………………………………☐

5. If working, what is your job title (examples - factory worker, welder, office worker, shop assistant, lawyer)?

.......……………………………………………………………………

If not working, or retired what was your last job title?

………………………………………………………………………..

6. Do you have a spouse or partner who is currently living with you?

Yes…. ☐ No…. ☐

If they are working, what is their job title (examples - factory worker, welder, office worker, shop assistant, lawyer)?

...…………………………………...………………………………

If they are not now working or retired, what was their last job title?

.......…………………………………………………….…………

If you are a widow, or widower, what was your spouse's last job title?

…………………………………………………………………………

8. What is your weight? …..stones ….lbs or ....…kgs

9. What is your height? ……feet ….inches or ...….centimetres

10. What is your current smoking status?

(Please put a cross in one box only)

Never smoked............. ☐

Previously smoked....... ☐

Currently smoking........

11.On average, how often do you drink alcohol***?***
(Please put a cross in one box only)

Daily or most days	Once or twice a week	Once or twice a month	Once or twice a year	Never
☐	☐	☐	☐	☐

12. How old were you when you left school? ……years old

13. Did you go on from school to full-time education or university?

Yes… ☐ If yes, what age did you finish full-time education?…………….

No…..☐

14. Have you gained qualifications through study as an adult ?

Yes......... ☐

No.......... ☐

15. Thinking about the cost of living as it affects you, which of these descriptions best describes your situation:

(Please put a cross in one box only)

Find it a strain to get by from week to week…….. ☐

Have to be careful with money…………….……… ☐

Able to manage without much difficulty…….……… ☐

Quite comfortably off………………………….…… ☐

16. Is your ethnic origin? ***(Please put a cross in one box only)***

White UK/European………… ☐

Afro Caribbean………………. ☐

Chinese………………………. ☐

Asian…………… ☐

African………….. ☐

Other…………….. ☐

Part 10 - About your health

We would like to know if you have any other health problems. Please put a cross in the box if you suffer from any of the listed problems.

1. Do you suffer from any of the following? Please tick any which apply to you. ***(Please put a cross in one box on each line)***

	Yes	No
a. Chest problems…………….........	☐	☐
b. Heart problems…..................……..	☐	☐
c. Deafness……………........……...	☐	☐
d. Problems with eyesight (excluding the need for glasses)...	☐	☐
e. Raised blood pressure…..……..	☐	☐

f. Diabetes……………...…………… ☐ ☐

2. Thinking back over the **past 3 months**, have you suffered from any of the following: ***(Please put a cross in one box on each line)***

Yes No

a. A fall or falls ……......................…… ☐ ☐

b. Difficulty remembering things…. ☐ ☐

c. Cough with spit……...................… ☐ ☐

d. Breathless when walking........... ☐ ☐

e. Dizzyness or unsteadiness....... ☐ ☐

f. Weakness in an arm or leg....... ☐ ☐

3. Please put a cross in the box to show whether you agree (yes box) or disagree (no box) with each of the following statements…..

(Please put a cross in one box on each line)

a. I am confused and start to do more than one thing at a time Yes …. ☐ No….. ☐

b. I have more minor accidents than usual (e.g. I drop things, I trip and fall, or bump into things) Yes …. ☐ No….. ☐

c. I react slowly to things that are said or done Yes …. ☐ No….. ☐

d. I do not finish things that I start Yes …. ☐ No…… ☐

e. I have difficulty reasoning and solving problems (e.g. making plans, making decisions, or learning new things) Yes….. ☐ No….. ☐

f. I sometimes get confused (e.g. I do do not know where I am, who is around, or what day it is) Yes …. ☐ No….. ☐

g. I forget a lot (e.g. things that happened recently, where I put things, or to keep appointments) Yes…. ☐ No….. ☐

h. I do not keep my attention on any activity for long Yes …. ☐ No…… ☐

i. I make mistakes more than usual Yes …. ☐ No…… ☐

j. I have difficulty doing things which involve thought and concentration Yes …. ☐ No…… ☐

4.Thinking back over the **past 4 weeks**, did you?

(Please put a cross in one box on each line)

Not On some

On most

at all nights

nights

a. Have trouble falling asleep ☐ ☐ ☐

☐ ☐ ☐

b. Wake up several times per night

c. Have trouble staying asleep ☐ ☐ ☐

d. Wake up after your usual amount of sleep feeling tired and worn out ☐ ☐ ☐

Thank you for completing Section A.

Please turn to Section B.

Section B

This section is about any pains you may have or any problems with your joints.

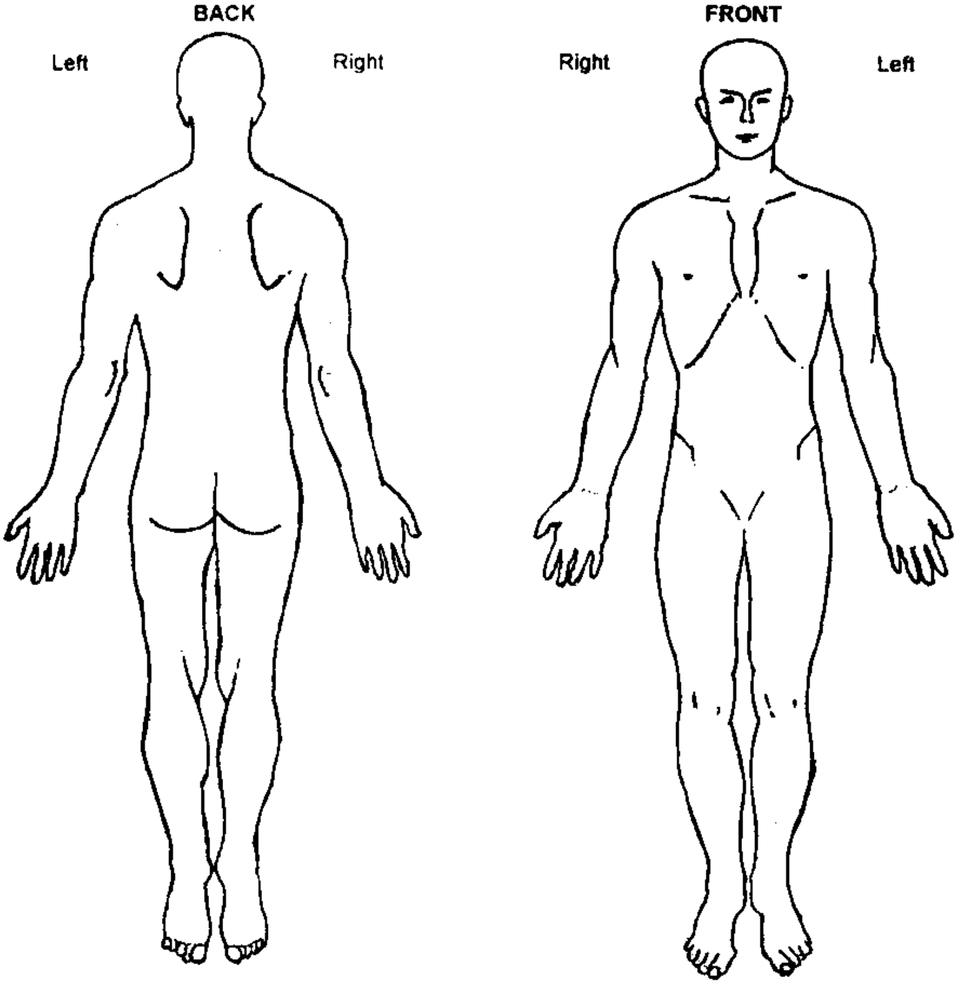
Please fill in all the parts even if you do not suffer from any pains or joint problems.

Please follow the instructions for each part.

Part A – Body Chart

Now we would like to ask about aches and pains. Please shade in the diagram below any ache or pain which has lasted for one day or longer **OVER THE PAST 4 WEEKS.** (Please do not include pain occurring only during the course of feverish illness such as flu).

If you **have not had any** body pain please put a cross in this box. ☐



Please turn over to complete section B.

Part B

We are interested to know how many people suffer from specific joint pains and problems. Please answer each of the following questions about your hands, hips, knees, and feet, even if you do not suffer from any problems.

We would like you to tell us if you have had **any problems** with your **hands**. For this questionnaire **'hand problems'** relate to **any hand**

symptoms you may have experienced; for example, **pain or stiffness**; or any **knobbly swellings** on your hands, including your fingers and thumbs.

1. Have you had any problems with your **HANDS**, including your fingers and thumbs, over the **last year**?
   (Please put a cross in one box only)

   Yes…. ☐ No…. ☐

2. Have you had any pain in your **HANDS**, including your fingers and thumbs, over the **last year**?
   (Please put a cross in one box only)

   Yes…. ☐ No…. ☐

We are also interested in **any problems** you may have with your **legs**. For these questions, please think about problems with your **hip, knee or foot**; for example **pain, stiffness, giving way or locking**.

3. Have you had any problems with your **KNEES**, over the **last year**?
   (Please put a cross in one box only)

   ☐ ☐

Yes….   No….

4. Have you had pain in the last year in and **around the KNEE?**
(Please put a cross in one box only)

Yes…. ☐ No…. ☐

5. Have you had any problems with your **HIPS**, over the **last year**?
(Please put a cross in one box only)

Yes…. ☐ No…. ☐

6. Have you had pain in the last year in and **around the HIP?**

(Please put a cross in one box only)

Yes…. ☐ No…. ☐

7. Have you had any problems with your **FEET**, over the **last year**?
(Please put a cross in one box only)

Yes…. ☐ No…. ☐

8. Have you had pain in the last year in and **around the FOOT?**

(Please put a cross in one box only)

Yes…. ☐ No…. ☐

Part C

It would be helpful if you could tell us about any tablets, pills or creams you use to reduce pain.

1. In the **past 4 weeks**, how often have you taken any medicines for your recent pain?***(Please put a cross in one box on each line)***

	All days	**Most days**	**Some days**	**Few days**	**No days**
a. Prescribed by your Doctor (e.g. paracetamol, aspirin, diclofenac, ibrufen)	☐	☐	☐	☐	☐
b. Bought in a pharmacy (e.g. paracetamol, aspirin ibrufen)	☐	☐	☐	☐	☐
c. Bought elsewhere (e.g. health	☐	☐	☐	☐	☐

food shop, supermarket)

Part D

We would like to know about any problems you may have had doing activities with your hands.

Please put a cross in one box on each line.

During the **past month…**	All days	Most days	Some days	Few days	No days
a. Could you **easily** write with a pen or pencil?	☐	☐	☐	☐	☐
b. Could you **easily** button a shirt or blouse?	☐	☐	☐	☐	☐
c. Could you **easily** turn a key in a lock?	☐	☐	☐	☐	☐
d. Could you **easily** tie a knot or a bow?	☐	☐	☐	☐	☐
e. Could you **easily** open a new jar of food?	☐	☐	☐	☐	☐

Part E

The following items are about activities you might do during a typical day. Does **your health now limit you** in these activities? If so, how much?

(Please put a cross in one box on each line)

	Yes, limited a lot	**Yes, limited a little**	**No, not limited at all**
a. **Vigorous activities**, such as running, lifting heavy objects, participating in strenuous sports……………………………..	☐	☐	☐
b. **Moderate activities** such as moving a table, pushing a vacuum cleaner, bowling, or playing golf…………………………………	☐	☐	☐
c. Lifting or carrying groceries…………………	☐	☐	☐

Yes, **Yes,**
No, not
limited **limited**
limited

	a lot	**a little**	**at all**
d. Climbing **several** flights of stairs……………	☐	☐	☐
e. Climbing **one** flight of stairs………………….	☐	☐	☐
f. Bending, kneeling, or stooping………………	☐	☐	☐
g. Walking **more than a mile**………………….	☐	☐	☐
h. Walking **several blocks**……………………..	☐	☐	☐
i. Walking **one block**……………………………	☐	☐	☐
j. Bathing or dressing yourself…………………	☐	☐	☐

Thank you for completing Section B.

Please turn to Section C.

SECTION C - CONTINUING TO HELP WITH THIS STUDY

Thank you very much for completing this questionnaire.

There will be more stages to this study, and we hope that people who have taken part will be able to help us again.

Would you be willing to be contacted again about the possibility of taking part further in this study? Giving us your permission to contact you again does not mean that you must take part. You are just agreeing to be contacted again.

Yes, I am happy to be contacted again ………… ☐

No, I do not want to be contacted again ……….. ☐

It is important for us to find out what types of treatments and tests people need. We can do this by reviewing medical records.

Would you be willing to give your permission for this? When we review the medical records, your name will not be used so that you will not be identified personally. We can assure you that any information will be held in the **strictest confidence**.

Yes, I give permission for my medical records to be reviewed … ☐

No, I do not want my medical records to be reviewed …………… ☐

Please enter today's date: Day ☐☐ Month ☐☐ Year ☐☐

Even if you have decided not to participate further in this study or would prefer us not to review your records, the answers in this questionnaire will still be very useful to us.

- Please check that you have answered all of the questions.
- Please return this questionnaire in the envelope provided (no stamp needed).
- If you have any questions, telephone Ross Wilkie on 01782 583927.

Thank you for taking the time to fill in this questionnaire.