



Equity in universal health systems: hip arthroplasties as a proxy
measure for access to healthcare in the public sectors of Brazil and
Scotland

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Abstract

Introduction

The central tenets of both the National Health Services of Scotland (NHS) and the Unified Health System of Brazil (SUS) are universality and equity of access to services on the basis of need, free at the point of delivery. Redistribution is designed into the Scottish system. This study uses a mixed methods approach to analyse access to health care and the influence of socioeconomic factors using hip arthroplasty as a proxy measure for equity in the public health care systems of Brazil and Scotland.

Methods

Three studies were conducted to establish the extent to which equity is achieved in each system and the extent to which inequalities in socioeconomic status and health service supply affect equity. First, an ecological study using routine data of hip arthroplasty rates in the public sector by country and geographic region (2009/10 to 2012/13) complemented by an analysis of supply, specifically per capita distribution of beds and staff nationally and by area. Second, inequalities in access due to socioeconomic status were analysed for Scotland using the Scottish Index of Multiple Deprivation (SIMD) in association with standardised rates; in Brazil two socioeconomic indicators (Gini and Human Development Index - HDI) were modelled (Zero Inflated Poisson - ZIP) with standardised municipal rates of arthroplasties (5,565 municipalities); and a Pearson's correlation. Finally, qualitative interviews were undertaken in both countries with civil servants, health workers and policy makers who were invited to comment on the quantitative results from stages I and II based on a script of open ended questions.

Results

There is an almost eight fold difference in treatment rates between Brazil (7.8-8.3/100,000) and Scotland between 2009/10 to 2012/13 (57.7-61.1/100,000). There are geographic differences within both countries. The health board areas with the lowest and highest regional rates in Scotland were Glasgow & Clyde with rates of 29.2-40.2/100,000 and Ayrshire & Arran with a rate of 60.2-88.5/100,000 respectively; in Brazil the lowest and highest regions were the North Region (2.3-4/100,000) and South Region (15.4-17.9/100,000) respectively. The two least deprived quintiles (4 and 5) in the Scottish population had both a higher utilisation (42.6%) and proportional growth in number of procedures than the two more deprived (1 and 2); quintile 3 had no consistent changes. In Brazil municipal rates showed a negative correlation with Gini ($r=-.226$) and a positive correlation with HDI ($r=.396$); the ZIP model demonstrated that for every standard deviation (SD) change in Gini, rates would be 23% higher or lower, for HDI each SD would lower or increase rates by 56%. Three major areas were identified

by interviewees as explanatory factors for these quantitative results: equity of access, health systems, evidence based actions/policies. Crucially the interviewees identified GDP spend on public health care, the ability of governments to redistribute and reallocate resources on the basis of need and the distorting effect of the market and private providers including physicians as key factors; and the need for better data collection from the private sector.

Conclusion

Although both countries aspire to universal health care, Brazil is very far from reaching that goal due to the widespread socioeconomic differences and that the health system does not redistribute resources, staff and beds according to need. Scotland appears to be achieving universal access on the basis of need, nevertheless there are geographic and socioeconomic differences in access that need to be carefully monitored and understood. In Brazil there should be better planning and resource allocation so that public resources are redirected towards those most in need of the North and Northeast regions.

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Capital and labour relate to each other here like money and commodity; the former is the general form of wealth, the other only the substance destined for immediate consumption. Capital's ceaseless striving towards the general form of wealth drives labour beyond the limits of its natural paltriness, and thus creates the material elements for the development of the rich individuality which is as all-sided in its production as in its consumption, and whose labour also therefore appears no longer as labour, but as the full development of activity itself, in which natural necessity in its direct form has disappeared; *because natural need has been replaced by historically produced need*. This is why capital is productive; i.e. an essential relation for the development of the social productive forces. It ceases to exist as such only where the development of these productive forces themselves encounters its barrier in capital itself.

Karl Marx, *in* The Grundrisse (1857)

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List of abbreviations

AIH	Hospital Admission Authorisation (Autorização de Internação Hospitalar)
ANVISA	National Agency of Sanitary Vigilance (Agência Nacional de Vigilância Sanitária)
IDB	Inter-American Development Bank
BMRC	British Medical Research Council
BRICS	Economic Formed by Brazil, Russia, India, China and South Africa
CNES	National Register of Health Establishments (Cadastro Nacional de Serviços de Saúde)
CONITEC	National Committee for Incorporation of Health Technology (Comissão Nacional de Incorporação de Tecnologias em Saúde do SUS)
COX-2	Cyclooxygenase-2
CPT	Current Procedural Terminology
GDP	Gross Domestic Product
GNI	Gross National Income
GP	General Practitioner
HCNA	Healthcare Needs Assessment
HDI	Human Development Index
HIC	High Income Country
HIS	Healthcare Improvement Scotland
HNA	Health Needs Assessment
HTA	Health Technology Assessment
IATS	Institute for Health Technology Assessments (Instituto de Avaliação de Tecnologias em Saúde)
IBGE	Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística)
IMD	Index of Multiple Deprivation
IMF	International Monetary Fund
INAHTA	International Network of Agencies for Health Technology Assessment
INTO	National Orthopaedic Institute (Instituto Nacional de Traumatologia e Ortopedia)
ISD	Information Services Division
LOS	Length of Stay (hospital admission)
LUIC	Length of Uninterrupted Care (hospital care)
LSE	London School of Economics
MoH	Ministry of Health
NHS	National Health System
NICE	National Institute for Health and Care Excellence
NJR	National Joint Registry
NSAID	Non-steroidal Anti-Inflammatory Drugs
OA	Osteoarthritis
OPCS	Office of Population Censures and Surveys
OTA	Office of Technology Assessment
PFI	Private Finance Initiative
PPI	Proton Pump Inhibitor

QMUL	Queen Mary and University of London
RAWP	Resource Allocation Working Party
SAP	Scottish Arthroplasty Product
SBOT	Brazilian Orthopaedics and Traumatology Society (Sociedade Brasileira de Ortopedia e Traumatologia)
SD	Standard Deviation
SHTG	Scottish Health Technologies Group
SIMD	Scottish Index of Multiple Deprivation
SMR01	General/Acute Inpatient Day Case Dataset
SUS	Unified Health System (Sistema Único de Saúde)
THR	Total Hip Replacement
UHC	Universal Health Care
UK	United Kingdom
UMIC	Upper Middle Income Country
UN	United Nations
UNDP	United Nations Development Programme (PNUD - Programa das Nações Unidas para o Desenvolvimento)
US	United States
WHO	World Health Organisation
ZIP	Zero-Inflated Poisson

1.Introduction: right to health, international comparative studies and equity

International comparative studies seek to clarify, explore or draw attention to specific research problems (1); when applied to public health, findings might contribute to the development of policies and improvement of services in the countries involved (2, 3). This study is a mixed methods research of access to healthcare in the public health systems of Brazil and Scotland, using elective primary hip arthroplasty as a proxy measure for equity.

Both the National Health System (NHS) of Scotland and the Unified Health System of Brazil (SUS) aspire to a public universal health system, free at the point of delivery. The goal of universal health care is to improve health outcomes and reduce inequalities in health by distributing resources according to need (4). The motivation for this study is to investigate equity of access to healthcare in the Scottish NHS and the Brazilian SUS from this universal care perspective.

1.1 The right to health

In 1864 the First Geneva Convention laid down the foundations for *international humanitarian law*, developed and approved after the First World War in the beginning of the 20th century through the Treaty of Versailles by the League of Nations. Following the Second World War world leaders approved the *Universal Declaration of Human Rights*, stating principles of brotherhood, equality and freedom for all men in the world (5). Defined as '*a common standard of achievement for all peoples and all nations*' (6), the declaration states basic principles of *universality* and *equality* which are the foundation for public health systems throughout the world. It states that '*everyone has the right to equal access to public service in his country*' (6); how such access is achieved, regulated and legislated vary throughout the world.

In the Scottish NHS the Minister has a 'legal duty to provide care', and is accountable to parliament as a guarantor for universal access to healthcare. In Brazil 'health is a citizen's right and an obligation of the State' inscribed in the New Constitution of 1988 (7); the State is responsible for meeting any health needs and is held legally accountable for provision. Both countries regard health as a right, however each uses different legal frameworks: in Scotland the responsibility rests in one individual, the Minister, in Brazil the responsibility lies within all three layers of the federal state (municipalities, counties and the federal entity) (8). The time gap of 40 years between the Scottish NHS in 1948 and SUS in 1990, explains the theoretical differences of contracts and frameworks for health.

1.2 Universal Health Care (UHC)

The general framework of universal health care originates from theories of social solidarity (9). In many European countries, sharing risks to prevent eventual misfortunes placed citizens as shareholders of a risk pool managed by the State, funded through taxation (10). The decline of the eastern European socialist countries and the rise of capital in democratic systems of western States challenge the equalitarian theories in which UHC and equity in health were originated (11). In the 2000s there has been a theoretical shift from the goal of achieving UHC towards Universal Health **Coverage**, promoted by the World Health Organisation (WHO) (12). The shift is from a social solidarity, and a theoretical framework of mutual help, in which human rights are based, towards a 'protection' from *financial hardship*; where healthcare is a commodity that individuals and families should *be able to afford*. Such change reflects mainstream market economic theories present in developed countries (13).

In low and middle-income nations, including the countries of Latin America, the public provision of health care underwent detrimental structural reforms, favouring private market

provision since the 1970s (14). Such reforms were promoted by international finance institutions following public debt management policies, based on the framework of fiscal austerity measures and cuts in public spending (15). These mechanisms are also at work in Greece, Ireland, Portugal, Spain and Cyprus (16, 17).

Despite the diverse ways of achieving universal health care, most European countries face social inequalities, crucially influencing health indicators, the so-called *social determinants of health* (11, 18). When related to individual health, sharing the same universal health system does not necessarily mean sharing the same opportunities: an individual living in a deprived area of Glasgow (Scotland) has a 12 years shorter life expectancy than one who lives in a wealthy area; although each has access to the NHS (19). The social gradient of health afflicts societies as a whole, what varies from country to country is the 'steepness' of the health gradient, usually following social inequalities (18, 20).

1.3 The Brazilian Health System

The Brazilian democratic State is a federal republic composed of 26 states (regions) and 200 million inhabitants. The modern Brazilian State can be traced back to the 1930s; a military coup in 1964 resulted in major political changes and infra-structure projects influenced by transnational companies. Along the 1980s the dissolution of the military rule, marked by social turmoil, saw the inauguration of a new National Democratic Constitution in 1988 (21). Under the new Constitution the State has responsibility for universal healthcare, which is the legal cornerstone of SUS: a national health system composed by the federal entity (Ministry of Health), county health authorities and local services managed by municipalities (22).

International bodies such as the International Monetary Fund (IMF), the World Bank and the Inter-American Development Bank (IDB) played a major role in the shape of public services with consequences for equity, and access to health and healthcare in the country (23).

Modern social policies started in The *Vargas Era* (1930-1945), the period in which President Getulio Vargas instituted basic worker rights such as minimum wages, right to holidays and maximum working journeys. Vargas was responsible for the first attempt to establish a National Insurance based on the direct contribution of workers through their wages, marking the beginning of state actions aimed at maintaining a national workforce through social policies (24).

Around the 1960s the international capital of multinationals was a decisive influence on the political and administrative agenda of the Brazilian state. More than 10 years after the death of Vargas and its social policies in 1954, the country was in deep economic recession due to the impact of the *Cold War* between the United States (US) and the Union of Soviet Socialist Republics (USSR). In that period, social movements and their public manifestations were seen as *possible communist threats* by conservative politicians. North Americans saw in Latin American countries potential economic and politic allies or, paradoxically, possible enemies (25).

In the public health field there was a considerable expansion in centralised services during the army rule. Several administrative, tributary and finance reforms were implemented in an attempt to cope with the modernization and growing complexity of industrialized urban life, introducing large scale social policies like the unified national *Social Insurance* in the 1960s (26).

In the 1970s, substantive financial resources from taxation were allocated to medical assistance and retirement funds for workers who were enrolled in the National Insurance System. The 1990s saw the establishment of the National Health System (SUS) and a National Institute of Social Security (INSS), responsible for pensions and sickness funds (27).

The end of the military regime in the 1980s was marked by social and political optimism. In 1988 a new constitution was implemented after two years of negotiation in the congress. The right to health and the definition of the Brazilian State as its guarantor was enshrined in the new National Constitution. SUS was, however, only established by the National Law 8080 after the first national democratic election of the new republic, in 1991.

The dream of a self-sufficient and universal public health system was gradually superseded by an aggressive economic inflation; the detachment of the workers contribution from the health national health budget in 1993 further limited funding possibilities. The problem of underfunding remains chronic after twenty years of increasing complexity of budgets, regulations and services. Since its establishment in 1990, expenditure on the public health system SUS remains proportionally the same, around 3.5% of the Gross Domestic Product (GDP); although increasingly complex and bureaucratic (28).

Brazil is nonetheless a federal country: all three levels national, county and municipalities bear responsibilities, levels of taxation and the provision of public services; thus, the allocation of resources within these three layers of state plays an essential part of public management in all sectors, including public health.

1.4 The Scottish National Health System

In the beginning of the 20th century poverty was widespread in the Scottish highlands and islands. The Highlands and Islands Medical Service is a forerunner of NHS Scotland: a state funded, comprehensive and centrally-controlled health service. The first World War hindered the implementation of the recommendations of the report made by Sir John Dewar in 1912, which was that government grants should be paid to doctors to treat those in need, charging low or no out of pocket payments at all. This service is considered as the predecessor of the NHS Scotland.

The inter-war period was marked by the Cathcart report in 1936, which recommended that general practitioners should be at the centre of a national health service. It's a pioneering approach focused on health prevention rather than a disease-treating care pathway. During the World War II an Emergency Hospital Service was established, with seven new hospitals strategically situated as far away as possible from potential bombing targets, more than doubling the number of general hospital beds in Scotland by 1939.

The Beveridge Report, published in 1942 was commissioned 'to undertake, with special reference to inter-relation of the schemes, a survey of the existing national schemes of social insurance and allied services, including workmen's compensation, and to make recommendations' (29). The scale of the report was a surprise; it was the blueprint of a state funded social welfare system, which included a National Health Service for the UK. The NHS was 'officially vested' in the 5th July of 1948, in Scotland it was established by an act passed in 1947; for the first time, Britons would have free access to healthcare and services such as a family doctor, prescription drugs, glasses, dentures and hospital services.

In Scotland prescription charges were enacted in 1952 and abolished only in 2011; general practitioner undergraduate training was established in 1963 and exported as a medical educational model to other countries. The first major reorganisation of NHS Scotland, after its establishment, was in 1972, with the NHS Scotland Act: it was concerned with service integration, the government proposed the implementation of 15 health boards and other bodies, in order to efficiently cope with the rise of demand by the population and the complexity of healthcare services. The act was reviewed in 1974, giving supplementary directives to newly established health boards.

The publication of the Black Report in 1980 (30) drew attention to the social gap in health outcomes in the UK; in Scotland, in 1991 the studies of Carstairs put social deprivation firmly on the public health agenda (31). She demonstrated that neighbouring areas of Glasgow had both the highest and the lowest expectancy of life in Scotland geographically side by side.

In 1989 the United Kingdom (UK) government introduced the internal market into the English NHS in a White Paper, called Working for Patients (32). The paper proposed a purchase-provider split, on the basis that competition improves quality and efficiency of the system as a whole. The newly established NHS trusts had autonomy as service providers and were commissioned by health boards; GP fundholding was inaugurated whereby family doctors could also commission services from trusts based on their allocated budget. In 1992, the Private Finance Initiative (PFI) was launched to speed up the construction of health facilities by removing the funding obligation from the National Treasury.

Throughout the 1990s Scotland researchers, social movements and parts of the government highlighted their discontent with the internal market, PFIs and General Practitioner's (GP) fundholding policies (33). The Scottish White Paper, Designed to Care in 1997 (34), was

intended to phase out the internal market in NHS Scotland and marked an increased differentiation from the English NHS (35). The 'UK Devolution Process' in 1999 gave to each member country of the UK the possibility of pursuing independent public policies through a democratically elected parliament, including decisions regarding the national health system. In 2004 the Scottish National Health Service Reform Act centralised responsibilities, reintegrated services into health board authorities and all NHS trusts were abolished, ending the internal market.

1.5 Brazil, Scotland and healthcare

Health is a Constitutional right in Brazil; to provide health prevention and treatment for individuals and communities is a duty of the state (7). Despite the legal guarantee of access to universal healthcare, the population of 200 million Brazilians has higher health inequalities than most OECD countries (36-38). There has been a gradual and steady increase of the private health sector in Brazil since the 1990s, even during the economic positive period of the 2000s (39-42). The growth of the private sector is a suggestion of possible unmet health needs despite the universal and free for all Unified Health System (SUS). Scotland is a high-income country (HIC) that shares with other United Kingdom members a pioneer health system setting: the autonomous National Health Systems (NHS) of England, Wales, Scotland and Northern Ireland. The Scottish NHS has restricted privatisation of services, although the outsourcing of public provision of health services has been a common trend in the English NHS (43).

Brazil and Scotland are economically distinct: the former is a UMIC (Upper and Middle Income Country) (41), the second is a HIC (High Income Country)(44). Nevertheless historic and socioeconomic discrepancies, life expectancy and health risks vary within and across

geographic locations, as does access to treatment and health technologies. Brazil has larger disparities (36, 45), because of its scale and socioeconomic characteristics.

Compared to Scotland, social rights and welfare were developed late in Brazil (28). The new constitution, known as *The Citizen Constitution* for its social welfare attributes, established in 1988 a universal system of social protection and healthcare, decentralising administrative and legal responsibilities from the federal sphere towards local governments at municipal level (24, 27). Public revenue is mostly tax based, collected in all three layers of the Brazilian state: municipalities, states and federal government. In spite of sharing legal obligations with local authorities, the federal layer keeps most funds retained through taxation and little has changed in real terms of redistribution of resources since the beginning of the 1990s (46). In Brazil the public health agenda (policy making) and funding is settled in the federal bodies, like the Ministry of Health, whilst the municipalities key role is as *policy implementation bodies*, with little space for tailored actions which could follow specific local needs (25).

Brazilian national health expenditure is 9.7% of its GDP, from which 3.9% is public and 5.8% is private (47). Around 26% of the population is covered by healthcare insurance schemes (41). The Brazilian public health system main focus is on Primary Health Care. Prevention programmes such vaccines and low cost treatments, targeted to the poorest regions of urban and rural areas, considerably improved basic health indicators such as malnutrition, life expectancy and child mortality in the past 20 years (22). The Brazilian government shared part of the economic gains of the 2000s with its population through public policies based in socioeconomic development goals. If on the one hand the decentralisation of the federal state towards the municipalities have improved general socioeconomic figures, on the other hand has kept constitutional welfare rights attached to economic stability (48).

In the international setting, when set side by side with other BRICS countries (economic group constituted by Brazil, Russia, India, China and South Africa), Brazil has been a successful case from the socioeconomic perspective. Other BRICS did not necessarily share the results of a growing economy with the population regarding income distribution. Brazil has proportionally lifted from misery more people than any other country of the BRICS (49); however, the Chinese growth was reflected in better health indicators than the Brazilian ones (48).

1.6 Why a comparative and mixed methods study

International comparative studies are described in social sciences as research that study changes in institutions, societies, cultures and systems over time (1). The World Health Organisation states that cross-country comparisons open the possibility of 'learning lessons' in a two way process: avoiding 'prescriptive reforms' as simplistic solutions for the health systems issues of access and equity, and giving evidence of successful initiatives to policy making processes without the need of 'experimentation' (3). This study takes both perspectives. It aims to understand how access to healthcare changes overtime in relation to socioeconomic variables and also how such changes are reflected or produced in/by the 'real world' of public health sectors of Brazil and Scotland. The rationale methods and research questions are explored in Chapter 2.

Comparative studies are characterised by a meticulous establishment of stages, starting with the selection of the object of inquiry; progressing towards research questions and finally choosing the comparators (variables) and units of analysis (50). The object of inquiry here is access to healthcare and equity and the comparators are elective primary hip arthroplasties and socioeconomics; the units of analysis are nations, in this case Brazil and Scotland.

Broad international comparisons involving quality and efficiency services indicators search for the improvement of health systems through flagging lower performance areas (51). It would be to oversimplify the complex issue of access and equity to healthcare by pairing rates between a high income country (HIC) like Scotland and an upper middle income country (UMIC) like Brazil¹. Large differences are expected when rates of elective arthroplasty are used as a marker for healthcare access (52); a mixed methods methodology can overcome the blunt difference of treatment rates between the two countries chosen for this research.

Linda Hantrais (1), is one of the few authors analysing international comparative research methodology. She comments on the well-known epistemological battle between quantitative and qualitative scientists: on one side, quantitative researchers praise their methods for being replicable, systematic and reliable, whilst considering qualitative research unrepresentative, untypical, ideological and subjective; qualitative scientists generally consider quantitative research as reductionist, not representative of the 'real world' and that it reifies social reality. This work brings together quantitative and qualitative, in order to try to avoid the pitfalls pointed at by critics, on either side.

Combining quantitative methods with qualitative research will enable us to understand the complexities involved in 'access to' and 'equity of' health and healthcare. The first will aid to explore and diagnose the size of the problem – or the gap – involving differences of treatment rates between Brazil and Scotland, and also within its regions; whilst the latter will bring the reality of the public health sector, constrained by economic reasoning. The *mixed methods*

¹ The Organisation for Economic Co-operation and Development (OECD) and the World Bank threshold is somewhat general for the UMIC category: countries with consistent socioeconomic differences like Mexico, Algeria, China, Botswana and Angola fall in the same classification. The OECD and World Bank international classification of countries is based on the Gross National Income (GNI) per capita: Low income country – LIC (\$1,045 or less); Lower middle-income country – LMIC (\$1,046 - \$4,125); Upper middle-income country – UMIC (\$4,126 - \$12,735); High income country – HIC (\$12,736 or more).

explanatory sequential design proposed by Creswell (53-55) is adopted by this research and fully explored in the methods section (Chapter 2).

1.7 Why elective primary hip arthroplasties are a good proxy for equity in healthcare

It is generally accepted that residents of geographic areas with low socioeconomic indicators tend to present higher health needs and, controversially, lower levels of access to health and healthcare than residents of more economically affluent regions (56); this phenomena is part of the socioeconomic health gradient and has been explored in the social determinants of health field (18, 57). Access and waiting times for elective procedures with high effectiveness rates such as cataracts, electronic heart implants, hip and knee arthroplasties have been used by a broad range of macro-level studies of access and equity to healthcare, highlighting and reinforcing the socioeconomic health gradient hypothesis (58-62). These procedures are specially sensitive to socioeconomic inequalities, highlighting differences of access to treatment in diverse health systems settings (56, 61, 63).

A major theoretical discussion in the health equity studies field concern which research methods are most appropriate for cross-country comparative studies (3, 51, 62). Issues such as data availability and differences in nature and quality of services are among the challenges for researchers (2). Elective primary hip arthroplasties are a good equity measure for healthcare access in the cases of macro-level country comparison studies because of some specific characteristics:

I. Need: the vast majority of cases of need for an elective primary hip arthroplasty are associated with worsened chronic osteoarthritis, which is a chronic condition that is highly prevalent in the western population over 40 years of age (64).

II. Effectiveness: the surgical procedure present a high rate of success, with positive outcomes associated with earlier interventions, comorbidities and socioeconomic conditions at individual level (65).

III. Data: there are available and reliable data about the utilisation of the procedure in Brazil and Scotland to establish a comparison of rates, socioeconomic factors and public healthcare services offer, all relevant to equity in health.

IV. Health System: both public health and legal systems of Brazil and Scotland consider that access to health and healthcare is a right of its citizens (7, 35), thus both NHS and SUS should offer similar access to healthcare despite socioeconomic regional characteristics.

V. Proxy measure: international medical standards for surgery procedures as elective primary hip arthroplasties allow comparisons (66), despite the socioeconomic differences between Brazil and Scotland.

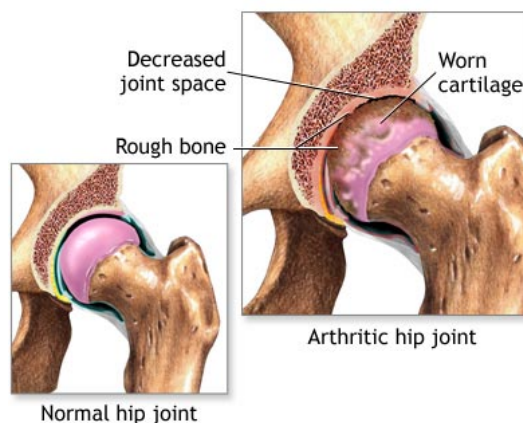
Specifically regarding Osteoarthritis and its close relationship with increased in need for elective primary hip arthroplasty, it is necessary to highlight that the disease prevalence and severity of symptoms tend also to follow socioeconomic differences (64). When compared to the less socially deprived, Individuals of socially deprived areas tend to be more involved in work related physical effort, later work retirement and to be more exposed to other conditions that may aggravate initial mild symptoms such as joint pain and stiffness (67). This relationship is explored in the next section of this chapter.

1.8 Osteoarthritis and elective primary hip arthroplasties

Osteoarthritis (OA) is a musculoskeletal chronic condition, and tends to be highly prevalent in the population over 40 years old, with increasing acuteness of symptoms overtime; ultimately leading to decreased physical mobility, joint stiffness and acute pain. Joint pain is culturally understood as an age related phenomena, which decreases the individual likeness of seeking medical help in earlier stages of chronic OA. In healthy persons the cartilage and the synovial liquid lubricate articulations, making physical movements possible and smooth. Although any articulation might be affected by OA, most cases are related to hands, knees, hips and cervical/lower back vertebrae; acute painful symptoms are most commonly associated to knees and hips (64, 68, 69).

The inflammation process is an organic attempt to heal the affected area, activating immune mechanisms (pro-inflammatory mediators) like prostaglandins and cytokines, followed by tissue destruction interposed by proteases. Initially pain symptoms were associated with the loss of cartilage, however cartilaginous tissue are avascular and do not have neural connections which can mediate pain. The pain mediation has been ultimately related to synovitis and bone marrow lesions, highlighting complex issues around individual pain perception; entailing individual experience and other factors hardly taken into account by classic medical assessment (64, 67, 69, 70).

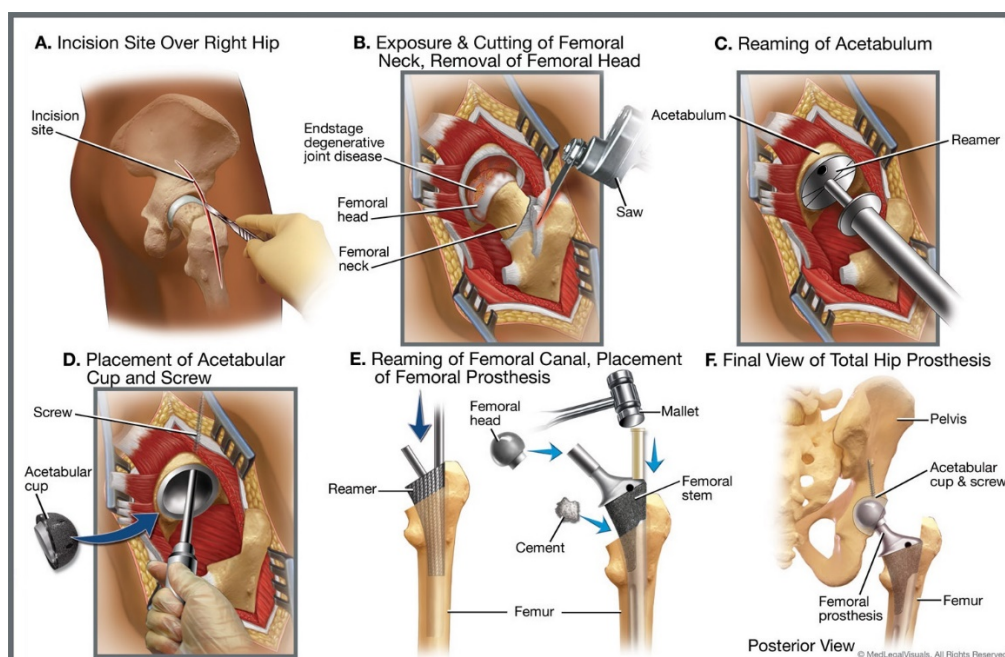
Figure 1.1 Osteoarthritis of the Hip



Source: Adapted from Health Central (69).

One in every ten new appointments with GPs in England are for musculoskeletal conditions. Of these no less than one in five are due to the knee or hip joint. It is estimated that around 8.5 million people in the UK suffer with joint pain and other symptoms compatible with OA. Nevertheless this population is not necessarily diagnosed or under medical care. The National Institute for Health and Care Excellence (NICE) recommendations for OA treatment range in earlier stages from over-the-counter painkillers (i.e. paracetamol) combined with topical non-steroidal anti-inflammatory drugs (NSAIDs); in case of no pain improvement, systemic NSAIDs, cyclooxygenase-2 (COX-2) inhibitors (in conjunction with a proton pump inhibitor – PPI) and intra-articular injections for specific cases (64, 67).

Figure 1.2 Elective primary hip arthroplasty



Source: Adapted from MedLegalVisuals©.

The focus of this research, however, is on later stages of OA and the treatment of patients refractory to pharmaceutical and alternative interventions. The acute phase is acknowledged as *Final Stages of OA* and usually occurs after 15-20 years from the first symptoms of mild joint pain, although this will vary from individual to individual as early interventions have a better success rate. The elective primary hip arthroplasty consists of removing the surfaces of affected joints, replacing them with synthetic materials like metal, ceramic and/or plastic; allowing the individual to return to daily activities and sports practices like golf, swimming, tennis or even running for younger patients, usually with less pre-operative comorbidities. Various surgical approaches, prosthesis models and fixation techniques will not be taken into account in this analysis; what is evaluated here is the access to *state-of-the-art* care and not its outcomes, which is another branch of the scientific literature pertaining to medical sciences. It is also necessary to highlight that although OA is the most common reason for the clinical indication of elective primary hip arthroplasty, accounting for around 85% of

individuals undergoing the procedure, it is not the only one; other reasons include accidents, bone fractures, rheumatoid and inflammatory arthritis (71-73) .

1.9 Osteoarthritis care in Brazil and Scotland

The burden of OA in Latin America and in Brazil is unknown, in Scotland data from NHS Scotland indicate around 86,000 GP appointments related to the disease in the last financial year (2015/16); the World Health Organisation (WHO) estimates a prevalence of 1% of the world's population (74, 75).

The Ministry of Health of Brazil offers clinical guidelines for OA care based in preventive care and in the primary care network of SUS, Conitec is about to release an updated Clinical Care Protocol in 2017; the Brazilian Society of Family and Community Medicine offers the translation to Portuguese of international guidelines for clinicians (76). NHS Scotland instructs General Practitioners (GPs) to follow the National Institute for Health and Care Excellence (NICE) Clinical Guideline 177 (CG177) or updated versions for specific issues (i.e. early age patients with osteoarthritis) in the Scottish Intercollegiate Guidelines Network (SIGN) website (77).

Both, NHS Scotland and SUS health systems use referrals throughout different levels of care and the primary care is the main 'entrance' point to access the system, however Accident & Emergency units can also act as access points referring individuals to other levels of care; although challenging, when centred in primary care the relationship between different levels of the system is more effective in the management of chronic diseases such as OA (78, 79).

The Brazilian SUS has been progressively transformed by the implementation of a Family Health Programme based on the national expansion of primary care (80), with direct impact

on basic health indicators such as infant mortality and preventive care coverage (41, 81). After expanding the number of SUS Basic Health Units to more than 38,000 nationally and accounting for more than 600,000 healthcare workers, the Brazilian Ministry of Health focused from 2011 in the improvement of quality of health services (82). The main policy tool for the improvement in quality of SUS is the Programme of Improvement in the Quality of Access to Basic Health or PMAQ; the programme has positive impacts in oral health, management of chronic diseases and expands a citizen-centred approach to preventive care (83-86).

The comparison between the health systems of Brazil and Scotland is relevant as equity of care is a cornerstone for both countries, however due to the specific economic and historic contexts NHS Scotland and SUS are at different stages of priorities and development. This work aims to elucidate some of these issues and propose alternatives to both health systems in increasing equity and access to health and healthcare.

2. Comprehensive review of the literature: a framework of analysis covering equity, healthcare needs and health technology assessments

This research will analyse access to universal healthcare funded and provided by the public sector in Brazil and Scotland using rates of utilisation of elective hip arthroplasties as a proxy measure of equity. The aim is to analyse whether access is equitable within geographic regions, and to look for explanatory variables for inequalities in both countries, if these are present.

This chapter builds a theoretical framework around the theme of equity and access to healthcare. The review has three stages, as follows:

I. An update of a previous review of studies relating equity and elective hip arthroplasties (58), highlighting findings and methods. The review looks at how these studies measured equity in health systems using arthroplasties as a proxy measure, and the strengths and limitations of the approach.

II. This chapter explores the concepts of *needs*, *needs assessment* and the origins, changes and theoretic influences of defining individual and collective needs, which are fundamental for the endeavour of assessing social equity of access in healthcare. This stage scrutinises the political, sociological and economic effects that were decisive in shaping these concepts over the past 40 years, influencing equity of access to healthcare. In exploring *need*, this stage aims to provide a theoretical base for the investigation of Chapter 5.

III. Economic constraints linked with inequalities of access to healthcare and *need* lead to the third and final stage of this literature review: health technology assessments (HTAs). The sociological, political and economic conundrum underpinning universal health systems after the 1980s demanded evidence-based methods that could be used as decision tools by policy-

makers, with the ultimate aim of making the most of scarce resources. HTAs have been widely used from the 2000s, providing policy-makers and other social actors with evidence-based information for decision-making, aspiring to maximise resources. The literature review of HTAs complements the review of *needs* in healthcare, also contributing to establish theoretical boundaries for the qualitative investigation of Chapter 5.

2.1 Comprehensive review of studies investigating equity in access to hip arthroplasties

Findings and summary of this section at a glance
<ul style="list-style-type: none"> ✦ This is an update of a previous literature review performed in 2005, with the same search terms; ✦ There is an increase in studies utilising elective primary hip arthroplasties as a proxy measure for equity in healthcare; ✦ Osteoarthritis is the major clinical reason for undergoing an elective hip primary arthroplasty; ✦ 51 studies were included in this review of equity of access to elective primary hip arthroplasties, of which 16 investigated utilisation of the procedure, 6 looked at the need for the procedure, 14 about the outcomes after the procedure, 3 considered social inequalities and 12 privileged the socioeconomic conditions to access the procedure; ✦ There are no studies on Brazil or its health system; ✦ Rates of elective primary hip arthroplasties are a good indicator for equity in healthcare when associated with socioeconomic variables; ✦ Statistics and research designs used for investigations vary following data availability and the local health system setting ✦ Socioeconomic variables include: age, gender, rurality, deprivation (or economic status), ethnicity (or race) ✦ How to estimate the need of individuals for undergoing elective primary hip arthroplasty remains a limitation of most studies

Ecological public health studies that involve variables relevant to equity in healthcare present a wide variety of research methods (87, 88). Depending on the kind of research problem, objectives and data available, scientists will make choices regarding the most adequate methods to their investigations (53, 89).

A previous study was performed by Judge and reviewed the possibilities of using elective primary hip arthroplasties as a proxy for equity, highlighting main findings of the international literature on the theme in 2005 (58); it had identified an increase in studies using utilisation of hip and knee arthroplasties as an equity measure in healthcare, classifying studies as of *provision* of the procedure, *need* for the procedure and, finally of *inequities of access* to

hip/knee arthroplasties. The aim of this section is to update this previous work from 2005. It is proposed a review of the literature on **equity in access to hip and knee arthroplasties from January 2006 until July 2013.**

Key findings of this previous work are summarised in Tables 2.1, 2.2 and 2.3.

Table 2.1 Key Findings of Judge literature Review – Provision

Category	Key Findings – Judge, 2008	
Inequalities – arthroplasty provision only (19 studies)	Hip	Knee
	<p>Age</p> <ul style="list-style-type: none"> - Rates increase with age up to 80 years old - Rates decrease in those aged 80–84, falling dramatically in over-85s - Effect of age is consistent in both sexes and all ethnic groups <p>Sex</p> <ul style="list-style-type: none"> - Women aged 65 or more tend to present higher rates than men - Younger groups up to 45–49, rates tend to be similar; the gender gap tends to increase in the over-50s <p>Socioeconomic Status</p> <ul style="list-style-type: none"> - Richer, better educated tend to present higher rates <p>Ethnicity (UK) or Race (US)</p> <ul style="list-style-type: none"> - Only US studies explored racial differences in rates - White Americans tend to present higher rates, increasing with age - Younger groups tend to present similar rates <p>Rurality</p> <ul style="list-style-type: none"> - Higher rates in rural areas (only three studies) <p>Geography</p> <ul style="list-style-type: none"> - Rates tend to vary geographically, with higher variations in older age groups 	<p>Age</p> <ul style="list-style-type: none"> - Rates increase with age up to 80 years old - Rates decrease in those aged 80–84, falling dramatically in over-85s - Effect of age is consistent in both sexes and all ethnic groups <p>Sex</p> <ul style="list-style-type: none"> - Women aged 65 or more tend to present higher rates than men - Younger groups up to 45–49, rates tend to be similar - In those aged 85+ there is no difference - Effect of gender varies with ethnicity <p>Socioeconomic Status</p> <ul style="list-style-type: none"> - Increasing rates with decreasing deprivation (only one study) <p>Ethnicity (UK) or Race (US)</p> <ul style="list-style-type: none"> - Rates vary following gender and ethnicity - Among women higher rates than Hispanic and blacks, higher gap between man (White and Black) - Higher income areas have lower racial gap <p>Rurality</p> <ul style="list-style-type: none"> - No studies found <p>Geography</p> <ul style="list-style-type: none"> - Rates tend to vary geographically, with higher variations in older age groups (demonstrated only in the US and Canada)
<p style="text-align: center;">Limitations of Studies in this category</p> <ul style="list-style-type: none"> - Defining an eligibility criteria to include certain joint replacements in the analysis (most studies include all, other studies exclude fractures, RA, infectious diseases and cancer; or only include replacements with OA diagnosis) - Differences in inclusion criteria might explain variations of findings - Limitations of datasets - Some studies related findings with only one variable (e.g. age) - Completeness and accuracy of routine data - Weak statistical methods only relating geography and utilisation - Main limitation of all studies is considering inequalities only in provision, not considering need 		

Table 2.2 Key Findings of Judge literature review – Need

Category	Key Findings – Judge, 2008
Inequalities – arthroplasty need only (5 studies)	<p>Wilcock (1979) – Early Study</p> <ul style="list-style-type: none"> - First to relate severity of symptoms and need for surgery - Survey with 828 subjects (over-65s) in Oxfordshire - 46 in need of hip operation (5.6%) 34 women, 12 men - 80 in need of knee operation (9.7%)
	<p>North Yorkshire Studies</p> <ul style="list-style-type: none"> - Aimed to determine need for hip and knee arthroplasty for 55 years and over - Postal questionnaires with a cut-off point to determine need using the index of severity of Lequesne
	<p>Somerset and Avon Survey of Health (SASH)</p> <ul style="list-style-type: none"> - Aimed to determine need for hip and knee arthroplasty for 35 years and over - New Zealand score criteria by post and clinical examination of those in possible need - Radiography taken for further examination
	<p>Wiltshire and Sheffield Studies</p> <ul style="list-style-type: none"> - Survey to determine need for hip and knee arthroplasty for 65 years and over with further sociodemographic variables - Need determined by the index of severity of Lequesne
	<p>Assessment of Need in Ontario, Canada</p> <ul style="list-style-type: none"> - Survey to determine need for hip and knee arthroplasty for 55 years and over - Need determined by the Western Ontario and McMaster Universities Osteoarthritis Index - Post questionnaires and clinical examination of sample - Estimate of need for total joint arthroplasty varied between 28.5/1000 to 36.2/1000
	<p style="text-align: center;">Limitations of Studies in this Category</p> <ul style="list-style-type: none"> - Different ways of assessing the severity of joint disease - Arbitrary 'cut-off' to determine need, meaning that different choices will have different estimates of need - Population-based studies in small geographic areas, however need may vary across geographical areas

The main criticism Judge (58) makes in his review is the lack of a relationship between utilisation rates and estimates of need for hip/knee arthroplasty. The review found that waiting times were the statistically weakest proxy of need, producing highly biased results due to the limitations in research methods. The most successful analyses are those which used population-based studies to identify those in need and then looked at differences between socioeconomic groups. The limitation of such studies is the size of the sample, which is usually a local group, hindering the generalisation of results.

Table 2.3 Key Findings of Judge literature review – Inequity

Category	Key Findings – Judge, 2008
Inequities related to access to arthroplasties (15 studies)	<p style="text-align: center;">Early Research</p> <ul style="list-style-type: none"> - Evidence of inequity of access to hip replacement using readily available routine data - GP consultations for osteoarthritis higher in areas occupied by lower social classes whilst hip operations more commonly performed in more affluent areas
	<p style="text-align: center;">Method I</p> <p style="text-align: center;">Examine inequity by identifying those in need of and relating to provision of services(67, 68, 73-76) surgery-</p> <ul style="list-style-type: none"> - Need increases with age - Need is greater in women over 75 than men - Rate of need of knee replacement falls by half after excluding those unfit for surgery - Rural areas had similar need to urban areas - Women are more likely to receive a joint replacement - Overall rates of provision are three times lower than need - Deprived people more likely to need knee replacement; however, less likely to receive it <p style="text-align: center;">Limitations</p> <ul style="list-style-type: none"> - Statistically weak studies; most do not consider socioeconomic factors, mainly accounting for age only
	<p style="text-align: center;">Method II</p> <p style="text-align: center;">Studies adjusting for measure of disease severity when assessing inequalities in provision(65, 66, 71, 72, 77, 78)</p> <ul style="list-style-type: none"> - Similar provision when considering disease severity between African American and white patients (two small cohorts) - Age is probably the main factor affecting utilisation - Increasing disease severity positively associated with age - In the UK National Health Service (NHS) the probability of receiving treatment was conditioned to the severity of the disease only and not by other factors <p style="text-align: center;">Limitations</p> <ul style="list-style-type: none"> - Population used in the studies not representative of the general population
	<p style="text-align: center;">Method III</p> <p style="text-align: center;">Studies looking at inequity in patients on the waiting list for joint replacement(79-82)</p> <ul style="list-style-type: none"> - In England those who rented their houses waited longer than home owners - In Canada those living in rural areas had shorter waiting times than those living in urban areas - Age not associated with waiting times(83, 84) - Over-80s had shorter waiting times(85) - No gender differences(86, 87) - Women had shorter waiting times(83) or had greater priority(85) <p style="text-align: center;">Limitations</p> <ul style="list-style-type: none"> - Conflicting findings, showing no agreement in research methods

2.1.1 Methodology

On the 22nd July 2013 an electronic search was conducted in the PubMed database and the Queen Mary Library Search tool using combinations and synonyms of the following terms for the title, subject, abstract and body of the text:

Table 2.4 Search Terms

Category	Search Terms	
Primary Hip/Knee Arthroplasty	- Arthroplasty - Replacement, Knee - Hip Joint - Knee Prosthesis - Knee Joint	- Hip Prosthesis - Arthroplasty, Replacement, Hip - Osteoarthritis, Hip - Osteoarthritis, Knee
Access to Healthcare, Inequity/Inequalities, Rates of Treatment and Routine Data	- Health Services Accessibility - Health Services Needs and Demand - Healthcare Reform - Delivery of Health Care - Health Planning - Health Policy - Social Class - Ethnic Groups - Minority Groups	- Health Services - Treatment Rates - International Comparison - Universal Health System - Distribution - Access to Healthcare - Routine Data - Distribution of Prosthesis - Planning - Need

The search was limited to English language studies. The references were imported to the EndNoteX5 Reference Manager Software, to be organised. After removing duplicates this review selected 3,332 studies.

I. Excluding studies from before January 2006

All references dated before January 2006 were excluded. This first stage was established with the aim of updating the previous research by Judge, which was performed in 16 December 2005.

From the initial number of 3,332 references, at this stage 1,336 references were excluded, leaving 1,996 (produced between Jan/2006 - Jul/2013) to be considered in the next stages.

II. Excluding articles based on abstracts

Each reference was assessed for relevance, based on the abstract. The aim at this stage was to take an inclusive approach, selecting any article that potentially examined inequalities in either the need for, or the provision of, hip and knee arthroplasties, as well as those examining

inequity in access to treatment. A coding system was developed to explain the reason why most references were excluded at this stage:

Table 2.5 Exclusion criteria based on abstract

Exclusion criteria	About	References
1. Disease Burden	Burden or severity of diseases for which the treatment is a hip/knee arthroplasty; treatment of osteoarthritis	65
2. Best Practice	Best practices or standards for hip/knee replacement surgery/procedure	27
3. Case Reports	Report of cases which had to deal with specific comorbidities or conditions affecting hip/knee arthroplasty – before, during or after the intervention	35
4. Costs or Reimbursement	Costs related to hip/knee arthroplasty; reimbursement and insurance systems	60
5. Surgical Approaches	Differences in approaches to hip/knee arthroplasties; diverse surgical approaches, methods and prosthesis	116
6. Education	Education of patients or health personnel related to hip/knee arthroplasty – before, during or after the intervention	15
7. Exercise	Analysis of the use of exercises before or after hip/knee arthroplasty	29
8. Infection	Analysis of/research in respect of infection sites (surgical wounds/prosthesis) in hip/knee arthroplasty	90
9. Literature or Systematic Reviews	Reviews of the literature about hip/knee replacement, systematic or not	23
10. Nursing Issues	Nursing issues related to hip/knee arthroplasty	16
11. Other Procedures	Procedures/interventions/subjects other than hip/knee arthroplasty which were gathered through the systematic electronic search	548
12. Provision	Provision of hip/knee replacement, analysing a broad variety of subjects other than equity such as: discharge of patients; kinds of implants; orthopaedic surgical navigation systems; surgical techniques; analysis of bone shapes, etc.	653
13. Risk of Indication	Risks which can lead to a clinical indication of hip/knee arthroplasty, such as obesity, age, fractures, body mass, bone necrosis, etc.	38
14. Technology Evaluation and Registers	Hip/knee replacement technology evaluations and/or national joint replacement registry systems adopted by some countries	30
15. Waiting Lists and Time to Access the Procedure	Issue of waiting times and lists (management/fairness); discussion of priority criteria for receiving a knee/hip arthroplasty	27
16. Other	All studies that were about hip/knee replacement but that did not match any of the criteria above	144

This stage involved the classification and exclusion of 1,916 studies, leaving 80 studies for the analytical stage of this literature review.

III. Examining articles based on abstracts alone

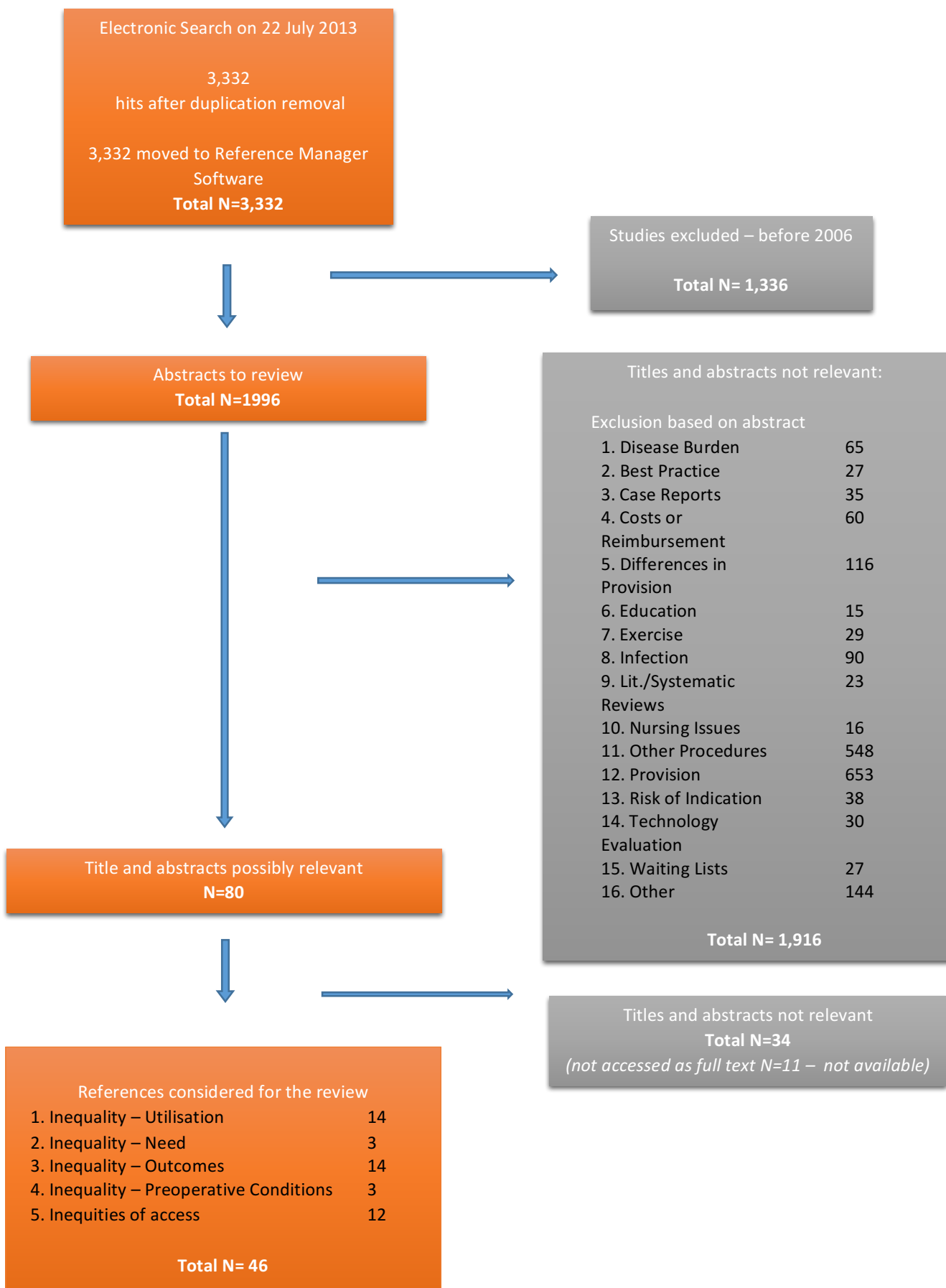
This stage consisted of a detailed analysis of the full text of each of the 80 remaining articles, excluding studies that would not be considered as an equity analyses of access to hip/knee arthroplasty. 29 references were discarded at this stage (including 11 which were not available through library loan or electronic download), leaving 51 articles to be considered by this review.

2.1.2 Limitations of this review

The electronic search was based only in two scientific databases (PubMed and the QMUL Library Search Tool) and grey literature was not considered. Ideally, a multiplicity of databases (Embase, ISI, Web of Science, Google Scholar) and languages, along with the inclusion of grey literature, would compose a more robust review.

The whole process was performed by one researcher only (Jonathan Filippon), limiting the scope of its analysis. Due to budget limitations there was no spending provision to hire an independent adviser. Under ideal circumstances, an adviser would classify randomly some of the chosen studies using the same definitions as the primary researcher and achieve similar results selecting references, thus highlighting cases of doubtful classification.

2.1.3 Quorum Statement



2.1.4 Results

Of the 46 articles selected, 29 considered hip and knee arthroplasties together (frequently mentioned as *major joint replacements*); seven references were just about hip arthroplasties; four references were just about knee arthroplasties; and, finally, there were six references which considered hip and knee arthroplasties together with other surgical interventions (cataract or spinal surgery for example). In contrast, Judge's previous review included only 19 studies from 1,329 hits using similar terms and methodology.

The 46 studies were further classified under five categories. The concepts of inequity and inequality, as proposed by Whitehead (86), were used to differentiate between studies measuring access to healthcare based on inequalities (unavoidable) or inequities (avoidable). Whitehead states that *inequality* is the perception of something unequal, diversely distributed; whereas *inequity* is within inequality, but implies an unfair distribution, and embeds ethical and moral concepts of social justice.

Table 2.6 Studies selected for analysis

Classification	Number of Studies
1. Inequalities in Utilisation	14
2. Inequalities in Need	3
3. Inequalities in Outcomes	14
4. Inequalities in Preoperative Conditions	3
5. Inequities of Access	12

I. Inequality in utilisation of elective primary hip and knee arthroplasty

Studies placed in this category looked at the distribution of hip and knee arthroplasties by age, gender, ethnicity and geographical location. The concern of such studies is the rate distribution of procedures throughout a defined population based on a specific variable.

Two studies analysed the variation in Nordic countries (90, 91), describing an increase of 67% in primary total hip replacement (THR) in Finland, reaching a rate of 112 procedures per 100,000 people, bearing considerable differences in the kinds of implants used. Francis et al. (92) have shown that the rural population in the US is more likely to undergo a wide range of procedures, including total knee replacement (TKR), with 30% more likelihood of doing so than the non-rural population.

Judge (59) and Dixon (93) used the UK Hospital Episode Statistics (HES) database and showed a geographic variation rate of 25%–30% between English counties for both THR and TKR. Culliford et al. (94) dismissed the hypothesis that the mean age for TKR was decreasing over time in the UK (data from 1991–2006); however, the body mass index of patients undergoing TKR was greater than for those undergoing THR.

II. Inequality in the need for elective primary hip or knee arthroplasty

There were six studies analysing the need for THR and TKR, from these, two showed a decrease in the need for large joint arthroplasties in patients with rheumatoid arthritis (95, 96). Their findings highlight that an advance in early diagnosis and intervention increased efficiency of treatment specifically for rheumatoid conditions, which are different from osteoarthritis characteristics. The large share of joint arthroplasty surgeries performed globally (more than 80% on average) are related to osteoarthritis – a chronic condition which tends to increase with age. There were no studies of inequality in the need for THR or TKR related to osteoarthritis. **The study by Piano (97) was the only recent study found by this review that related trends in arthroplasties to a Brazilian population;** it registered the decrease in need of arthroplasty in a cohort of individuals suffering from rheumatoid arthritis.

Studies placed in this category looked for variables to explain why THR and TKR tend to be unequally distributed across a population regarding the need for the procedure. Judge et al. (98) contributed with one study of the need for THR/TKR: their work described how to estimate needs for hip and knee arthroplasties at local level. By crossing the estimates of need with utilisation rates this study showed evidence of inequities of access to healthcare among the English population when using the NHS.

Steel et al. (99, 100) estimated need for THR and TKR, showing that the population of the north of England, women, less wealthy, black, African Americans and less educated experienced high levels of need but did not have more access to arthroplasties in the UK and the US than other parts of the population which presented less need.

III. Inequality in clinical outcomes of elective primary hip or knee arthroplasty

Three studies were dedicated to the surgery outcomes of hip or knee arthroplasty in a defined population and one considered only TKR. Peltola et al. (91) highlighted the importance of national registers for evaluating the quality and cost of healthcare in THR and TKR. Pai et al. (101) used a small sample to demonstrate that Maori patients in New Zealand have more comorbidities before undergoing THR/TKR when compared with the white population. However, length of hospital stay and complication rates were not significantly different. Lavernia et al. (102) showed that African Americans have not just worse preoperative conditions, they also present lower scores of patient-perceived outcomes after the procedure (well-being, pain, and function).

Ten studies looked at the outcomes of THR and TKR associated with socioeconomic disparities. Some of these considered outcome and access to healthcare concomitantly. One

study discussed the influence of socioeconomic status on the outcomes of large joint replacements as a statistical variable (103).

Hollowell et al. (104) suggested that healthier patients are being chosen for surgery through a differential selection in the care pathway and stated that hospitals serving deprived communities should receive more funds for the same procedures as their patients tend to stay longer on a ward. Cookson and Laudicella (60) demonstrated that age and comorbidities are the strongest variables associated with a prolonged stay in hospital when considering large joint arthroplasties.

Insurance type was considered by some American studies, showing that publicly insured patients tend to be older, wait longer for the procedure and have more comorbidities than their private counterparts (105-108). Among elderly Medicare beneficiaries undergoing TKR, African American patients were more likely to be admitted in hospital with higher risk postoperative rates of complications and mortality than the Caucasian population (109).

Just one study was based in more than one country (110). This study showed that deprivation was associated with need for TKR but did not influence the outcomes – again, the worst outcomes were strongly associated with self-reported health assessments (111).

IV. Inequality in preoperative conditions before undergoing elective primary hip or knee arthroplasty

Preoperative clinical conditions are directly associated with income distribution, as people from deprived areas tend to undergo arthroplasty at a later stage of the disease (112) and travel further to access orthopaedic healthcare services (113). African American and Hispanic patients tend to have lower hip and knee function scores in the US (114).

V. Inequity of access elective primary hip or knee arthroplasty by the population

There were 11 studies which were specifically about inequity in the provision of THR and TKR. These used a broad range of methods to approach the theme, leading to diverse conclusions about access to healthcare.

The study by Cooper et al. (115) concludes that the health policy reforms in the English NHS in the 2000s did not harm the equity of the system. The study suggest that the health system actually improved its capacity by reducing waiting times for THR and TKR; and that social gaps were eventually reduced across the diverse income groups in England. Judge et al. had shown that healthcare access inequities persist for hip and knee arthroplasties in England if need for the procedure is locally estimated (59).

Most studies based in the US evaluate the effect which diverse kinds of social health insurance and an ambiguous relation with the private sector have on access to arthroplasties. Lavernia et al. (116) presented two hypothetical situations regarding trying to arrange appointments for orthopaedic surgeries in South Florida: a patient insured by Medicaid and another insured by a private company. All offices offered an appointment to patients with private insurance; however only 14.3% offered an appointment for Medicaid patients – with a longer mean waiting time until appointment. Disparities were not found between different kinds of health insurance, but when residence and comorbidities were considered, inequities were highlighted in THR and TKR (117). Medicare is the main primary payer for the population after age 65 , however rates for this population are lower for blacks versus Caucasians (118) and higher for communities in rural areas as against urban regions (119).

Social deprivation was associated with less orthopaedic consultations (120) and with lower replacement rates in the indigenous population and in the population in remote areas of

Australia (93). Brennan (121) highlighted the need for further investigations to determine if the geographical variation in rates for THR and TKR in the Orthopaedic Association National Joint Replacement Registry is due to lifestyle factors, socioeconomic factors or health system biases.

According to Manderbacka et al. (63), inequities in the provision of arthroplasties are sustained by differences in respect of access, use of co-payments and plurality of providers. Their study suggests that ambulatory care and a reinforced primary care pathway directly increases the access to elective surgeries such as THR and TKR. The argument that more private provision increases access for the deprived population was also refuted by Derrett et al. (122) when analysing the two-tier health system in New Zealand. There, a mix of public and private services was maintained after the introduction of a prioritisation system which did not shift inequities in access to arthroplasty, prostatectomy or cataract surgeries.

VI. Socioeconomic variables used by the selected studies

The second part of this review provides a description of the socioeconomic variables used by the 51 selected studies to analyse the issue of equity in access to hip or knee arthroplasty.

a) Primary elective hip arthroplasty

i. Age

Studies have shown that the number of hip arthroplasties carried out on patients increases with age up to 80–84 years old. After the age of 80–84 rates tend to decrease (123), falling substantially after 85 years of age. The effect of age is consistent in both sexes and affects all ethnic groups (59, 95, 105, 120, 121, 124, 125).

Most studies looking at inequities in hip arthroplasties used standardised age rates to observe the distribution of procedures in defined populations. Dixon et al. (93) justify the regional variations in THR in England by the disproportional distribution of elderly people in specific regions, highlighting however that possible inequities could only be highlighted if socioeconomic data are considered.

When taking into account types of medical insurance, Matlock et al. (125) observed that at the age of 65 the insured population and the general public suffer an upward shift in the incidence of arthroplasties. The effect happens despite the type of insurance: public insurance was the primary payer for the procedure of both groups (insured and uninsured). The study from Judge et al. (59) compared the provision per age-group and need, observing that the younger groups (50–59) got less THR related to need than those in the older group (60–84). Those with age ≥ 85 received less provision than both former groups, despite need. Steel et al. (100) demonstrated that people over the age of 74 are in greater need of hip replacement. In a study comparing the US and Ontario, Ravi et al. (126) have shown that in America there is a significant increase in the rate of younger patients (less than 60 years of age) receiving THR, mainly in the US.

The age rates for joint replacement related with rheumatoid arthritis in the middle aged population decreased (ages 40–59). For the ≥ 60 s, rates followed a similar pattern to that presented by the general population, steadily increasing in a time series. The decrease in the younger population is attributed to more aggressive and efficient treatment for rheumatoid arthritis.

ii. Gender

The gender variable in hip arthroplasties shows that women tend to receive more replacements than men, and tend to have worse scores of physical functionality, with a bigger prevalence of osteoarthritis (102, 127, 128).

In the study by Borrero (124), men and women were equally likely to undergo the procedure, sharing the same indications, despite less utilisation by men. Three studies found a higher prevalence of THR in men: Hawkins et al. (117), Rahman et al. (120) and Brennan et al. (121).

When need is considered, Judge et al. (59) have shown that men receive more hip replacements in relation to need than women in England, and Steel et al. (99, 100) previously demonstrated that, among other variables, women were in greater need of THR. In the preoperative sample studied by Neuburger et al. (111) women had worse scores of severe pain and disability than men, but less self-related longstanding problems.

iii. Rurality

Three studies considered the differences between urban and rural areas as influencing variables for the utilisation of hip arthroplasties. All three found that individuals living in rural areas are more likely to undergo a hip arthroplasty. The study from Francis et al. (92) widened their first analysis (119) including other surgical procedures together with hip and knee replacements: cataract surgery, carotid endarterectomy, lumbar spine fusion, abdominal aortic aneurysm repair, prostatectomy, aortic valve replacement and appendectomy. In all cases, people living in rural areas were more likely to undergo those procedures than their urban counterparts. Considering rurality in developed countries, there is strong evidence that people living in rural areas are more likely to undergo hip arthroplasties.

iv. Geography, deprivation and socioeconomic status

Many studies investigating equity in the provision of hip replacement considered as explanatory variables those relating to region, regional deprivation indexes and/or local socioeconomic status (59, 117, 120). These variables can assist future health system planning, mainly in the context of universal health systems such as exist in Scotland and in Brazil.

In England Dixon et al. (93) found the highest rates of hip replacement in the south west and in the Midlands; the lowest rates were in the north west, south east and London regions. Their main explanatory variable was demography, as some places have a concentration of the elderly population. In another study, Cooper et al. (115) related waiting times for elective procedures in the NHS with individual socioeconomic status: from 1997 to 2007 waiting times were reduced across socioeconomic groups for hip and knee arthroplasties and cataract surgery.

A deprivation index was used by Derrett et al. (122) to analyse the impact of a prioritisation programme in a two-tier universal health system. The offer of private provision of THR through public funds was not associated with better access to elective surgery procedures (joint arthroplasty, prostatectomy and cataract surgery) by the most deprived regions of New Zealand.

Social deprivation was associated by Jenkins et al. (129) with lower functional scores before undergoing hip replacement but not with higher body mass index (BMI) or length of stay (LOS). Worst general health status (EQ-5D validated questionnaire) in the preoperative setting was associated with social deprivation by Soljak et al. (130) and greater need by Steel et al. (99, 100) and Judge et al. (98). When looking at surgical outcomes, lower economic groups are associated with lower hip functionality scores (111).

When related to regional rates of THR, socioeconomic factors had no apparent influence in the Nordic population of Finland. Variations were associated with the decision-making process where a few surgeons were the only ones responsible for the care pathway (52). Socioeconomic status was strongly associated with lower rates of THR in Australia (131): social economic gradient affects access to orthopaedic consultation rates too, with the wealthy population quintiles presenting higher treatment frequency by consultant surgeons than the deprived ones (120).

Recognising that patient deprivation is associated with greater need for THR and higher risk factors in respect of post-surgical complications, Hollowell et al. (104) found no significant association between preoperative risks and socioeconomic factors. The same result was found for postoperative morbidity. Their conclusions suggest a differential selection care pathway for healthier patients undergoing surgery in that urban setting. There is evidence that in the case of THR, higher LOS is associated with clinical comorbidities and not with a socioeconomic gradient (60). LOS and length of uninterrupted institutional care (LUIC) shortened in the past 15 years, from around 10 days in 1998 to 5.2 in 2008 (91) due to technological and infection control advances.

There is strong evidence in the literature that socially deprived regions or individuals face greater need for hip arthroplasties. The socially deprived also present worse preoperative conditions, showing more comorbidities; as a consequence post-surgical outcomes are poorer for the least deprived sections of society.

v. Ethnicity or race

Ethnicity and race are frequent variables associated with equity in studies of access to hip arthroplasties. Racial disparities can be larger than income disparities (132). There is strong evidence that ethnic minorities have less access to healthcare considering THR (118), undergo the procedure at a later stage of the disease (112), have more comorbidities (101) and show worse preoperative function of the hip (114).

Hausmann et al. (133) suggested that differences in treatment rates by race could be based on patient preferences, however their sample was not significant when compared with larger studies. A more significant study in terms of sample had shown that elderly African American patients were more likely than Caucasian patients to be admitted in hospitals with higher risk-adjusted surgical complications and mortality rates (109).

Ethnic factors can also be related to culture and the diverse ways of experiencing osteoarthritis. Patients born in Italy and Greece living in Australia illustrate this hypothesis: they present lower rates of THR in relation to the general population even after controlling for BMI, education level, age, gender and physical functioning (134).

b) Large joint replacements for rheumatoid arthritis

Poorly treated rheumatoid arthritis can lead to the need for THR or TKR. The characteristics of this disease differ from osteoarthritis – mainly, but not necessarily, increasing with age. Therefore rates of joint arthroplasty for patients suffering from rheumatoid arthritis are not an adequate measure of equity as the treatment outcomes vary too much between different individuals, leading to biased epidemiological analyses. Despite not being an equity measure, this review gathered four studies reporting the decline in treatment rates in the past decade

in respect of THR and TKR for people with rheumatoid arthritis. The decrease in the rates of treatment is associated with more aggressive and effective treatment for this kind of arthritis (95-97, 135).

2.1.5 Conclusion – How to estimate need for arthroplasty?

Despite the fact that arthroplasty has been given the tag *orthopaedic operation of the century* (136), the methods, surgical materials and approaches, prostheses and willingness to undergo the procedure vary immensely across populations, researchers and surgeons.

Along the care pathway for chronic osteoarthritis there are well documented variables in the literature (such as age and sex) and others variables that have less evidence but are important for health systems management towards equity (deprivation, differences of utilisation/offer). It seems that privately covered patients tend to have better access to joint arthroplasties, receiving the procedure at an early stage – when need for a replacement is not so acute. On the other hand, deprived groups tend to seek more pharmaceutical help to control symptoms (mainly pain and stiffness), and do not necessarily receive a joint arthroplasty when one is needed or demanded. Different interpretations of pain scores and willingness of the general practitioners to refer the case to a consultant possibly have a direct influence; however, despite its importance, it is methodologically complex to analyse/research these factors.

The WHO recommendations and the evidence-based scientific movement from the 1980s onwards centred care pathways around the individual self-perception of pain. Orthopaedic care evolved from a previous setting where mobility and function scores were the only definers of need for surgery, to the now widely used patient-centred scores, where self-reporting of pain has a higher variable weight than function/mobility (e.g. New Zealand score, WOMAC Score).

Epidemiological variables interacting with a patient-centred approach to need necessarily require a complex framework, blending individual health needs and demands with population health planning. From both, clinical and patient points of view, hip arthroplasties pass the 80% mark of successful expected outcomes (64). They improve mobility and self-dependency avoiding chronic disability. Despite these many potential advantages, however, it is difficult to estimate willingness to undergo such procedures. Faced with this limitation, scholars have used different *cut-off* measures for need, consequently presenting diverse results (58, 59, 98, 123).

The New Zealand score uses a patient-centred approach, considering self-reported pain as a main criteria to define the need for arthroplasty (137). It is estimated that around 10% of people over 55 years old with symptomatic hips will present also a radiographic image compatible with osteoarthritis. From this population suffering from osteoarthritis, around 10% will have possible indication for surgery. The cut-off measure considering self-reported pain (New Zealand score compatible with surgery indication) and a positive radiography diagnosis of osteoarthritis is agreed to be an efficient measure of need for arthroplasty in a population (59, 98).

An arbitrary cut-off measure is statistically limited if the objective is to generalise findings throughout the population. Judge (58) previously demonstrated the limitations of findings from equity studies without need measurement and proposed a methodology to overcome this issue: local measurements of need associated with offer of care, establishing access indicators divided by deprivation, sex and age groups. His study demonstrated the persistence of inequalities within the NHS; however, his findings did not differ in general terms from most of the studies which did not consider individual levels of need.

The purpose of this review was to update the analysis framework, methods and variables used to relate equity and access to hip arthroplasties. The findings gathered contributed to the development of methods of chapters 3 and 4.

2.2 Literature review of the concepts ‘need’ and ‘needs assessment’ in public health

Findings and summary of this section at a glance

- ✚ The concept of *need* in health and healthcare changed from a post second World War definition of ‘help those in need’ to a realist approach of ‘action through reasonable use of resources’;
- ✚ The process of *needs assessment* of a population is based on a pragmatic and rational process, in which the scarcity of resources is taken into account – superseding the previous *sociological approach to need* in which the *right to health* was based;
- ✚ *Need* is a resource input and the ‘capacity to benefit’ (from a healthcare action) is the outcome measure of a health system;
- ✚ The changes of the concept of *need* have been underpinned by the global economic scenario;
- ✚ The establishment of a rationality of *needs assessment* has brought the creation of public bodies responsible for the standards of methods and decision making processes at national, regional and local levels of health systems;

2.2.1 Objective of this review

The concept of *need* in health and healthcare is a matter of scientific debate (138-142). As pointed by the review of studies utilising elective primary hip arthroplasties as a proxy for equity in healthcare (session 3.1 of this study), to estimate need remains a major issue for studies considering equity in healthcare using access to procedures as outcome measure. Thus, this portion of the literature review is concerned with the concept of *need* in healthcare and how such concept relates to the distribution and utilisation of services by the population. This review focus on the changes of how health sciences previously understood need and how *need* is interpreted now in health systems planning. A set of questions is proposed in order to organise the narrative of this review:

- I. What is *need*?
- II. What is the concept of need in the health field? Is it different for healthcare?
- III. Has the concept of need changed over the 20th century and up to the first decade of

the 21st century?

- IV. What is needs assessment? What is needs assessment in healthcare?
- V. What is needs assessment in public health?
- VI. Are there different levels of needs assessment?
- VII. Why and by whom have needs assessments been used in public health?

The literature regarding the concepts of 'need'(s) in health and healthcare, including scientific articles, books and grey literature around the theme. The methodology used for this review is described in the following sub-section.

2.2.2 Methodology

On 9 October 2013 an electronic search was conducted in the PubMed database and the Queen Mary Library Search tool using combinations and synonyms of the following terms for the title, subject, abstract and body of the text:

- 'Needs' terms:
 - Need(s)
 - Health
 - Healthcare
 - Policy
 - 'Health Policy'
 - Concept
 - 'Concept Evolution'
 - 'Health Systems'
- 'Needs assessment' terms
 - 'Needs Assessment'
 - 'Health Policy Analysis'
 - 'Social Justice'
 - 'Health Care Reform'
 - 'Health Planning'

The search was limited to English language studies. The references were imported to the EndNoteX5 Reference Manager Software and organised. After removing duplicates this

review identified 5,646 studies – from which 206 were considered as being of possible relevance to answer the questions proposed.

2.2.3 Limitations of the review

A main limitation when reviewing the concept of need in health is the broad range of studies gathered, including grey literature. In carrying out a review of such a broad concept as part of a major PhD study important limitations arose, in respect of the time schedule and the use of one analyst only (Jonathan Filippou). This affected the whole literature review process, narrowing the scope of findings. Only two databases were considered. The quorum statement depicts how broad the subject is and the amount of literature produced around it. To stick to the proposed time scheduled in the research plan, it was decided to consider only seminal works about the subject from the 1960s, 1970s and 1980s; as the contemporary concept of need is drawn from and based on the theoretical discussions during these decades. From 1990 onwards a more comprehensive approach was used, although still limited by the arguments exposed above. References from the 1990 decade onwards were thoroughly analysed.

The limitations of this review lie in the very concept of need itself, as it covers many fields of research and knowledge. In these fields the lack of agreement about a definition boost the amount of theoretic material produced. For this review we opted for a rather more flexible methodology than was used in the literature review of studies of equity in the distribution of THR and TKR. 'Need' has many different emphases when related to health and health policies. The aim of the review was to give an unbiased view of the concept in the international literature on needs and needs assessment, to unveil the diverse approaches to the subject.

2.2.4 Results

The word *need*, as a verb, has two meanings in the English language: if applied in the first person, 'to need' means the *necessity to have something or to want something very much*; or, in the third or second person, if someone *needs* something, it denotes that *they should have it, or would get an advantage from having it* (143). The health concept of need is based on the last connotation, in which a third or a second person, who can be an individual or a population, will or would be benefitted if a health need is fulfilled either by care, or political, ecological or social action (144).

Donabedian (145) coined the concept of *health need* around the human perception of 'some disturbance in health and well-being (...) defined, therefore, in terms of phenomena that require medical services'. This is a rather humanitarian view which, in simple terms, asserts that 'where [there] is human suffering, we must do something about it' (139). The Hippocratic characteristic of helping the sick and needy, popular in the first decades after the Second World War, was gradually superseded in the 1960s and 1970s by economic arguments about limited resources, which argued that it is economically impossible to be endlessly generous whilst still being socially fair. Studies like the one by Matthew (140), as well as others, presented a *realistic* approach to health needs, identifying need only when it can be fulfilled using a 'medical intervention that has positive utility and that actually alters the prognosis of the disease in some favourable way at reasonable cost'. In other words, in the *realistic* approach need should be identified only when it is possible to do something about it, through the 'reasonable' use of resources.

The dispute between the humanitarian and the realistic view of health needs has been central to the very formation of health systems: from the end of the Second World War, this dispute

shaped policies, health reforms and has been the subject of political, social and scientific disagreements. Whilst humanitarians focus on identifying possible benefits of medical interventions to individuals or populations, realists ask a second question: is the cost of the action reasonable? Stevens *et al* (146) identified the historical stages passed through by this dispute: defining the 1960s as the *sociological approach to need* and the 1970s as the *rational planning* stage. With the further pragmatic approach established from the 1970s onwards, economical terms became a part of the *needs assessment* of the health of populations.

Conceptually, *need* and *demand* were placed in antagonist positions. For Boulding (138) *need* was a mechanical concept, which denied human autonomy and individuality; whereas its opposite, *demand*, accounted for human autonomy and individual preferences - in his words, 'only the slave has needs, the free man has demands' (p.202). However, Boulding adds that this concept of demand, when applied to health, is limited by knowledge. In order for an individual to have preferences he must *know and understand* his options beforehand, and then choose one, following some rational criteria of self-benefit. The individual demand in healthcare is constrained by lack of information/knowledge, or the results of knowledge represented by research. The learning process which will make possible a multiple range of beneficial options is socially placed in the hands of medical professionals – this relation emerging from the fragility of the individual demand in the first instance.

The concept of need in healthcare arises from the medical perspective: 'one's demand for medical care is what he wants; his need for medical care is what the doctor thinks he ought to have' (138 p.203). The process of being 'cured' from a disease, becoming 'healthy', if mediated by a medical professional, will involve a consumption relation; ultimately based on the health professional's framework of needs. Boulding recommends that to be useful for

health research, the concept of need (as he poses it) must be considered in a wider context, within the health system, as a basis for the development of policies, reforms and rationale; not abandoning completely the individual concept of demand attached to free-will.

Recently, following the 21st century debate in the scientific literature, health *demand* has been defined as ‘what people would be willing to pay for in a market or might wish to use in a system of free health care’ (147); the concept of *supply* referring to what is really provided. Besides the clear conceptual distinction between need, demand and supply, Stevens et al. states that from the policy-making point of view it is ‘tempting to measure supply and demand as surrogates of need’ (147 p.4). These authors suggest that the three concepts overlap each other when considering health systems, and their boundaries suffer pressures from other knowledge, political and social entities (Figure 2.1). The authors mention that measuring need by reference to what is demanded (what people want) or supply (what is on offer) is misleading if a public health rationale is applied.

Figure 2.1 Need, demand and supply

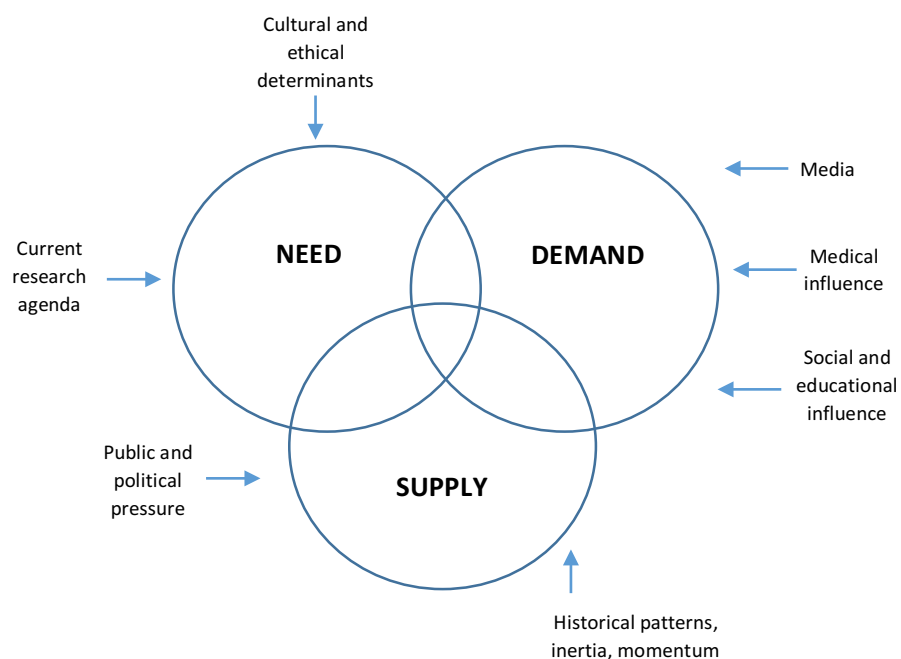
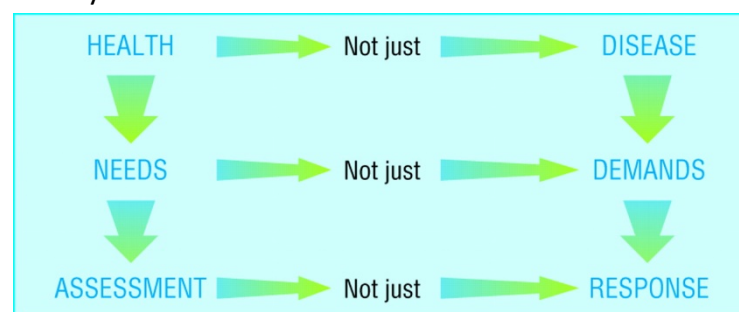


Figure 2.1 Adapted from Wright et al. (144) and Stevens et al. (147).

Bradshaw (148) proposed a taxonomy of need, defining four categories of health needs: normative (appointed by professionals), felt (desires, wishes), expressed (use of services, vocalised needs) and comparative (similar needs between similar individuals/populations); ultimately the author argued that his classification was undermined by inherent problems with the definition of the concept of need (149). From a philosophical standpoint, Baldwin (150) proposed a teleological need, which in a crude manner would be the gap between the goal (fulfilment of need) and the necessity or need. When applied to healthcare this approach highlights a conditionality for intervention, meaning a choice to act in relation to the perceived need or not: this condition for action has been restrained by ‘whether it is effective, how effective and for whom’ (141). Considering the Baldwin definition in the context of health systems, it is possible to relate the arguments to the practical view of Green and Kreuter (151) of need: ‘whatever is required for health and comfort’; this is, in conceptual terms, the practical hardship when developing needs-oriented health services.

Figure 2.2 Taxonomy of need and health assessment



Source: reproduced from Wright, J (144).

The ‘capacity to benefit’ is considered as the outcome measure of a health system and ‘need’ a resource input – two different concepts, with diverse measures which do not necessarily match (142, 152). In a more practical definition, the British Medical Research Council (BMRC) defines as ‘in need’ an individual functioning under (or about to be below) a minimum pre-established health level, for whom there is an effective (at least partial) medical intervention

within achievable resources (153). The economic standard of priority setting is based on the belief that the 'capacity to benefit is always going to be greater than available resources' (144, 154). The relationship between the 'capacity to benefit' and need is mediated by the equity of access to health and healthcare; for Culyer & Wagstaff the issue for health policy-makers is the disagreement around the concept of 'need' (155). Equity of access to care is directly related to the demand for services which will in turn influence expressed need; only equitable access to care can guarantee a comprehensive universal health coverage (156). The concept of 'capacity to benefit' is adapted from the field of economics and does not express the necessary holistic view of public health and need for health and healthcare (157, 158). Under the influence of economics, concepts like *effectiveness* and *cost-effectiveness* became part of the variables to be considered when analysing health needs from the 1980s onwards.

The economic influence was induced by the oil price crisis in the 1970s, defying the Keynesian economy which supported the after war years spending in social policies. The global influence of institutions like the IMF and the World Bank was expanded, finally becoming an impelling factor affecting health systems around the globe. This constrained economic direction was embodied in the administrative field as the *new public management*. In the UK, one of the places where it was manifested the earliest, it was responsible for the transference of two-thirds of former state-owned businesses to the private sector over the past 30 years (159). Reforms based on the principles of the new public management in Britain resulted in the separation of the roles of funding and providing healthcare.

Through the 1990 National Health Service Act health authorities were required to assess health needs of their local populations, using this knowledge to set general health priorities (160). Although priorities were to be assessed, the social responsibility embedded in the

decision-making processes concerning these priority choices could not be left unconsidered or taken lightly (161). The content of health system reforms has changed according to the diverse historical, political, economic and social contexts of each western nation (162).

Despite the controversial economic theoretical discussions, health needs assessment (HNA) has been defined in health policy practice as an evidence-based method of tailoring health services around the specific health needs of a population . Health inequalities are the subject of HNA, which identify recipients of inefficient, ineffective or inappropriate care and non-recipients of beneficial health interventions (147), or unmet needs. The UK Health Development Agency, which was absorbed by NICE in 2005, defined HNA as ‘a systematic method for reviewing the health issues facing a population, leading to agreed priorities and resource allocation that will improve health and reduce inequalities’ (163). Needs assessment combines comparative and qualitative methods with epidemiology, with the ultimate goal of influencing policy, research and multi-institutional collaboration to support rational decisions in the use of resources, improving the health of individuals and populations (164). There are, roughly speaking, two main stages for an HNA process: first, the health problems of a population must be estimated following epidemiology-based studies; second, the evidence of possible beneficial or harmful actions/effects must be reviewed for each health issue, establishing priorities for further actions (165).

The contemporary approach to *need* in public health policy, *assessing needs* to build health systems around populations’ needs, is directly influenced by global economic constraints. The global capitalist crisis in the 20th century (the 1929 breakdown; the 1970 oil crisis) and the 21st century (the US crisis of 2005–7; the European Union crisis of 2007) imposed and replicated a social system that is liable to be inequitable in terms of the distribution of material and non-

material goods. 'Need' tends to be conceptualised in the *ethics* domain in the health field, maintaining a bourgeois morality which perpetuates the status quo of irregular distribution among society (166). From this prism Robertson (162) argues that the Marxist 'commodity fetishism', a central concept in the theory of surplus value in which the capital/productivity is increased by the maximum use of labour, has been replaced in the 21st century by a 'services fetishism' – bringing a whole repertoire of unnecessary or false needs into the healthcare field. The concept of *false need* touts the excessive medical diagnose exercise which the new millennia society is under. Such over diagnosing phenomena mobilises large amounts of capital to fund expensive procedures, rather than low-capital related actions such as a balanced diet, exercise, ingestion of fluids and sanitation.

I. Healthcare Needs Assessment (HCNA)

After the early 1960s concepts based on free-will and the 1970s debates focused on economic constraints, from the 1980s onwards health needs became part of the production and research of medical evidence: the *evidence-based* movement, an empiricist approach that is based on epidemiologic, demographic and clinical findings. Starting with seminal works by Cochrane (167), and reports such as those by the Resource Allocation Working Party in 1976 (168) and the 1992 Health of Nation Initiative the contemporary approach to health needs was established, as has been described by Stevens et al.: 'these new cost-constrained purchasers required a mechanism for determining what services they should purchase and at what volume (...). This mechanism was to be *needs assessment*' (147). The shift to an empirical approach towards needs boosted the evidence-based research movement which became one of the key players in health systems reform from the 1990s onwards, with increasing numbers of research centres and agencies gathering data related to the population which could be

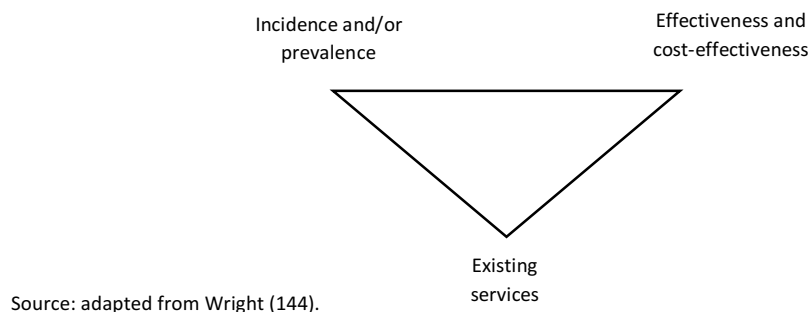
relevant to policy-makers – directly influencing decision-making processes. However, as part of the society dynamics conundrum, these agencies are not exempt from political and economic pressures; economists argue that needs assessments are ‘simply distractions from the difficult decisions of rationing’ (144, 169). The process of synthesising data to highlight needs that can be fulfilled by healthcare actions (health education, disease prevention, diagnosis, treatment, rehabilitation, terminal care) is currently named *healthcare needs assessment* (HCNA).

A boundary must be placed between the concepts of *health needs* and *healthcare needs*. The former is broad and refers to need in general terms; it is related not just to individual clinical aspects, but equally to morbidity, ecological and socio-demographic factors and measures – wider social and environmental determinants of health (deprivation, housing, diet, education, employment). The latter concept is more specific and is directly related to *possible actions* towards health needs, based on the clinical evidence of efficacy and benefit. HCNA is a founding stone of current reforms in health systems throughout the world, being defined as the *population’s ability to benefit from healthcare* (140, 141, 160); nevertheless these reforms have not necessarily guaranteed a more comprehensive healthcare system.

HCNA is associated with the possible benefit that the fulfilment of a need will provide for an individual or population. The aim of assessing the health needs of a population is ultimately to improve general health through service planning, rational allocation of resources and increased efficiency. *Disease-based* assessment brings together incidence/prevalence of a condition; the effectiveness and cost-effectiveness of a healthcare action and, finally, the existent services available (147). This modus operandi is based on the medical knowledge

regarding health and a *healthy state*. Nevertheless approaches from other sciences should be also taken into account (139).

Figure 2.3 Need, prevalence and cost-effectiveness



The evidence-based movement in healthcare over the past 20 years has been followed by the establishment of many agencies throughout the western world. In the UK the creation of NICE is justified as providing the ‘most effective ways to prevent, diagnose and treat disease and ill health, reducing inequalities and variation’ (between geographical regions) (170, 171). HNA produces methods and tools to monitor and propose feasible actions to tackle health inequalities and inequities (172, 173).

II. The practice of a needs assessment process

A process of needs assessment can vary in scale, however its core of spatial allocation of resources, efficiency and targeting is maintained – what varies, following the assessment scale, are the final objectives of the process.

National level – At this level assessments can be carried out when legislative improvements are needed. The objective of such assessments is to tackle inequities between geographic regions in terms of access and distribution of services/actions.

Regional level – The concerns of regional level assessments relate to services distribution, spatial equity and efficiency targets. Such assessments are tailored more specifically to the population and regional characteristics/needs.

Local authority – This is the level where the service purchasers exist (in systems where the roles of funding and providing have been split, like in part of the NHS). Local councils and decision-making processes framed by national guidelines exist at the local authority level.

Individual practice/practitioner level – This is the closest level to the targeted population, where business interests and competition among providers can influence the relation between preventive or curative actions; the latter linked with the secondary care level in terms of use and need (supply and need).

III. The epidemiological approach to needs assessment and its counterparts

The needs assessment used in public health policy-making processes, based on the triangle presented in Figure 2.3 (incidence/prevalence – effectiveness/cost-effectiveness – services) is called the epidemiological approach to needs assessment (147). Healthcare purchasers and private companies (for profit and non-profit) are likely to use two other approaches to needs assessment: the *comparative* or the *corporate* approaches.

Corporate approach – This considers the perspective of political, professional and general public agents, based mainly on the demands and wishes of a specific targeted group. It does not necessarily use a scientifically grounded evidence base in its framework of analysis, but centres actions and analysis through a *business view* – most of NHS reforms from the 1990s onwards encouraged this approach in the UK (146).

Comparative approach – This approach is centred on the comparison of two areas or groups and is a powerful tool for the internal development of a health system. However, standards of comparison must be well established following local data – as it is not necessarily the case that what applies for one geographical region does so in another. Need and capacity to benefit must be weighted and balanced in this approach (150).

Epidemiological approach – Stevens *et al.* (147) proposed a protocol for the epidemiological approach of needs assessment, in order to establish a criteria to develop a disease-based approach to public health:

1. Statement of the problem
2. Sub-categories
3. Prevalence and incidence
4. Services available and their costs
5. Effectiveness and cost-effectiveness of services
6. Quantified models of care and recommendations
7. Outcome measures, audit methods and targets
8. Information and research requirements

All steps are considered crucial for the development of an effective needs assessment, however step number 3 must be highlighted. Through the epidemiological data it is possible to *predict needs* – which is essential when planning improvements for a health system based on cost containment and constricted resources. Although this approach (called ‘epidemiology of indications’) has been subjected to intense debate, it has at the same time emphasised the difficulty involved in defining boundaries between what are health needs and what are healthcare needs (174). This an uneasy task, as was previously demonstrated in this review.

2.2.5 Conclusion

This literature review proposed to review the concepts of need(s) and need(s) assessment in the public health policy field, discussing possible roots and changes over the last few decades. The evolution (or transformation/creation) of these two concepts was directly influenced by global economic constraints in the 20th century and the beginning of the 21st century. During this time other fields of knowledge were brought to bear in the public health realm. *Needs assessment* itself is conceived of by reference to the economist mantra of prioritising actions, increasing efficiency and the rational use of resources. However, this influence cannot replace basic and recognised public health reasoning and understanding of preventive care, equity in access by geographical area and local planning – essential knowledge which defines the science of public health itself.

2.3 Literature review in Health Technology Assessments (HTA)

Findings and summary of this section at a glance

- ✦ HTAs are concerned with the safety, clinical efficacy, effectiveness, cost, cost-effectiveness, organisational implications, social consequences, legal and ethical considerations of the incorporation of health technologies (mostly pharmaceuticals, procedures and devices/products);
- ✦ HTAs might vary in terms of study characteristics and methods from country to country;
- ✦ HTAs methods lack a broader consideration of the socio-political context in which the processes of technology evaluation are inserted;
- ✦ HTAs are widely used worldwide by developed and under developed countries to base decision-making processes in healthcare, health systems and, most of all, to justify budget allocations not necessarily considering need;
- ✦ HTAs can aid governments to avoid the *artificial obsolescence* of a health technology;
- ✦ HTAs should be a continuous evaluation process, even after the incorporation of the technology;
- ✦ Despite an apparent more rational use of resources through HTAs, its application does not necessarily promote better equity of access to health technologies.

In the third and final portion of this literature review, which will provide the framework for the comparative study of equity of access to elective primary hip arthroplasties in Brazil and Scotland, it is proposed the review of concepts which underpin HTA. After reviewing the literature around equity in the distribution of hip arthroplasties in health systems (Chapter

2.1) and the issues relating to the assessment of need in healthcare in the public health field (Chapter 2.2), it is important now to consider the mainstream answer given by scientists to policy-makers (and society in general) as regards analysing/suggesting the use of new technologies within health systems. Thus, the questions for this review are:

- I. What is HTA and what are its origins?
- II. Which fields of knowledge are combined in HTA processes?
- III. Are there ethical implications in the processes involved in HTA?
- IV. Is it possible to place HTA under any social theory which can explain its appearance as a mainstream scientific mechanism (or process), spreading to more than 30 countries in the past 10 years?
- V. Which kind of answers do HTA processes give and what rationale is used for these results?

It is proposed to review the literature regarding HTAs, including scientific articles, books and grey literature around the theme. The methodology used for this review is described in the following sub-section.

2.3.1 Methodology

On 4 January 2014 an electronic search was conducted in the PubMed database and the Queen Mary Library Search tool using combinations and synonyms of the following terms for the title, subject, abstract and body of the text:

'health technology assessment'

- origin(s)
- 'fields of knowledge'
- disciplines
- ethics
- 'social theory'
- economics
- results
- process

The search was limited to English language studies. All references were imported to the EndNoteX5 Reference Manager Software to be organised. After removing duplicates this review identified 10,012 studies – out of which 84 were considered as being of possible relevance to answer the questions proposed.

I. First selection criteria

The 10,012 studies were filtered by the EndNoteX5 Software sorting tools using diverse combinations of the research items (already cited before) – excluding mainly clinical studies around HTAs. At this level of exclusion, 9,769 studies were discarded as not being related to the questions proposed by this review, leaving 243 references to be considered at the next selection level.

II. Second selection criteria

The 243 selected studies were analysed by their abstract by looking for relevant answers or discussions around the seven proposed questions for this review. At this stage 226 articles were discarded, leaving 17 articles to be included in this review as possibly relevant to the theme.

III. Further inclusion criteria

During the analysis of the selected articles in full, relevant references cited by the authors were searched and included if they contained relevant information or discussions about HTA. The references included grey literature, which enriched the discussion of this review.

2.3.2 Limitations of this review

A main limitation when reviewing HTA is the broad range of studies gathered, including grey literature. In carrying out such a broad review as part of a major PhD study important limitations in respect of the time schedule and the use of one analyst only (Jonathan Filippou) had a considerable weight in the development of the whole process, and imposed limitations as regards the scope of the findings. Only two databases were considered and the quorum statement depicts just how broad the subject is and the amount of literature produced around it. To respect the proposed time scheduled in the research plan, it was decided to consider only seminal works on the subject in the 1960s, 1970s and 1980s, as the contemporary concepts which underpin HTA are drawn from and based on the theoretical discussions during these decades. From 1990 onwards a more comprehensive approach was used, references from the 1990 decade were thoroughly analysed.

Table 2.8 Literature in HTA using proposed filters

Search terms by filter proposed	QMUL Library Search Tool	Google Scholar	PubMed
1. Health Technology Assessment/HTA	5,717	56,100	10,012
2. Results	4,611	10,900	3,673
3. Process	2,458	7,130	2,425
4. Ethics	876	6,730	592
5. Economics	83	71	89

2.3.3 Results

I. What is HTA and what are its origins?

The meaning of the word *technology* refers to the use, transformation or creation (knowledge) of tools/crafts: it conceptualises the influence of such abilities in relation to the social and physical environment (175). The Greek word *technologia*, when etymologically

divided, means “*techne*” (craft) and “*logia*” (saying/meaning). So, broadly speaking, HTA involves evaluating (assessing) technologies (meaning of tools/crafts) within health and healthcare sciences. As will be explored by this review, HTA is deeply embedded in western scientific knowledge and its way of producing/understanding science in terms of methods, values and ongoing ethical/moral issues.

The term *technology assessment* came into use in the US around the 1960s, in the context of government commissioned studies for the Office of Technology Assessment (OTA). The studies were related to possible impacts of promising new technologies at the time (such as supersonic transport and massive genetic screening) in society. In these early studies HTA was defined as a kind of policy research, concerned with short- and long-term societal, economic and ethical issues in the application of such technologies in America. The OTA was active from 1972 until 1995, when it was closed. During this time many of its suggestions and methods formed the base for the actual mainstream methodology used in HTA processes worldwide. The original term *medical technology assessment* changed to HTA in the 1980s, just as many other terms in the scientific health field were modified in the same period, a result of the multidisciplinary approach (175). The first technology assessment processes in health were related to *in vitro* fertilisation, choosing the sex of newborns, changing human behaviour and retardation of ageing. However, the first HTA that was carried out in an in-depth manner, similar to today’s processes, was the assessment of the totally implantable artificial heart by the US National Institute of Health in 1973 (176, 177).

Taylor and Taylor (178) defined this form of HTA as: “a multidisciplinary activity that systematically examines the safety, clinical efficacy and effectiveness, cost, cost-effectiveness, organisational implications, social consequences, legal and ethical

considerations of the application of a health technology – usually a drug, medical device or clinical/surgical procedure” (p.1). For these authors the main concerns of HTA will vary from country to country. In the UK HTA processes mainly relate to clinical and cost-effectiveness, based on two questions:

- How do the health outcomes of the technology compare with available treatment alternatives?
- Are these improvements in health outcomes commensurate with the additional costs of the technology?

Although it is not without criticism, HTA is considered to bridge evidence and policy-making, providing policy-makers with evidence-based information, clarifying their decisions about the adequate use of technology and the corresponding efficient allocation of resources. After the 2000s there have been concerns regarding a possible over-emphasis on efficacy and cost-effectiveness issues (179, 180). As mentioned by Banta (181), a leading authority on HTA and a former member of the extinct OTA in the US, “broader inquiry into the socio-political context of health technologies almost does not exist in HTA” (p.9). The base knowledge for HTAs is the creation of an economic model that gives a value (currency) to each year gained with the assessed technology – the Quality Adjusted Life Years (QALYs). Ethical/social concerns are assessed throughout the process, usually with patient-related focal/meeting groups.

Over the past 30 years HTA spread from the US to developed and under-developed economies, up to a point that it is even possible to identify a *trend of development* or, as it has been called by Battista and Hodge (182) a “natural history” of HTA implementation on a global scale. The authors suggest a framework of three identifiable stages in the

implementation of HTA. However, they highlight that the broadness of local processes are directly proportional to national scientific capacity and the capability of knowledge translation by different bodies.

Table 2.9 The “natural history” of HTA

	Emergence	Consolidation	Expansion
Why?	<ul style="list-style-type: none"> • Convergence of needs, demands, and supply • Key individuals are “champions” of HTA • Receptive policy/political environment 	<ul style="list-style-type: none"> • Early successes attract interest of more decision-makers • Expansion of demand for HTA products • Formalised priority setting process 	<ul style="list-style-type: none"> • HTA as part of official political discourse • Increased demand for diversified products
What?	<ul style="list-style-type: none"> • Narrow interpretation of health technology • Focus on high intensity technology (Imaging) • Exclusion of pharmaceuticals 	<ul style="list-style-type: none"> • Broadening of scope of HTA • Possible addition of pharmaceuticals • Shift from specific technologies to care processes for the management of health conditions 	<ul style="list-style-type: none"> • Further broadening of scope of HTA (pharmaceuticals, public health, delivery models, social services) • Existing practices and new interventions
How?	<ul style="list-style-type: none"> • Modest resources, at times project- or deliverable-specific • Minimal scientific capacity 	<ul style="list-style-type: none"> • Expansion of scientific team • Modest addition of resources • Research partnerships sought 	<ul style="list-style-type: none"> • Significant increase in resources • Expansion of scientific team and partnerships • Diversification of products • Clinical practice guidelines
And, then What?	<ul style="list-style-type: none"> • Knowledge translation minimal • Efforts directed to policy-makers, often by means of personal communication 	<ul style="list-style-type: none"> • Progression of knowledge translation efforts • Broadening of target audiences 	<ul style="list-style-type: none"> • Consolidation of multiple target audiences • Increased proportion of resources

Adapted from Battista and Hodge (182).

II. Which fields of knowledge are combined in HTA processes?

In the beginning of the 1980s there was an international consensus that some common practice interventions were harming, and were of low efficacy for, the population’s general health, with wide variations in the clinical practice in some healthcare fields across geographical regions (181). The utilisation of strict scientific research based on evidence is the western answer to the question of how to obtain clinical efficacy, involving an empiricist approach to health sciences. From the beginning of the 1990s the Cochrane Collaboration Centres have been one catalyst of evidence-based medicine (183), establishing criteria and

standards for clinical trials and systematic reviews of the literature through international scientific cooperation and sharing of findings based on trustworthy evidence.

However, the issue for health systems decision-makers is to identify not just the possible benefits to patients, but also to measure the intervention costs and their feasibility on a large scale, as healthcare budgets (public or private) tend to be increasingly tight due to a gradual loss of public revenues (184). So, together with clinical evidence, health economists developed systematic methods to associate efficacy with efficiency, including the variable of costs in decision-making processes, highlighting the allocation of limited funding resources. Clinical evidence associated with an economic rationale became a mainstream for HTA, becoming its actual core (179) – being widely seen as the best way of informing policy-makers about matters around choice of treatment/services to be offered within health systems, in private or public settings (182).

To recognise that costs play an important role when allocating resources in order to socialise healthcare equitably is not a simple matter and can be very controversial. The proposal of maximising the health of a population by including an economic rationale conflicts with medical autonomy regarding choice of treatment, asking health professionals to assume other care/political paradigms. On the other hand, health system reforms should be based on scientific evidence in relation to funding and providing healthcare, and should be assessed with the same rigour as clinical interventions – in other words, being equally based on evidence (185).

HTA in developed economies involves diverse organisations, such as government agencies, insurance companies, the medical industry, professional associations, hospitals and all sorts of private institutions. According to the International Network of Agencies for Health

Technology Assessment (INAHTA), there are currently 56 entities affiliated to the network, representing 33 countries. Of these, 12 are located in developing countries: Argentina, Chile, Taiwan, South Africa, Korea, Brazil, Colombia, Malaysia, Uruguay, Kazakhstan, Latvia and Mexico (186).

Besides the increasing importance that HTA receives in the global scenario as a basic tool for decision-making processes in respect of public policies, it differs widely in its influence from one country to another. The effect of HTA is connected with the power relations of many disciplinary fields (epidemiologists, economists), sectors (academia, managers, health professionals) and interests – industry, patients, service providers, government (187).

III. Are there ethical implications in the processes of HTA?

In a seminal work, Russel (188) affirmed that the main determinants for technology diffusion in health were commercial competition, the kind and size of hospitals, demography, reimbursement methods, prestige and the presence of education activities in an institution. In Russel's work there is no association between technology diffusion and an assessment of the morbidity patterns of the local population.

Other ethical factors in regard to technology diffusion are local legislation and regulation. From an economic point of view these are considered barriers when imposing limits to the availability of equipment through the rationalisation of resources. For an emerging technology to be recognised by providers as *established* it must pass through these barriers, in order to finally be reimbursed by the state or insurance companies, subsidising procedures following a clinical consensus regarding health/quality improvement related to the concerned technology. The ethical concern in respect of access remains and is actually reinforced by the attachment of HTA processes to an economic approach in terms of recommendations.

In developing countries the inequity of resources distribution and social inequalities has a direct effect on access to healthcare technologies, especially if these are complex and expensive compared to already available equipment. The rate of technology innovation since the Second World War was not followed by a similar rate of technology abandonment or replacement, resulting in an increase in the number and variability of available healthcare technology. Throughout this process there is *artificial obsolescence*, a strategy designed by the industry in which changing small characteristics of a product brings about an increase in sales by dislodging *technologically outdated* goods or processes (175). To avoid this kind of pitfall, mainly in the public sector, government bodies can use evidence based on HTA to establish priorities and policies to incorporate or reject certain technologies.

HTA should be a process of continuous evaluation, involving the systematic study of consequences in the short and long term of certain groups of, or single, technologies or healthcare processes (189). Despite its political influence, HTA must be based on scientific methodologies and ethical principles, with valid and replicable results. It should also consider social and legal impacts associated with the technology. However, in reality, characteristics such as efficacy, effectiveness, safety and costs usually come first, considering that a failure in any of these points condemns the whole commercialisation process.

It is fair to say that health technologies are not limited to providing cures or comfort for individuals. They go beyond this purpose: they influence the triangular sociologic relation of family, work and society. The scientific movement that is concerned with these impacts is nominated *health impact assessment*.

Health systems vary throughout countries in regard to organisational, coverage and funding aspects. If decision-making processes regarding the incorporation of new technologies, or the

expectations of a population about new possibilities of care, are taken into account the scenario is no different. Variations follow political, economic and cultural influences. HTA is defined by Goodman (1998) as a multidisciplinary field of policy analysis which involves studying the clinical, social, economic and ethical implications of the development, diffusion and use of technology in healthcare.

For developing countries, the continuous technological innovation of the northern hemisphere brings economic constraints: multiple rapid information-sharing channels within the scientific community are intertwined with the action of transnational enterprises, creating local demand for innovation from health professionals and procedures. The media and more educated sections of the population increase the pressure for changes in health systems when health technology is concerned.

IV. What kind of answers do HTA processes give and what is the rationale for these results?

To measure the effect of a health technology, when more than a single clinical indicator (e.g. blood pressure) is implicated broad measures related to health quality can be added to enrich evaluations of impact. Dimensions such as social functions, cognitive aspects, anxiety/sadness, physical mobility, physical pain and general health self-perception must be taken into account.

HTA can be focused on three distinct aspects (178):

- Assessment of the technology itself (one or more than one technology altogether), which concerns decisions around the registration and incorporation of the technology into the health system.

- Problem oriented – elaboration of clinical guidelines; the benefits/risks that can be expected from determined procedures/technologies – to guide allocation of resources in healthcare.
- Implementation of an item of equipment or specific technology in a defined place (e.g. a tomography scanner in a defined hospital).

The focus of any HTA tends to reflect the interests of the body commissioning the assessment. Health insurance companies may evaluate procedures and costs to decide about levels of reimbursement, a hospital manager may look at a technology acquisition from the financial standpoint, being concerned with what the technology means in terms of budget and administrative impact. These are all fair enough views; however, a government responsible for the management, planning and maintenance of a healthcare system has to broaden its scope of considerations. The perspective to be adopted by assessors that have been publicly commissioned should come from the society as a whole: the costs and benefits for all society groups and classes must be taken into account and the HTA should not be conducted according to the interests of specific groups alone.

2.3.4 Conclusion

HTAs are a useful tool for decision-making processes related to maximising the use of resources for health promotion and healthcare. The processes do not substitute the institutional hierarchy needed to organise primary, secondary and tertiary care; considering primary healthcare care as the 'entrance' of the health system. Despite the global spread of HTA methods and practices, political pressure and, most of all, capacity to influence decision-making in health policy varies considerably between countries. In some developing countries HTA policies have been used to politically justify budgetary cuts in public health. For most

developed countries HTA is a decisive tool for resource allocation. However, the application of HTA does not necessarily mean better equity in access to health and healthcare.

2.4 A proposal for a study of equity of access to healthcare using primary elective hip arthroplasties as a proxy measure based on the results of this literature review

Comparative research associated with social welfare systems can be traced back to the early post World War II period (190), when policy makers were looking for experiences of other countries to base local reforms (191, 192). The 1980s globalisation resulted in 'mixed economies of welfare' (10). The economic constraint of public health budgets have been gradually undermining the equity of access to health and healthcare of most western countries, at all levels of economic development (15, 193, 194). Equity of access to health and healthcare is a multifactorial issue (63, 195-197) and the main concern of this study.

This chapter has reviewed the scientific literature that relates arthroplasties and health equity offering a comprehensive overview of previous studies relating primary hip arthroplasties and equity. It gave an account of the analysis variables used by the selected studies and findings, pointing out that there are research limitations concerning how health needs are measured and related to health supply factors (rates of medical personnel, hospital beds, private health services), only partially fulfilled by surveys and statistical models. Bearing these limitations, the chapter has also reviewed the concept of need and needs assessment in health and healthcare, searching for an adequate theoretical framework to investigate equity and health needs in public health. The concern with health needs led to the review of the role of health technologies assessments (HTA) as the chosen tool of decision makers for health systems planning.

Taking into account the findings of this literature review, the investigation was set up as a mixed methods ecological study, with two quantitative stages that are explored by a third of qualitative characteristics. Each of the analysis chapters present a separated methods section, specifying the analysis performed, how the data was obtained, limitations/bias and objectives. In order to explore the data possibilities, it was convened that only **primary elective hip arthroplasties** would be considered for analysis; by not considering other kinds of arthroplasties (e.g. knees) the study expected to diminish findings bias. The main research question of this study is presented followed by its objectives.

2.4.1 Research Question:

Do people living in Brazil and Scotland have equitable access to public funded healthcare if in need of an elective primary hip arthroplasty?

2.4.2 Objectives:

1. To compare age and sex standardised rates of elective primary hip arthroplasties between Brazil and Scotland in the public sector by country and region for the period 2009/10-2012/13;
2. To explore the contribution of health services availability (physicians and beds including public and private sectors) to differences in treatment rates;
3. To examine whether there is a socioeconomic gradient for access to elective primary hip arthroplasty treatment rates in Scotland (2009/10-2012/13) and Brazil (2010/11);
4. To analyse the issues regarding access to elective primary hip arthroplasties in the public sectors of Brazil and Scotland by undertaking interviews with civil servants, policy makers and health professionals focusing on the findings of objectives 2 and 3.

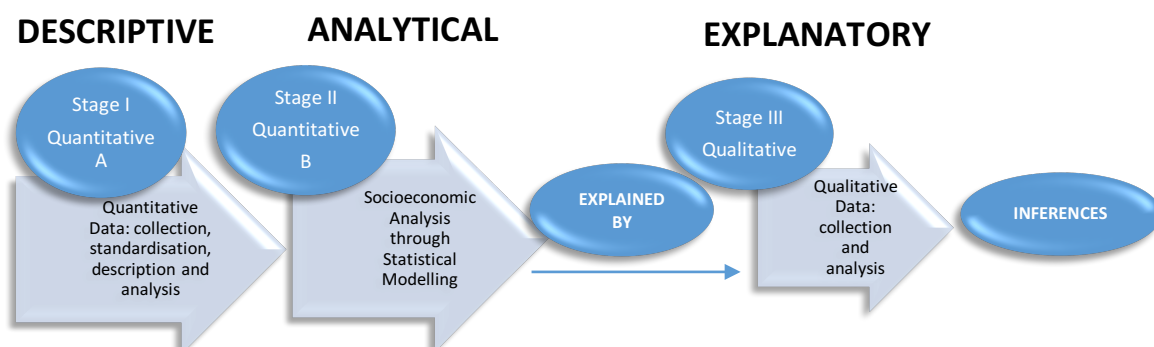
2.4.3 Mixed methods research and the explanatory design

The so-called mixed methods approach is a fairly recent approach, accounting for around 25 years of practical application (89). From an epistemological prism, it is the philosophical result of theoretic assumptions originated between an empiricist view of science *in association with* a humanistic/rationalistic approach. Some authors describe mixed methods research as ‘the third research paradigm’, the other two paradigms would be qualitative and quantitative research (198). For Creswell, the definition of mixed methods research is:

An approach to research in the social, behavioural, and health sciences in which the investigator gathers both quantitative (closed-ended) and qualitative (open-ended) data, **integrates the two**, and then draws interpretations based on the combined strengths of both sets of data to understand research problems. (53 p.2) – My bold emphasis.

The ultimate aim of looking into both kinds of data, closed and open-ended, is to answer the proposed research question in a way that neither, quantitative or qualitative approaches would be able to do if solely applied. According to Creswell, “quantitative research provides an opportunity for generalisation and precision; qualitative research offers an in-depth experience of individual perspectives” (54 p.15). When investigating health inequalities, both perspectives are true and complementary (199).

Figure 2.4 Creswell’s explanatory sequential design for mixed methods research



Source: adapted from Creswell (53).

There are several models of mixed methods research. The choice of model is linked to the research problem, data availability and research expectations regarding results (54); in other words, with the general aspects of the subject under investigation. The model that fits into the proposed research question and follows an adequate rationale to the multifactorial issue of equity of access to health is the *explanatory sequential design for mixed methods research*.

This model proposes an initial quantitative stage that is *explained by* a qualitative stage, which *together* will provide inferences or the answer to the main research question. Figure 2.4 presents an adaptation of this research taxonomy, showing each analysis chapter of this work.

Chapter 3 explores the national and regional age and sex standardised utilisation rates of primary elective hip arthroplasties in Brazil and Scotland. It relates rates with health systems supply factors, investigating its influence on access to the procedure by geographic regions in Brazil and by NHS Healthboards in Scotland.

Chapter 4 associates the standardised treatment rates to socioeconomic factors. The analysis explores the Multiple Deprivation Index used in Scotland in association with routine NHS data, evaluating trends over time between 1993/94 to 2012/13. The socioeconomic analysis in Brazil is limited by data, as there are no socioeconomic indicators associated with routine data in SUS. To overcome this limitation the study proposes a statistical model associating municipal age and sex standardised treatment rates with two socioeconomic indicators: Human Development Index (HDI) and Gini Income index.

Chapter 5 explores the quantitative findings of Chapters 3 and 4 with health professionals, policy makers and civil servants in Brazil and in Scotland, searching for an explanatory framework of the research problem. Interviewees were asked to discuss the results in an audio-recorded interview constituted of open-ended questions. The audios were transcribed

and translated (if in Brazilian Portuguese) for analysis; coded by subjects and grouped into three major themes: Equity of access to healthcare, Health Systems and Evidence based actions/policies. A narrative exploring each of the major themes is established, unveiling factors that might hinder equity, demonstrated by the quantitative findings presented in the first two stages of analysis.

Finally, at Chapter 6 the study highlights findings and makes health policy recommendations aimed to improve health equity in both countries, Scotland and Brazil. This section also considers aspects of future research in the theme of health access equity in universal health systems.

3. Hip replacement treatment rates in Brazil and Scotland and the relationship with private sector coverage, physician and bed supply in the public sector

Findings and summary of this section at a glance

- ✚ The Brazilian population grew exponentially from 51 million in 1950 to 190 million in 2010, compared with the Scottish population that remained at around 5 million people in the same period;
- ✚ Between 2009/10 to 2012/13 NHS Scotland elective primary hip arthroplasties crude rates had a seven-fold difference than the Brazilian SUS, for age and sex standardised national rates there is an eight-fold difference to the Scottish NHS;
- ✚ There are consistent differences of standardised rates within the geographic regions of Brazil and Scotland, the regions with lower rates in Brazil are 20-fold lower than the worst performing healthboard of Scotland;
- ✚ Brazil has one quarter of its population enrolled in private healthcare insurance whilst in Scotland the private sector does not compete with the public sector regarding elective arthroplasties;
- ✚ There is a lack of data from the private sector in both countries regarding elective primary hip arthroplasties;
- ✚ There is a two-fold difference between the Scottish NHS regarding the availability of hospital beds in comparison with the Brazilian SUS;
- ✚ The number of available hospital beds in Brazil and in Scotland has fallen over time;
- ✚ The number of private hospital beds has been increasing in Brazil and not in Scotland;
- ✚ For both, General Practitioners and trained specialists in orthopaedics, rates per head of population are similar between Brazil and Scotland;

Hip arthroplasty, commonly known as hip replacement surgery, is a highly effective orthopaedic intervention that reduces physical disability and pain levels for those in the acute stages of osteoarthritis (66). The procedure is often referred to as the 'orthopaedic operation of the 20th century' (136). Elective arthroplasty has been used as the basis of health equity studies, and to examine geographic and socioeconomic variations in access to care in health systems (59, 93, 115, 117, 120, 200).

The goal of universal health systems is to ensure that the population has access to the same range of services for the treatment, prevention and diagnosis of pathologies (whether chronic or acute) regardless of socioeconomic differences and place of residence (40). In this chapter primary hip arthroplasty treatment rates (utilisation) from the public sectors of Brazil and Scotland, the Unified Health System (SUS) and the National Health Service (NHS) respectively, are used as a proxy measure of access.

In high income countries the number of arthroplasties has generally been increasing over time (52, 90), despite regional differences in provision (92, 93, 123). Studies of population needs (96, 97) and clinical outcomes of the procedure (91, 101, 102), show that healthier and younger patients have a lower cost associated with treatment, as a result of a shorter hospital stay and decreased complication rates post-operatively unlike more socially deprived communities, which may have increased clinical comorbidities (60, 104). Higher levels of social deprivation are associated with longer travel distances to access orthopaedic care (113) and late surgical intervention with more advanced osteoarthritis (112). Ethnic minorities also have lower function scores for large joints (hips and knees) (114).

Increasing age is associated with need for intervention in both sexes and across all ethnic groups (59, 95, 105, 120, 121, 124, 125, 200). Women presenting worse hip function scores suffer a higher prevalence of osteoarthritis (102, 127, 128) but may not receive more arthroplasties than men with similar morbidity (117, 120, 121). Individuals living in rural settings have a higher probability of undergoing arthroplasty (92, 119); however, when geography and deprivation are combined, deprivation is associated with less and/or later access to surgical care for osteoarthritis (59, 117, 120).

Waiting time for surgery in the public sector is around 70 days in the NHS in Scotland, from clinical indication to intervention (201), whilst in the SUS in Brazil the wait for the public sector is estimated between two to four years for arthroplasties. Variations in treatment rates can be explained by differences in public and private supply, including in regard to beds and staff (202).

Use of healthcare depends on supply factors and on the price charged for services (203). In universal public systems without out-of-pocket co-payments the price system does not apply

at the consumer level as prices are not necessarily established through competition (203). The use of elective hip arthroplasty in the NHS and SUS depends upon supply and demand characteristics: i.e. the availability and distribution of medical workforce and the available number of hospital beds. Price competition only arises in the case of choosing to go outside of the public healthcare service, through the private/independent sector. In this sector the procedure is paid for through out-of-pocket fees, insurance reimbursements, or through health plans. Out of pocket and private insurance are present in a small extent in Scotland (204), private healthcare insurance cover a quarter of the Brazilian population (22).

3.1 Objectives

The objectives of this chapter are as follows:

- (1) to describe and compare primary elective hip arthroplasty treatment rates in those aged 30 years and over in the public health services of Brazil and Scotland at national and regional level from fiscal years 2009/10 to 2012/13;
- (2) to compare the supply of orthopaedic hospital beds and orthopaedic surgeons in Brazil and Scotland in the public and private sector; and
- (3) to discuss the extent to which lack of data from the private/independent sector, differences in healthcare supply, differences in morbidity/need account for differences in utilisation rates within and across countries.

3.2 Data sources – elective primary hip arthroplasty procedures, bed data and workforce data

i. Primary elective hip arthroplasty treatments

DataSUS Brazil – the Ministry of Health website publishes all aggregated data on hip arthroplasties, by number of procedures and geographical state (there are 26 states in Brazil, plus the Federal District, where the national capital Brasilia is located). Partially raw files derived from hospital admission authorisations (AIHs) were used to obtain patient-level data. In 2008, the present codes for procedures were implemented following directives of the Ministry of Health.

Information Services Division NHS Scotland (ISD) – the researcher applied for patient-level data as these data are not publicly available from NHS Scotland. The public sector in Scotland follows the Office of Population Censuses and Surveys 4 (OPCS-4) codification of procedures, used for coding in-patient interventions which, differently from the Brazilian codes, are comparable to the American Medical Association Current Procedural Terminology (CPT). The data extract application asked for all hip replacements to be extracted from the national database ‘General/Acute Inpatient and Day Case dataset’ (SMR01), following the OPCS codes of the Scottish Arthroplasty Project² (SAP) performed between 2009/10 and 2012/13, divided into age groups (four-year intervals), gender, NHS board of treatment/residence and Scottish Index of Multiple Deprivation (SIMD) quintile.

² Available in http://www.arthro.scot.nhs.uk/OPCS_codes_summary_150710.pdf.

ii. Bed data: Bed returns, private and public

DataSUS Brazil – data regarding hospital beds are collected monthly by DataSUS from the National Register of Health Services (Cadastro Nacional de Serviços de Saúde – CNES) and are available at the DataSUS website for public access. In Brazil, hospital beds are defined by specialty or clinical services (obstetrics, paediatrics and others). Recovery beds and day bed units are included in all beds.

ISD Scotland – ISD releases Excel spreadsheets using midnight returns and publishes these data by NHS board in Scotland³. With regard to hospital beds, the administrative definition of hospital beds in NHS Scotland includes beds in wards (including those open less than seven days per week), beds in clinical facilities (e.g. intensive care units), beds in cardiac care units, beds in private rooms and cots in neonatal units.

iii. Workforce data

Federal Medical Council of Brazil – data about general and specialised medical workforce available in Brazil. The definitions of Brazil and Scotland are not the same regarding consultants, surgeons and/or specialists in medical professions (e.g. it is common in the Brazilian case for orthopaedists to only work as consultants).

ISD Scotland – Excel spreadsheets, with the number of medical professionals by specialty, year and health board in Scotland, are available via the service website for download.

³ ISD Scotland: <http://www.isdscotland.org/Health-Topics/Hospital-Care/Beds/>.

iv. Private sector coverage

Brazil: National Agency of Supplementary Health – the government agency that regulates the private sector in Brazil publishes data on the number of people enrolled in private healthcare insurance in the Brazilian population over time and by region.

Scotland: Health System Review by the London School of Economics (LSE) – an account of the private/independent sector in Scotland is described in this report by LSE as part of the Health Systems in Transition series (204).

3.3 Data sources – Denominators

For Scotland, the mid-year census population of 2009/10–2012/13, given by the General Register Office of Scotland⁴ were used. For Brazilian rates, the census estimates published by the Brazilian Institute of Geography and Statistics (IBGE) for the same period⁵ were used.

3.4 Methods

i. Crude elective primary hip arthroplasty rates per 100,000 people by age group and gender were calculated: For both Scotland and Brazil data were aggregated for those aged 30 years and over.

ii. Direct age and sex standardised rates were calculated based on a hypothetical population (the Canadian population in 1991) as standard for both countries, following a directive from WHO on cross-country comparisons between highly different population profiles (205); national and regional rates were calculated. In Scotland the regional division was based in the

⁴ Available in <http://www.gro-scotland.gov.uk/statistics/theme/population/estimates/mid-year/>.

⁵ <http://www.ibge.gov.br/home/>.

14 territorial NHS health boards and in Brazil it was based on the five socioeconomic regions.

Age/sex standardised rates were calculated by the following equation:

$$dsr = \frac{1000}{p^{(s)}} \sum_{ij} \left(\frac{e_{ij}}{p_{ij}} \right) p_{ij}^{(s)}$$

Where:

dsr = the direct standardised rate

e_{ij} = the number of events of each age/sex group

p_{ij} = the population of each age/sex group

$p^{(s)}$ = total size of standard population

iii. Standard error intervals (95% confidence intervals) were calculated for each age/sex standardised rate ($dsr \pm 1.96se(ds)$) as follows:

$$se(ds) = \frac{1000}{p^{(s)}} \left\{ \sqrt{\sum e_{ij} \left(\frac{p_{ij}^{(s)}}{p_{ij}} \right)^2} \right.$$

Where:

se = standard error

dsr = direct standardised rate

e_{ij} = number of events of each age/sex group

p_{ij} = Population of each age/sex group

$p^{(s)}$ = total size of standard population

iv. Total numbers and rates were described over time nationally, per region and per regime (private or public) in Brazil, and nationally and per NHS board in Scotland.

v. Workforce: for this research no distinction was made between surgeons or consultants because of data limitations. Rates and total numbers were presented over time nationally and per region in Brazil, and nationally and per NHS board in Scotland.

3.5 Sources of bias and limitations

i. Reliability of secondary data from large national databases. NHS Scotland has a small population in comparison with Brazil, and has fewer challenges with data reliability (for population sizes see Table 3.1).

ii. Incomplete data and lack of information from the private/independent sector (in both countries). In Scotland the great majority of procedures are publicly funded; however, in Brazil the opposite is the case, with at least three times more procedures performed by the private sector than by the SUS. There is no official information/register of private-funded procedures. According to unofficial accounts around 70,000⁶ hip arthroplasties are performed every year in Brazil, of which only around 17,000 are publicly funded. According to DataSus 75% of the Brazilian population rely only on the public sector and are not covered by private healthcare insurance (around 150 million people).

iii. Different coding between the two databases. In the Brazilian public sector at this point of time there are five codes for hip arthroplasty (hybrid/non-cemented, cemented, resurface, partial) and one for revision (excluding specification of prosthesis types and specificities of cases). In Scotland the OPCS-4 coding system uses more than 50 codes for arthroplasty and more than 30 for revisions. The level of medical knowledge regarding chronic osteoarthritis and its treatment standards is similar in both countries, so the differences in coding should

⁶ Three unofficial sources available: <http://www.artriterreumatoide.blog.br/artrose-protese-de-quadril-e-joelho-devolvem-mobilidade-ao-paciente/>; http://www.boehringer-ingenheim.com.br/conteudo_imprensa_texto.asp?conteudo=12&texto=988 ; <http://www.diagnosticoweb.com.br/noticias/tecnologias/pesquisadores-reprovam-protese-metalicas-de-quadril.html>

not affect the findings (206, 207). Elective primary hip arthroplasty was considered as a single unit, excluding revisions and including all ways of performing a primary hip arthroplasty.

iv. In both countries administrative data regarding hospital beds are liable to variations due to incomplete electronic records at local level. Differences are expected in administrative definitions of hospital beds when making cross-country comparisons. How these differences are accounted for and the diverse methods of calculating the average number of beds available are limitations of this study.

v. Definitions related to the medical workforce can also be an issue. No difference was established between definition of orthopaedic surgeons and/or only orthopaedic consultants who do not necessarily perform hip arthroplasties in Brazil.

vi. The use of Canadian population estimates establishes a standard and at the same instance differs from both population profiles of Brazil and Scotland.

The limitations of this study are inherent of macro equity analysis (208), in this case specifically about the utilisation of primary elective hip arthroplasties in the public sectors of Brazil and Scotland based on routine data. The methodological outline of this chapter seeks to diminish limitations to a minimum standard based on data availability and limited research resources of a PhD study. An ideal scenario to investigate equity would be to use a set of indicators including other treatments (elective and non-elective) and multiple data bases, crossing results and overpassing some of the cited limitations; such approach would demand resources that were not available for this research.

3.6 Results

3.6.1 Crude and adjusted treatment rates by age in the public sectors of Brazil and Scotland between 2009/10–2012/13

Quantitative findings from patient-level data routinely collected in the Brazilian SUS and the NHS in Scotland are presented. Table 3.1 shows the change of population denominators in both countries. Brazil has quadrupled, while Scotland has remained roughly similar.

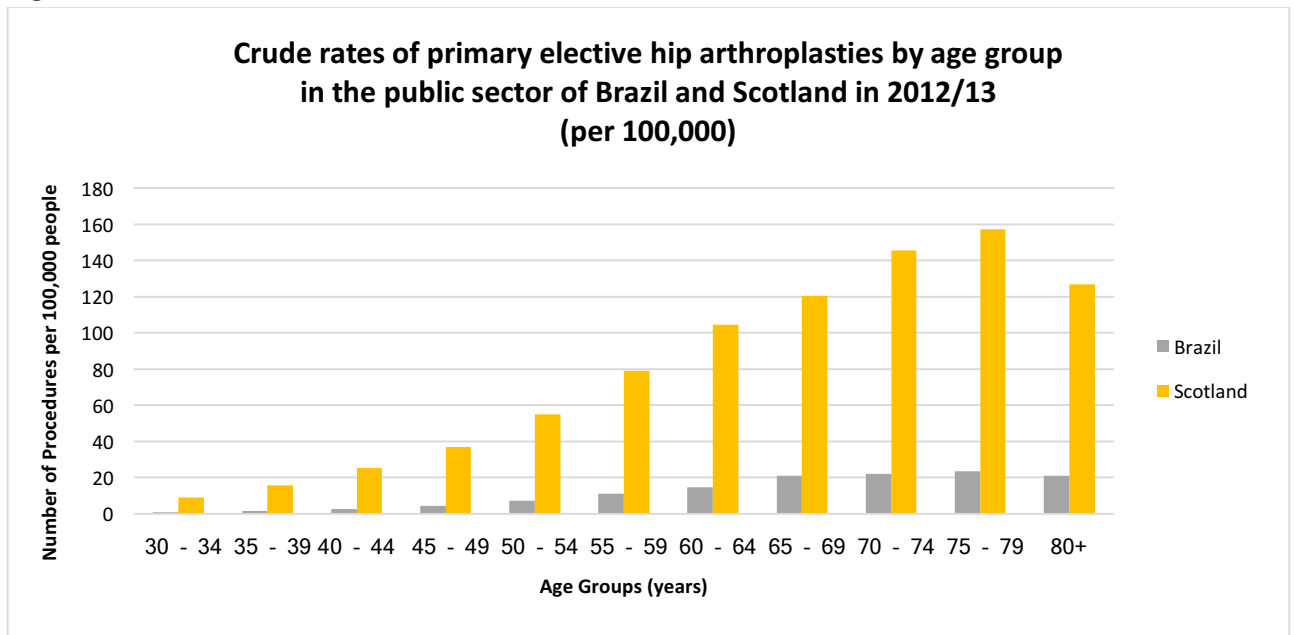
Table 3.1 Population of Scotland and Brazil by decade – period of 1950 – 2010

	1950	1960	1970	1980	1990	2000	2010
Scotland	5,100,847	5,177,658	5,213,700	5,193,900	5,081,270	5,062,940	5,222,100
Brazil	51,941,767	70,070,457	93,139,037	119,002,706	146,825,475	169,799,170	190,732,694

Sources: National Statistics of Scotland and Brazilian Institute of Geography and Statistics.

Figure 3.1 shows crude rates for those aged 30 years and over in 2012/13, divided by age groups (30–34; 35–39; 40–44; 45–49 and so on, up to 80. The final group is 80+). The chart shows the crude treatment rates of the five-year age groups. In Scotland crude rates steadily increase from the 30–34 age group up to the 75–79 group, and then decrease in the 80+ age group. Brazil presents a gradual but smaller increase: the younger age groups between 30 and 40 years old have a near zero rate; rates increase from the 40–44 to the 75–79 age groups, but decrease in the 80+ group. The highest rate in both countries is in the 75–79 age group, however the rate for this age group is six times higher in Scotland than in Brazil; for the younger group 30–34 years the rate is nine times higher in Scotland than in Brazil.

Figure 3.1



3.6.2 National rates of elective primary hip arthroplasties in Brazil and Scotland 2009/10–2012/13

Figure 3.2 shows a seven-fold difference in age standardised rates between Scotland and Brazil. The Brazilian rates remain similar over time, while the Scottish rates slightly decreased in 2010/11.

Figure 3.2

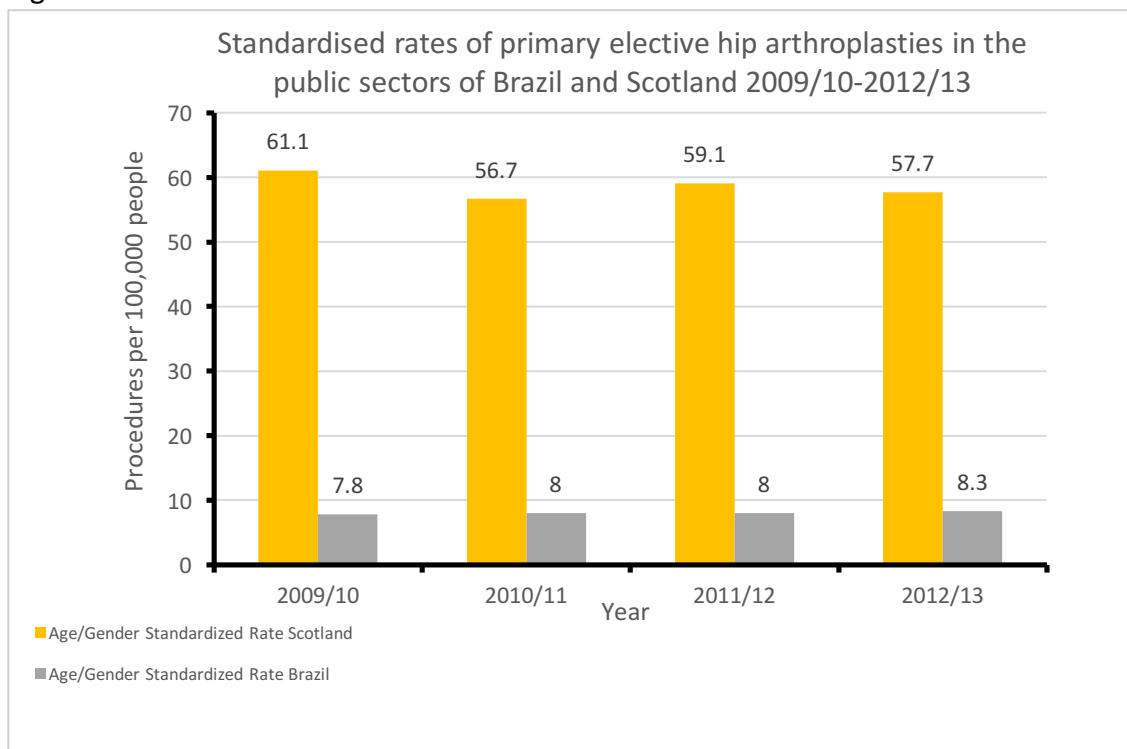


Table 3.2 sets out all standardised rates, with the respective confidence intervals of the estimates for both countries. After standardisation the difference is attenuated, however is still no less than 50/100,000 for the analysed period (only in the over-30s population). Overall rates remained about the same in the period (2009/10-2012/13) in both countries, slightly increasing in Brazil (from 7.8 to 8.3/100,000 95% C.I. ± 0.2 from 2009/10 to 2011/12) and decreasing in Scotland (from 61.1 to 57.7/100,000 95% C.I. ± 2.4).

Table 3.2 Primary elective hip arthroplasties in Brazil and Scotland – standardised rates per 100,000 people in the over-30s population 2009/10–2012/13 (95% C.I.)

Country/Category	2009/10	2010/11	2011/12	2012/13
Scotland Stand. Rate	61.1 (58.6 – 63.6)	56.7 (54.3 – 59.1)	59.1 (56.7 – 61.5)	57.7 (55.3 – 60.1)
Brazil Stand. Rate	7.8 (7.6 – 8)	8 (7.8 – 8.2)	8 (7.8 – 8.2)	8.3 (8.1 – 8.5)

3.6.3 Regional treatment rates in Brazil and Scotland in 2009/10–2012/13

Table 3.3 shows regional differences in elective hip arthroplasty rates. Standardised rates in Scotland vary by NHS board. The two highest rates in 2012/13 for Scotland were the remote and rural Shetland and Orkney, with 185.6/100,000 (C.I. 95% ± 62.6) and 172.7/100,000 (C.I. 95% ± 70.9), respectively.

Table 3.3 Elective hip arthroplasties in Scotland by NHS board – age and sex standardised rate per 100,000 people in the over-30s population 2009/10–2012/13 (95% C.I.)

NHS board	2009/10	2010/11	2011/12	2012/13
Ayrshire/Arran	70.5 (60.2–80.8)	67.8 (57.7–77.9)	59.3 (50.5–68.1)	78 (67.5–88.5)
Borders	97 (76.8–117.2)	130 (104–156.1)	110.5 (87.9–133.1)	206.5 (83–130)
Dumfries/Gall.	114.3 (93.3–135.3)	100.2 (79.9–120.5)	97.7 (80–115.4)	89.6 (71.6–107.6)
Fife	89.5 (83.6–95.4)	78.6 (67.9–89.3)	155.4 (67.4–88)	69.5 (60–79)
Forth Valley	87.6 (75.3–99.9)	85.1 (72.7–97.6)	92.6 (79.3–105.9)	89.1 (76.2–102)
Grampian	48.4 (41.5–55.3)	36.7 (30.8–42.6)	52 (44.9–59.1)	50.6 (43.7–57.5)
Glasgow/Clyde	33.2 (29.2–37.2)	31.6 (27.7–35.5)	36.1 (32–40.2)	30.4 (26.7–34.1)
Highland	78 (62.2–93.8)	70.5 (60.2–80.8)	76.2 (65–87.4)	65.2 (54.9–75.5)
Lanarkshire	65.7 (57.7–73.7)	62.5 (54.7–70.3)	63.1 (55.5–70.7)	68.9 (61–76.8)
Lothian	45 (39.5–50.5)	43.6 (38.2–49)	39.6 (34.5–44.7)	45.8 (40.3–51.3)
Orkney	225.1 (151–299.2)	176.8 (115.5–238.1)	123.8 (74.1–173.5)	172.7 (101.8–243.6)
Shetland	214 (143.9–284.1)	185.3 (117.5–253.1)	216.5 (146.6–286.4)	185.6 (123.1–248.3)
Tayside	64.1 (55.1–73.1)	58.6 (49.9–67.3)	56.1 (47.2–65)	54.8 (46.2–63.4)
Western Isles	182.9 (130.2–235)	142 (94.3–189.7)	195.9 (140.1–251.7)	191.4 (111.9–270.9)
Scotland	61.1 (58.6 – 63.6)	56.7 (54.3 – 59.1)	59.1 (56.7 – 61.5)	57.7 (55.3 – 60.1)

In more populated areas, i.e. the Greater Glasgow and Clyde NHS board (30.4/100,000 C.I. 95% \pm 3.75) and the Lanarkshire NHS board (68.9/100,000 C.I. 95% \pm 7.9), there was a two-fold difference in the rate of elective interventions, between Lothian NHS board (45.8/100,000 C.I. 95% \pm 5.5) and Forth Valley NHS board (89.2/100,000 C.I. 95% \pm 12.9). The regional variation in Scotland is maintained over the period shown, taking only into account rates with smaller Standard Errors (which do not change, remaining within the treatment rate range of \pm 10/100,000 over the years), reflecting relatively stable national numbers (Figure 3.3).

Figure 3.3

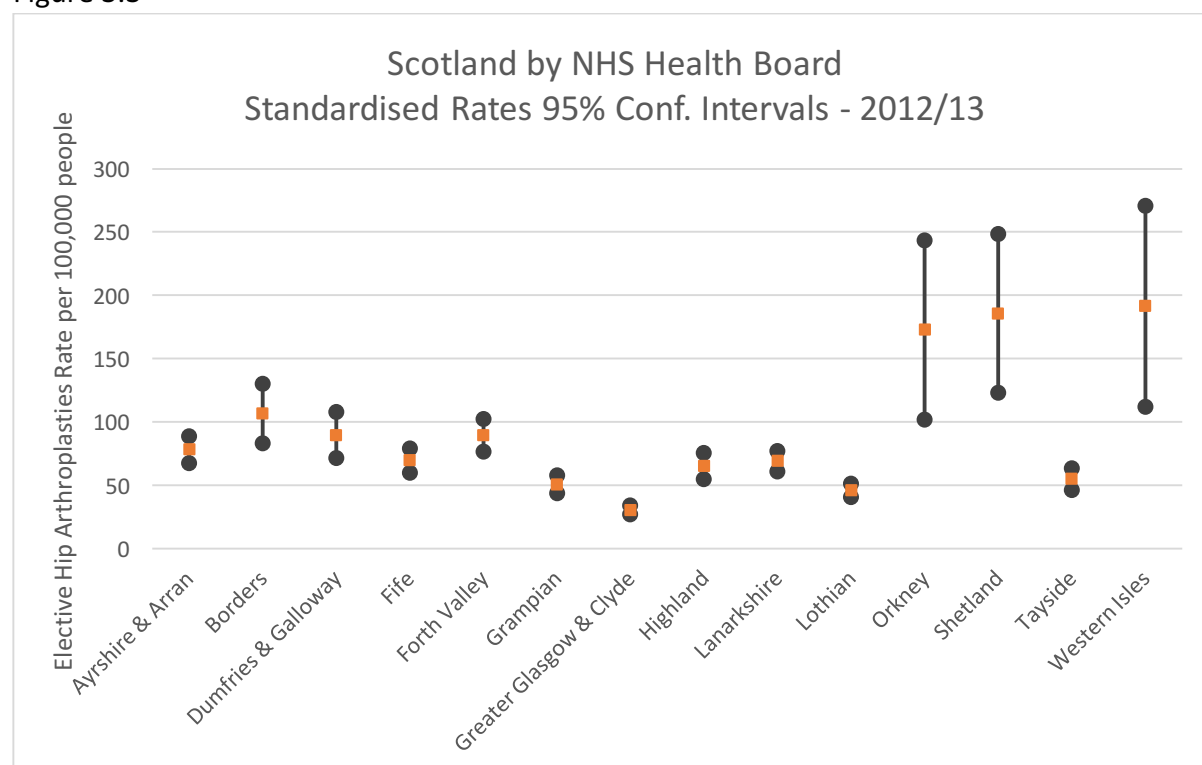


Figure 3.4 and Table 3.4 show that in Brazil, although the national rate increased slightly in the period (2009/10 – 2012/13) from 7.8 to 8.3/100,000, the gap between the extreme north and south increased from 13.2 to 14.8/100,000. The Southeast region has similar rates to the national rate (around 8/100,000); the South region is twice that of national rates, and seven

times that of the North region. With higher population numbers and a profile similar to the standard population used for the comparison, standard errors for Brazil did not exceed the \pm 0.2 to 0.7 range in all regions.

Figure 3.4

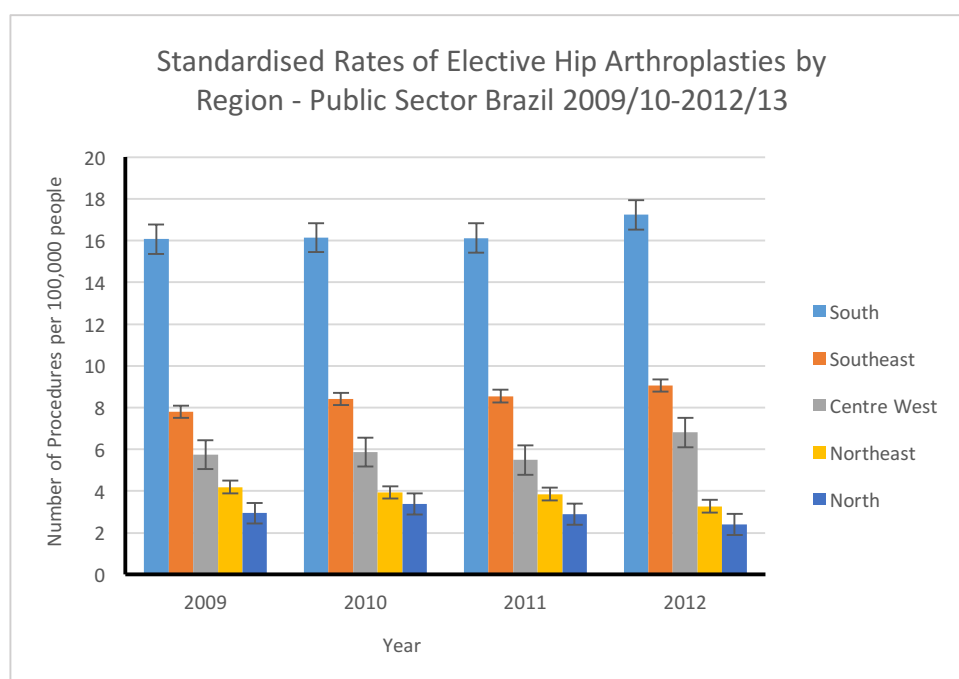


Table 3.4 Elective hip arthroplasties in Brazil by geographic area – Standardised rate per 100,000 people in the over-30s population in the period 2009/10–2012/13 (95% C.I.)

Region	2009/10	2010/11	2011/12	2012/13
South	16.1 (15.4 – 16.8)	16.1 (15.4 – 16.8)	16.1 (15.4 – 16.8)	17.2 (16.5 – 17.9)
Southeast	7.8 (7.5 – 8.1)	8.4 (8.1 – 8.7)	8.5 (8.2 – 8.8)	9 (8.7 – 9.3)
Centre West	5.7 (5 – 6.4)	5.9 (5.2 – 6.6)	5.5 (4.8 – 6.2)	6.8 (6.1 – 7.5)
Northeast	8.4 (3.9 – 4.5)	3.9 (3.6 – 4.2)	5.3 (3.5 – 4.1)	3.3 (3.1 – 3.5)
North	2.9 (2.3 – 3.5)	3.4 (2.8 – 4)	2.9 (2.4 – 3.4)	2.4 (1.9 – 2.9)
Brazil	7.8 (7.6 – 8)	8 (7.8 – 8.2)	8 (7.8 – 8.2)	8.3 (8.1 – 8.5)

In 2012 there was a nearly two-fold difference in treatment rates between the higher performing region in Brazil (South, 17.2/100,000 C.I. 95% \pm 0.7) and the lower performing NHS board in Scotland for the same year (Glasgow and Clyde 30.4/100,000 C.I. 95% \pm 3.7). There is a 30-fold difference between the worst performing region in Brazil and the best

performing Scottish NHS board (with a standard error smaller than 10 (Brazil – North 2.4/100,000 C.I. 95% \pm 0.5, compared with Scotland – Fife 69.5/100,000 C.I. 95% \pm 9.5).

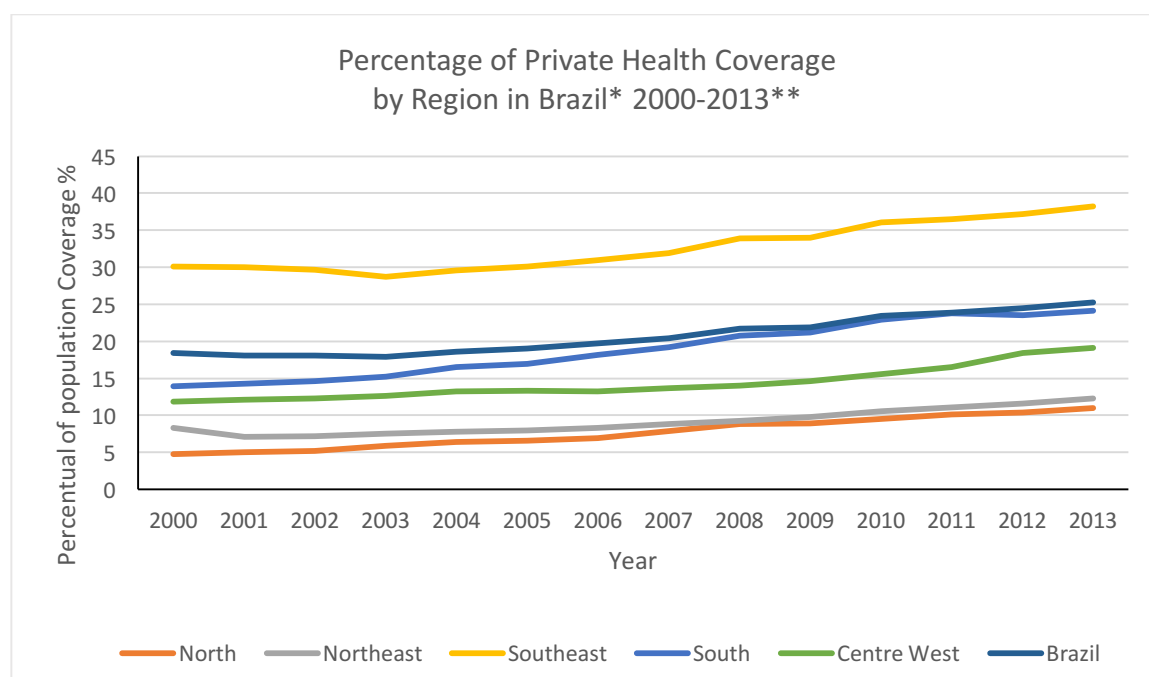
3.6.4 Analysis: supply factors influencing results – private insurance, hospital beds, medical staff rates and other utilisation aspects

I. Private sector in Brazil and Scotland

The number of Brazilian citizens enrolled in private health insurance increased over time in the period 2000 until 2013, and in all regions. In 2013, 25.3 million individuals, about a quarter of the population of 200 million people, were enrolled in private healthcare insurance schemes (Table 3.5), Southeast had the higher percentage of population coverage in 2013 (38.2%) and the North region the lowest (11%).

There are no figures available regarding private insurance/out-of-pocket payments for healthcare in Scotland, only estimates for the UK as a whole (209). The purchase of private medical insurance has been in long-term decline, with demand for health insurance showing relatively flat estimates, with roughly around 11% of the UK population contracting some kind of health insurance (210). 'The figure, however gives a misleading impression as far from all that cover is comprehensive' (209) – differing from the Brazilian case, where most healthcare insurance offers comprehensive coverage. The broad estimate is that around 3% of all GP consultations in UK are linked with the private sector (211).

Figure 3.5



*Percentage in relation to the whole population

**Source: National Agency of Supplementary Health (Agência Nacional de Saúde Suplementar – ANS)

Table 3.5 Percentage of private health insurance coverage by region in Brazil*2003–2013**

Region	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
South	15.2	16.5	17	18.2	19.2	20.8	21.2	22.9	23.8	23.5	24.1
Southeast	28.7	29.6	30.1	31	31.9	33.9	34	36.1	36.5	37.2	38.2
Cen.West	12.6	13.2	13.3	13.2	13.7	14	14.6	15.6	16.5	18.4	19.1
Northeast	7.5	7.8	8	8.3	8.8	9.3	9.8	10.6	11.1	11.6	12.3
North	5.9	6.4	6.6	6.9	7.9	8.8	8.9	9.5	10.1	10.4	11
Brazil	17.9	18.6	19	19.7	20.4	21.7	21.9	23.4	23.9	24.5	25.3

*Percentage in relation to the whole population

**Source: ANS

The private/independent sector in Scotland was regulated from 2000 to 2011 by the Scottish Commission for the Regulation of Care and is now overseen by Healthcare Improvement Scotland (HIS). The voluntary and/or not-for-profit sector comprises 10 hospices, seven acute hospitals, 10 mental health clinics and two specialist cosmetic clinics.

Table 3.6 Private and not-for-profit sector in Scotland 2014 – number of institutions and beds available*

Sector	Institutions	Beds	Day care
Acute Medical and Surgical Hospitals	7	306	-
Mental Health Hospitals and Clinics	10	342	50
Voluntary Hospices	15	286	160
Specialist Cosmetic Clinics	2	-	-
Scotland	34	934	210

*Source: NHS Scotland

II. Trends in public hospital beds in Brazil

In Brazil the number of public beds per 100,000 population has been decreasing since 2007 in all regions, with the sharpest decrease in the Centre West region. A similar decrease in beds is also observed in Scotland (Tables 3.9 and 3.10).

Table 3.7 Rates* and number** of public sector hospital beds by region in Brazil 2007–2014

Region	2007	2008	2009	2010	2011	2012	2013	2014	Dif.***
South*	202.3	194.1	193.0	194.4	192.9	189.8	181.9	183.9	-23.7
**	(54,074)	(53,377)	(53,504)	(53,235)	(53,170)	(52,624)	(52,365)	(53,362)	(-2,632)
Southeast*	177.2	168.2	164.6	162.9	159.2	154.7	146.6	142.5	-37.2
**	(137,997)	(134,915)	(133,213)	(130,910)	(128,877)	(126,186)	(123,815)	(121,329)	(-19,715)
Cen. West*	206.3	196.2	191.3	186.2	181.2	175.5	165.4	163.0	-50.9
**	(27,279)	(26,875)	(26,579)	(26,156)	(25,814)	(25,310)	(24,798)	(24,807)	(-3,039)
Northeast*	206.2	196.7	191.9	191.5	186.8	184.1	175.1	173.4	-37.2
**	(106,280)	(104,443)	(102,846)	(101,642)	(99,954)	(99,244)	(97,697)	(97,404)	(-10,027)
North*	160.7	157.6	158.0	154.5	153.2	149.0	142.5	140.0	-11.3
**	(23,534)	(23,866)	(24,316)	(24,505)	(24,661)	(24,357)	(24,247)	(24,158)	(+1,932)
Brazil**	189.7	181.1	177.8	176.4	172.8	168.9	160.6	158.3	-34.2
**	(349,165)	(343,477)	(340,460)	(336,451)	(332,478)	(327,722)	(322,923)	(321,061)	(-33,482)

*Annual average number of beds available per 100,000 people

*** Difference between years 2007 to 2014

The difference between the number of beds in the Brazilian public sector in 2014 compared to 2007 was negative for all regions, except in the North region where there was a positive difference of 1,932 more beds.

III. Trends in private hospital beds in Brazil

The numbers and rates of hospital beds in the private healthcare sector increased in most regions. Although the highest increase was observed in the Southeast (the richest and most socially unequal region in Brazil), with an average of +8.65/100,000 more beds from 2005 to 2012, there was an increase in the North region, with +8.2/100,000 more hospital beds, despite having lowest private health coverage in the country (Table 3.5).

Table 3.8 Rates* and number** of non-public hospital beds by region in Brazil 2007–2014

Region	2007	2008	2009	2010	2011	2012	2013	2014	Dif.***
South	75.0	74.4	76.1	78.2	78.4	78.1	76.9	75.5	+3.28
**	(20,062)	(20,448)	(21,097)	(21,419)	(21,615)	(21,667)	(22,142)	(21,915)	(+1,852)
Southeast	78.7	78.1	80.2	83.1	84.2	84.2	81.6	82.5	+8.65
**	(61,320)	(62,605)	(64,885)	(66,781)	(68,182)	(68,685)	(68,960)	(70,220)	(+8,900)
Cen. West	77.5	74.6	76.1	77.4	77.2	78.2	79.5	80.8	+6.90
**	(10,246)	(10,222)	(10,569)	(10,868)	(10,991)	(11,284)	(11,924)	(12,300)	(+2,054)
Northeast	33.0	33.0	34.8	37.0	37.0	36.3	35.3	35.5	+1.37
**	(17,015)	(17,530)	(18,667)	(19,643)	(19,792)	(19,565)	(19,688)	(19,961)	(+2,945)
North*	41.7	39.1	39.1	39.1	41.1	44.3	44.7	44.3	+8.22
**	(6,101)	(5,920)	(6,020)	(6,201)	(6,613)	(7,239)	(7,599)	(7,649)	(+1,548)
Brazil	62.4	61.6	63.3	65.5	66.1	66.2	64.8	65.1	+4.74
**	(114,745)	(116,727)	(121,239)	(124,914)	(127,195)	(128,442)	(130,314)	(132,047)	(+17,302)

* Annual average number of beds available per 100,000 people

*** Difference between years 2007 to 2014

All regions of Brazil saw an increase in the number of private sector beds over the seven years to 2013/14, with a total increase of 17,302.2 beds in this period.

IV. Trends in hospital beds – NHS Scotland

The average numbers of NHS beds and rates per 100,000 population decreased between 2005 and 2014 in all of Scotland and in all NHS boards, with the exception of Dumfries and Galloway, where there was an overall increase of 63.7 beds in the period.

Table 3.9 Average rates* of NHS hospital beds by health board in Scotland 2007–2014**

Region	2007	2008	2009	2010	2011	2012	2013	2014	Dif.***
Ayrsh/Arran	327.3	323.5	324.6	314	269	300	295.7	296.9	-30.4
Borders	356.4	353.2	340.6	318.4	303.8	276.6	229.7	214.7	-141.7
Dumf/Gallo.	294.1	289.9	348.8	352.4	343.5	346.7	346.2	351.4	+57.3
Fife	234.7	234.6	229.1	219.8	213	213.3	201.3	228.8	-5.9
Forth Valley	224	229.5	233.8	205.7	192	217	206.9	210.2	-13.8
Grampian	359.5	345	335.8	327.5	309	307.4	304.3	301.7	-57.8
Glasgow/Cly.	457.5	456.8	442.7	435.4	428.2	416.2	405.1	400.6	-56.9
Highland	346.9	334.3	338.1	325	296.2	281.2	273.4	276.3	-70.6
Lanarkshire	239.5	236.1	233	233.8	231.3	220.2	231.6	233.3	-6.2
Lothian	314.2	312.8	310.8	305	291.8	282.5	287.6	283.9	-30.3
Orkney	255.9	207.1	227.2	226.5	214.1	207.6	210.1	195.1	-60.8
Shetland	252.9	204.7	212.6	216.4	216.4	243.3	250.2	244.6	-8.3
Tayside	354.4	341.7	339	336.1	348	341.8	340.4	337.8	-16.6
West. Isles	534.1	481.3	475.2	463.6	433	409.8	369.8	384.5	-149.6
Scotland	338.6	333.4	332.1	324.5	314.5	308.7	304.6	305.1	-33.5

*per 100,000 people

**Source: ISD

*** Difference between years 2005 to 2014

In Scotland there was a decrease in the number of beds per 100,000 population in the period 2007 to 2014, from 338.6 to 305.1, across all health boards – except Dumfries and Galloway, which increased. Glasgow and Clyde health board, on the other hand, closed 471.6 beds overall.

Table 3.10 Number of NHS hospital beds by health board in Scotland 2007–2014*

Region	2007	2008	2009	2010	2011	2012	2013	2014	Dif.**
Ayrsh./Arran.	1,213.6	1,203.7	1,209	1,170.7	1,106.5	1,119.7	1,100.5	1,101.8	-136.6
Borders	399.9	400.4	386.9	362	345.9	314.6	261.5	244.8	-133.2
Dum./Galloway	442.3	437.7	527.3	532.4	520.1	522.9	520.2	526.9	+96.5
Fife	841.9	844.8	828	797.2	778.1	781	738.4	840.4	-28.8
Forth Valley	652.6	672.4	687.8	608.9	572.2	649.2	319.9	631.5	-81.8
Grampian	1,971.2	1,910.3	1,877.9	1,849.6	1,759.8	1,762.5	1,762.5	1,762.6	-146.4
Glasgow/Clyde	5,087.5	5,101.4	4,968.1	4,910.6	4,861.3	4,734.1	4,609.3	4,577.4	-471.6
Highland	1,091.9	1,059.2	1,075.9	1,037.7	952.6	899.3	877.7	886.3	-211.9
Lanarkshire	1,536.8	1,521.9	1,508.5	1,518.3	1,507.4	1,436	1,511.5	1,524.3	-48.5
Lothian	2,518	2,530.2	2,538	2,518.1	2,440.8	2,383.6	2,443.3	2,436	-79.7
Orkney	52.7	43	47.6	48.1	45.9	44.7	45.3	42.1	-23.2
Shetland	56.5	46	48.4	49.9	50.3	56.5	58	56.8	-1.2
Tayside	1,411.8	1,373.5	1,370.8	1,368.2	1,427.7	1,407.2	1,403.2	1,397.7	-57.1
West. Isles	145.3	131.3	130.3	128	119.9	112.9	101.3	104.8	-57.7
Scotland	17,504	17,344	17,374	17,077	16,666	16,401	16,229	16,315	-1,243

*Source: ISD; ** Difference between years 2007 to 2014

V. Comparing trends in hospital bed numbers in Brazil and Scotland over time

The difference in the availability of public hospital beds between Scotland and Brazil is almost two-fold. In Brazil the number of beds per 100,000 people in 2014 was 158.3, compared with 305.1 for the same year in Scotland.

Table 3.11 Rates* and number of hospital beds in Brazil (SUS and private) and Scotland (only NHS) for 2007/2014**

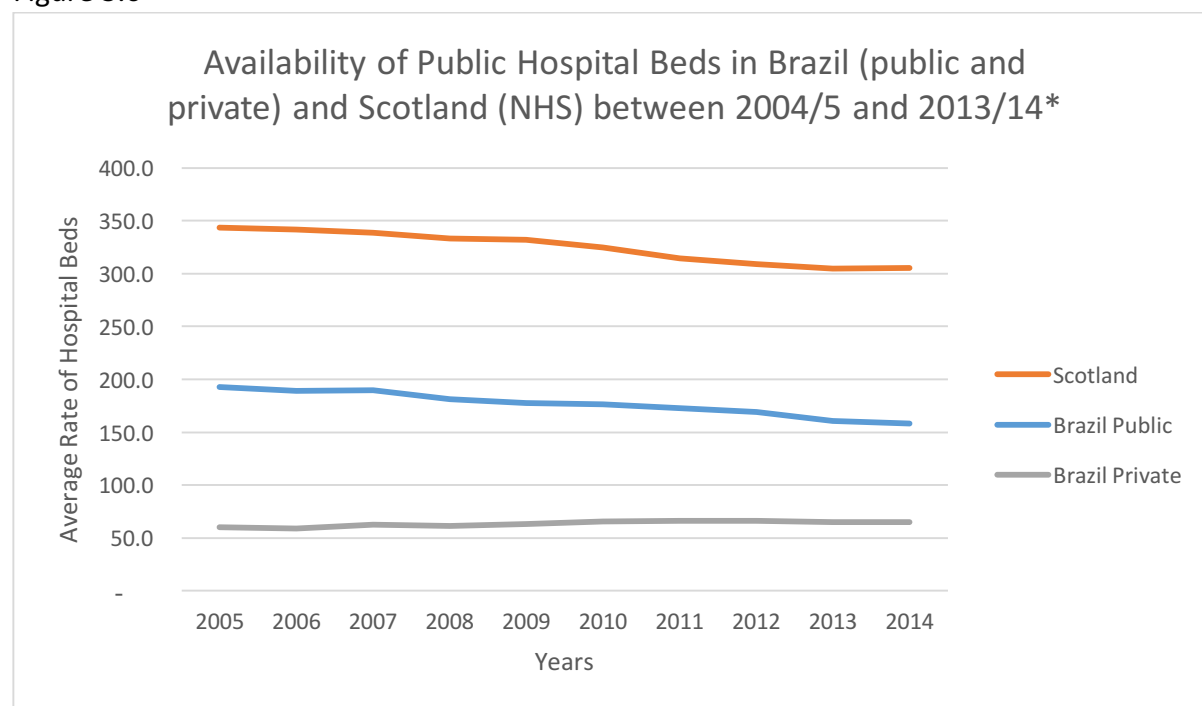
	2007	2008	2009	2010	2011	2012	2013	2014	Dif.***
Scotland	338.6	333.4	332.1	324.5	314.5	308.7	304.6	305.1	-33.5
Brazil SUS	189.7	181.1	177.8	176.4	172.8	168.9	160.6	158.3	-31.4
Brazil private	62.4	61.6	63.3	65.5	66.1	66.2	64.8	65.1	+2.7

*per 100,000 people

**Sources: NHS Scotland and DataSUS

*** Difference between years 2005 to 2014

Figure 3.6



*per 100,000 people

VI. Specialised hospital beds – orthopaedic beds in Brazil (private and public) and Scotland

Table 3.12 shows an increase of +0.9/100,000 orthopaedic beds at national level in Brazil. The region with the smallest rate of hip arthroplasties, the North, presents the highest national increase of +2.0/100,000 beds for orthopaedic interventions.

Table 3.12 Average rates* of public sector orthopaedic surgical beds per region in Brazil 2007–2012**

Region	2007	2008	2009	2010	2011	2012	Dif.***
South	4.7	4.9	5.3	5.6	5.7	5.8	+1.1
Southeast	5.3	5.2	5.3	5.6	5.6	5.6	+0.3
Centre West	8.0	8.2	8.0	7.9	8.3	8.8	+0.8
Northeast	4.8	5.1	5.4	5.8	5.9	6.2	+1.4
North	3.9	4.3	4.7	5.1	5.4	5.9	+2.0
Brazil	5.2	5.3	5.5	5.8	5.9	6.1	+0.9

*per 100,000 people

**Source: Hospital beds – DataSUS; population – IBGE

*** Difference between years 2007 to 2014

When comparing both countries, the national rate of public sector orthopaedic surgical beds for Brazil in 2012 was 6.1/100,000; in Scotland this rate for 2012 was 26.3/100,000. Scotland has nearly five times the number of beds per 100,000 that Brazil has.

Table 3.13 Average rates* of NHS orthopaedic/trauma surgical beds per health board in Scotland 2005–2014**

Region	2007	2008	2009	2010	2011	2012	2013	2014	Dif.***
Ayrsh./Arran.	28.1	28.2	27.7	29	26.1	24.9	24.3	24.2	-3.8
Borders	30.5	29	30.1	31.2	29	27.8	29.8	30.1	-0.4
Dum./Galloway	28.9	23.1	23.5	24	23.4	21.1	20.5	20.2	-8.8
Fife	20.2	20.2	20.1	18.8	18.3	18.7	17.9	18.1	-2.1
Forth Valley	32.4	33.6	30.3	30.7	22.6	15.7	13.4	13.6	+18.8
Gold Jub.	-	-	-	-	-	-	-	-	-
Grampian	16.1	17.1	17.2	15	13.7	14.6	14.5	14.5	-1.6
Glasgow/Clyde	129.6	126.6	123.5	124.9	118.5	116.9	110.8	109.9	-19.7
Highland	11.1	11.1	10.4	10.2	9.7	9.4	9.2	9.2	-1.8
Lanarkshire	17.1	16.9	17	18	16.7	18	16.6	17.1	-0.01
Lothian	936.3	868.6	808.5	845.7	765.1	672.6	709.6	702.2	-234.2
Orkney	0	0	0	0	0	0	0	0	0
Shetland	0	0	0	0	0	0	0	0	0
Tayside	542.9	527.5	505.1	509.7	580.3	572	552.3	546.3	+3.4
West. Isles	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	+0.01
Scotland	29.7	29.3	28.5	28.5	26.9	26.3	25.4	25.5	-4.2

*per 100,000 people; **Source: ISD; *** Difference between years 2007 to 2014

Regional rates of orthopaedic surgical beds in the private sector have not expanded as much as they have in the public sector. National rates of private sector beds only for orthopaedic purposes had an average increase of 0.7/100,000 at national level, with the highest increases in the North and the Southeast, both with a figure of +1.0/100,000 more private sector beds.

Table 3.14 Average rates* of private sector orthopaedic surgical beds by region in Brazil 2005–2012**

Region	2005	2006	2007	2008	2009	2010	2011	2012	Dif.***
South	1.5	1.6	1.7	1.9	2.0	2.3	2.3	2.2	+0.7
Southeast	1.3	1.5	1.7	1.7	1.8	1.9	2.2	2.3	+1.0
Centre West	2.8	2.9	3.0	2.8	2.7	2.8	2.7	2.7	-0.1
Northeast	1.2	1.3	1.3	1.3	1.5	1.5	1.6	1.7	+0.5
North	0.7	0.9	1.2	1.0	1.1	1.3	1.4	1.7	+1.0
Brazil	1.4	1.5	1.6	1.6	1.8	1.9	2.0	2.1	+0.7

*per 100,000 people

**Source: Hospital beds – DataSUS; population – IBGE

*** Difference between years 2007 to 2014

VII. Medical workforce and orthopaedic specialists in Brazil and Scotland

The distribution of medical doctors in Brazil is uneven: the Southeast region has the highest numbers of specialists and non-specialists per head of population (Table 3.15). The South region has a high rate of specialists, being 64.9% of all registered medical doctors. In the period in question Brazil had 198.8 medical doctors per 100,000, compared to 327.4 in Scotland for the same period (Tables 3.15 and 3.16).

Table 3.15 Rates* and percentage** of medical doctors and consultants in Brazil per region – 2013

Region	Non-specialised	Medical Specialist	All Practitioners
South	72.9 (35.1%)	134.8 (64.9%)	207.7 (100%)
Southeast	126.9 (47.9%)	138.1 (52.1%)	265.1 (100%)
Centre West	81.4 (40.1%)	121.6 (59.9%)	203.0 (100%)
Northeast	64.0 (52.1%)	58.8 (47.9%)	122.7 (100%)
North	55.2 (55.2%)	44.8 (44.8%)	100.0 (100%)
Brazil	92.3 (46.4%)	106.5 (53.6%)	198.8 (100%)

*per 100,000 people; ** Percentage from the whole medical doctors workforce; *** Source: Nominator and percentage – Perfil dos Médicos no Brasil(212) ; denominator: population – IBGE

Although more than half of Brazilian medical practitioners are specialists, there is a high proportion of non-specialist clinicians (46.4%). There are 53 recognised medical specialties in Brazil, however six specialties account for nearly half of all professionals (48.6%) (Table 3.17): paediatrics (11.2%), obstetrics and gynaecology (9.3%), general surgery (8.3%), general practice (8.2%), anaesthesiology (6.8%) and occupational medicine (4.8%). Orthopaedics is eighth in this list, accounting for 3.9% of all professionals.

Table 3.16 Number and rates* of general practitioners and medical specialists in Scotland per health board – 2012

Region	Number of General Practitioners	Rate of General Practitioners	Number of Medical Specialists	Rate of Medical Specialists	Rate of All Medical Doctors
Ayrsh./Arran.	313	83.9	616	169.9	253.8
Borders	118	103.8	195	160.9	264.7
Dum./Galloway	152	100.8	247	198.9	299.7
Fife	278	75.9	515	150.5	226.4
Forth Valley	268	89.6	455	164.2	253.8
Grampian	553	96.4	1,232	246.8	343.2
Glasgow/Clyde	1,071	94.2	3,392	309.5	403.7
Highland	392	122.6	471	178.5	301.1
Lanarkshire	411	63	909	148.9	211.9
Lothian	842	99.8	2,049	251.9	351.7
Orkney	26	120.8	29	116.1	236.9
Shetland	33	142.2	30	112	254.2
Tayside	368	89.4	1,076	280	369.4
Western Isles	39	141.5	16	87.1	228.6
Scotland	4,859	91.4	236	236	327.4

*per 100,000 people

** Source: Nominators and population denominators – ISD

Table 3.17 Number and percentage of practitioners per medical speciality in Brazil – 2013

Specialisation	Number	Percentage	Cumulative Percentage
1. Paediatrics	30,112	11.2%	11.2%
2. Obstetrics and Gynaecology	25,032	9.3%	20.6%
3. General Surgery	22,276	8.3%	28.9%
4. General Practice	2,890	8.2%	37.0%
5. Anaesthesiology	18,236	6.8%	43.8%
6. Occupational Medicine	12,756	4.8%	48.6%
7. Cardiology	11,568	4.3%	52.9%
8. Orthopaedics and Traumatology	10,504	3.9%	56.8%
9. Ophthalmology	9,862	3.7%	60.5%
10. Radiology and Image Diagnosis	7,925	2.9%	63.4%
11. Psychiatry	7,558	2.8%	66.3%
12. Dermatology	5,930	2.2%	68.5%
13. Otolaryngology	4,976	1.9%	70.3%
14. Plastic Surgery	4,818	1.8%	72.1%
15. Intensive Care	4,275	1.6%	73.7%
Others Specialties	70,488	26.3%	100%

Source: Brazilian Federal Council of Medicine (212)

Orthopaedics is the eighth most popular specialty in Brazil, with 10,504 surgeons or consultants, representing 3.9% of the whole medical workforce – in the UK this specialty is also in eighth position, accounting for 4.5% of all specialists. In Brazil the number of orthopaedic surgeons is 5.2 per 100,000, compared with 6.4 in the UK for 2012.

3.7 Discussion

This study shows seven- and eight-fold differences in the national crude and standardised treatment rates between Brazil and Scotland in 2009/10 to 2012/13, as well as major within-country differences.

Brazil has a higher percentage of people enrolled in private health care plans. About 25% of the Brazilian population are enrolled in the private sector, despite the existence of universal public care in the country. However, these discrepancies cannot be entirely explained by

differences in the supply of beds and staff in the public and private sectors. The study also shows inequalities in supply at regional level in both countries.

Other studies have already shown an inverse association between treatment rates and social deprivation (more social deprivation – less procedures) (59, 117, 120).

Although the Brazilian data used by this study were from the public sector only (DataSUS), the two regions with lower enrolment rates for private health coverage for 2012 (North 10.4%; Northeast 11.6%) had lower hip arthroplasty rates in the public sector. In the North region, 89.6% of the population relied only on the public sector for healthcare in 2012, and in the Northeast region this percentage was 88.4% of its citizens. If the private sector data from these regions were available, the figure would be only respective to around 10% of the population covered by healthcare private insurance in these regions. The data for this research covers roughly 90% of the whole population of the North and Northeast of Brazil – its poorest regions. The highest percentage of private sector coverage in Brazil is in the Southeast region (37.2% in 2012), where rates of hip arthroplasties follow the national average of around eight procedures per 100,000 people, well below the Scottish NHS rate of over 60 procedures per 100,000 people for the same period. The missing data from the Brazilian private sector could partially explain the apparent lack of hip arthroplasties in the country in relation to Scotland.

The share of the private healthcare system in Brazil and the lack of official data about its performance must be highlighted, as it is estimated by unofficial accounts that this sector performs at least three times more elective primary hip arthroplasties than its public counterpart every year⁷. The three times higher national estimate of procedures indicates

⁷ For these 'unofficial accounts' sources see footnote 6.

that osteoarthritis possibly has a similar morbidity in Brazil and Scotland. Such a probability would be consistent with the literature about the prevalence of this condition in the western global population (213). In other words, if the cause of the small rates in relation to Scotland was to be attributed to regional morbidity differences of OA in the Brazilian population, the private sector would likely follow the public sector indicators, as they relate to the same population. The higher number of procedures by the private sector most likely indicates an unmet need of the population dependent only on SUS. Nevertheless, without available data it is not possible to be precise about the size of the gap between these rates per region, or to estimate possible population needs.

Another factor influencing the utilisation rates of hip arthroplasties in our main findings might be related to the number of hospital beds per 100,000 people available in the public sector of both health systems. National rates of beds in the public sector of Brazil and Scotland have decreased from 2005 to 2012, with a roughly two-fold difference between the SUS and the NHS over that period: 158.3/100,000 in Brazil for 2014 and 305.5/100,000 in Scotland for the same year. The decrease in the period 2005–2014 was -34.2/100,000 beds in Brazil and -38.5/100,000 beds in Scotland. It is claimed that most of this decrease is due to rationalisation of administrative processes, improved actions related to infection control, and better oriented care and clinical decisions at the hospital setting (214), which translated into shorter admission periods in both health systems. Nonetheless, in Brazil some of the decrease is attributed to the closing of local small hospitals throughout the past decade – a cause of disagreement between central government and municipalities (215).

The number of private sector hospital beds increased in most regions of Brazil, following the expansion in private health coverage to the population. As mentioned, in both countries

availability of hospital beds was diminished in the public health sector; however, in the Brazilian case this was followed by an increase in beds by the private sector. The sharpest decrease in public hospital beds in Brazil was in the Southeast region, with a decrease of 37.2/100,000 beds, whilst in the same period the private sector expanded its provision by 8.2% in that region, increasing by 8.6/100,000 beds (82.5/100,000 is the actual rate for 2014). This meant 61,320 more beds for the sector in that region alone. In short, in the Southeast, where there was the highest rate decrease of beds in Brazil, the private sector increased its coverage ratio.

Notwithstanding the wide differences in procedure rates, public hospital beds, demography and socioeconomics, there is a relevant similarity between Brazil and Scotland: the medical workforce. The similar national rate of non-specialised medical doctors in Brazil (92.3/100,000) and general practitioners in Scotland (91.4/100,000) and orthopaedists (5.2/100,000 in Brazil and 6.4/100,000 in the UK), paired with the presented rate results, provides evidence that the distribution of these professionals in Brazil deserves attention. It is thus difficult to reliably estimate how many of these professionals there are in the public or in the private sector, as most of them practice medicine in both; for Brazilian medical specialists, to become gradually involved with the private sector means developing a successful career (216). The small independent sector in Scotland (the country's equivalent of a private healthcare sector) probably does not influence specialist wages as much as is the case in Brazil (217), where professionals are paid for each procedure performed under the aegis of pre-paid healthcare insurance or considerably higher out-of-pocket payments.

Another aspect of the Brazilian medical workforce is that the majority of specialists are trained in publicly funded hospitals linked to universities and medical schools (which in Brazil

are also, mostly, subsidised by the state). The public health system in Brazil bears the cost of training specialists who will, as they gradually progress in their careers, move steadily further away from the SUS-dependant population (215, 216). Training of specialists also happens in the public sector of Scotland in a similar way, the difference is on the medical career progression. This is possibly one of the central controversies related to the Brazilian private sector: with highest wages and multiple profit possibilities, this sector diminishes the availability of a specialised medical workforce in Brazil in accordance with the inverse care law (218).

3.8 Conclusion

Brazil and Scotland both show regional variations in sex and age standardised hip arthroplasty rates. However, Brazil has 20-fold lower rates than Scotland in some of its regions: the North and Northeast of Brazil had the lowest rates. Economically underdeveloped regions (219), both have been the main targets of federal social programmes of income distribution (220) in the past decade with successful health outcomes (221, 222).

The influence of the health system setting in Brazil, with two sub-health systems, a public and a private one, does not guarantee access. There is a highly skewed distribution of specialists towards wealthier areas with more private provision.

Scotland has significant regional variations in respect of the hip arthroplasties rate indicator. In the next chapter we will add the SIMD scores available in the ISD data extract to evaluate utilisation associated with socioeconomic factors. Procedures will be aggregated at national level and by NHS board for this analysis.

The difference in treatment rates between Brazil and Scotland is striking but so to be expected, the within country variations raise another question: is there a social gradient in utilisation of hip arthroplasties performed by the public sector of Brazil and Scotland?

4. Socioeconomic indices and elective hip arthroplasties – the Scottish Index of Multiple Deprivation and a national level healthcare access measurement for Brazilian SUS

Findings and summary of this section at a glance

- ✦ Lower levels of utilisation of healthcare services are not only linked to material deprivation, but also with the reduction of opportunities caused by social deprivation;
- ✦ The Scottish Index of Multiple Deprivation is the aggregate result of data from seven deprivation domains: income, employment, health, education, access to services, living environment/housing, physical environment and crime;
- ✦ All routine data produced by NHS Scotland is automatically associated with the local deprivation index based on the citizen's postcode, providing a strong framework to evaluate access to healthcare in relation to socioeconomic factors;
- ✦ The routine data produced by the Brazilian SUS has improved from 2008 onwards, after changes following international standards of data collection and management, however it is not linked with any deprivation measurement;
- ✦ The number of elective primary hip arthroplasties in the public sector of Scotland has grown between 1993/94 to 2012/13, however the growing rate was considerably higher for the less deprived quintiles (4 and 5);
- ✦ In relation to elective primary hip arthroplasty rates in Scotland, the most deprived quintile (1) did not significantly grow since 2005/06, while all other quintiles (2,3,4 and 5) presented a steady increase;
- ✦ For the year 2010/11 there is an inverted correlation between the municipal Gini Income Index and municipal rates of elective primary hip arthroplasties performed by the Brazilian SUS, meaning that as more unequally income is distributed within the population, the lower the procedure rates will likely to be;
- ✦ For the year 2010/11 there is a positive correlation between the municipal Human Development Index and municipal rates of elective primary hip arthroplasties performed by the Brazilian SUS, meaning that as more local Human Development (levels of education, income distribution and life expectancy), the higher the procedure rates will likely to be
- ✦ Fitting a Zero Inflated Poisson Regression model to the municipal elective primary hip arthroplasty rates of 2010/11 by the Brazilian SUS demonstrates that: for each standard deviation of Gini Index, local treatment rates would be 23% higher or lower, for Human Development each standard deviation would correspond to a 56% increase or decrease of rates;
- ✦ Nearly half of the Brazilian municipalities (5,565) presented zero values, hence the need of a Zero Inflated Poisson Regression;
- ✦ Brazilian municipalities with higher proportions of population over 60 years of age were more likely to present one or more procedures;
- ✦ Municipalities with higher proportions of the population falling in the category of low income were more likely to present zero values for rates of elective primary hip arthroplasties;
- ✦ There is a social gradient for access to elective primary hip arthroplasties in both countries, Brazil and Scotland, however the higher social inequality levels of the former increase the steepness of the gradient at national level for Brazilians.

Universal access to healthcare through publically funded health systems aims to achieve collective welfare regardless of social class, gender, age or ethnicity, ultimately reducing inequalities (223). Despite this intent, differences in regard to access to health and healthcare are present, to some extent, in all public health systems (224). The WHO Commission on Social

Determinants of Health in 2005 illustrates the close link between social conditions and inequalities of health and sees this as a global concern (225).

A constant challenge for social medicine and population health policies is how to measure inequalities in access to health and healthcare based on evidence (56): clinical/scientific knowledge or statistical methods and, most importantly, reliable primary data. No research method can produce valid findings without trustworthy primary level information, even though some methods reduce limitations caused by data problems, good quality primary level data remains essential in public health studies and planning (55).

Higher levels of poverty are mostly associated with worse health indicators (88). The association of poverty with substandard health has been interpreted and named in various ways by social and medical scientists across countries. Lack of material and social conditions in a multi-dimensional basis, ranging from basic needs to a wider context of access to goods, housing and education, is referred as *deprivation* by Peter Townsend and others (226-228). These authors build up a concept that goes far beyond a simplistic matter of associating low income and poverty. Professor Amartya Sen debates the *deprivation of choices*, which would directly affect the *individual freedom of making choices*, in other words, what an individual wants to be or do (227). Broader constraints on well-being, such as discrimination, disability, a hazardous living environment and others, might directly affect the variety of options that a person will have to choose from, not just their financial income (229) .

In this chapter the origins of measuring social inequalities in the UK are described briefly from some earlier attempts to measure poverty up to the contemporary Index of Multiple Deprivation (IMD) and its reviews. IMDs are a widely used tool in the UK to measure *relative deprivation*, in other words how some people live in deprived conditions in relation to others

of the same population. Although sharing a common conceptual framework of deprivation, every UK country uses different data sources to calculate area based IMDs; limitations and differences within UK member countries are summarily presented. The focus here is the IMD used by Scottish researchers and government, the Scottish Index of Multiple Deprivation (SIMD).

Data from Chapter 3 containing rates of elective primary hip arthroplasties in Scotland are analysed in association with SIMD variables, named index of multiple deprivation, depicting the social aspects of access to elective healthcare in Scotland. This study formerly established a comparison of national and regional rates between Brazil and Scotland. Data were directly standardised⁸, allowing comparisons, and some limitations of the Brazilian routine data collection have been highlighted. The direct comparison of Scotland and Brazil related to deprivation levels and access to elective hip arthroplasties is not methodologically feasible, due to limitations in, and differences in the available Brazilian public sector routine data. What is possible, however, is to propose a method which evaluates if elective procedures offered by the Brazilian public sector follow, at municipal level, a socioeconomic gradient regarding access to healthcare.

Scottish data allow historic trends of deprivation over time to be analysed, used in association with age and sex standardised rates. Data obtained from Brazil cover one fiscal year (2010/11) due to resources/time limitations. The method can be replicated in association with municipal rates of any other procedure, hence the availability of reliable values of the local Gini

⁸ The method of *direct standardisation* is applicable when specific age/sex rates of an event are available and placed in a standard population distribution for the sake of analysis, method described and used in Chapter 3 to compare rates of elective primary hip replacements between the public sectors of Brazil and Scotland. An *indirect standardisation* method would be used if such information was not attainable, increasing the error margin of estimates.

coefficient and Human Development Index (HDI). Further limitations and strengths of this study are presented in the methods section and debated in the discussion of the study results.

4.1 Objectives

The objectives of this chapter are as follows:

- (1) To review and describe the theoretical basis of indices of multiple deprivation (IMDs), focusing on the work of Jarman, Carstairs and Townsend; and to present data sources, strengths and limitations of the socioeconomic measurement methods proposed by these authors.
- (2) To describe and analyse age and sex standardised deprivation quintiles in Scotland (1993/94–2013/14) for patients who received elective primary hip arthroplasties, based on the SIMD.
- (3) To verify if there is a social gradient for utilisation of elective primary hip arthroplasties in Scotland in the given period.
- (4) To analyse utilisation of elective primary hip arthroplasties at municipal level performed by the public sector following two mainstream socioeconomic indicators.
- (5) To verify if there is a correlation of utilisation of elective primary hip arthroplasties with the chosen socioeconomic indicators at the municipal level in Brazil for the year of 2010/11.
- (6) To build a statistical model on routine data from the Brazilian SUS (Elective Hip Arthroplasties) with two mainstream socioeconomic indexes for the fiscal year of 2010/11.

4.2 The works of Jarman, Carstairs and Townsend – pathways to an Index of Multiple Deprivation and socioeconomic issues related to healthcare

The measurement of deprivation presented in this chapter is the result of theoretical discussions and experimentation building from seminal research works dating from the early 1970s (230). The issue of measuring poverty had already been highlighted by household surveys in the 19th century (231). Measuring inequalities, poverty and deprivation has deep roots in the establishment and maintenance of the British welfare system (194). In 1980 the publication of the Black Report (30) highlighted large differences between social classes in Britain, with those in the upper classes having more favourable outcomes in relation to mortality and morbidity, and those in lower classes facing issues that were not redressed by social or health services (232).

Three authors directly influenced policy-making in the UK: professors Brian Jarman, Vera Carstairs and Peter Townsend. All three shared a common goal of searching for more effective distribution of scarce resources for healthcare and improvement of the measurement of health needs.

I. Jarman Index

The *underprivileged area score* or Jarman index was an attempt to improve the measurement of general practitioners' (GPs') workloads, consequently indicating how to better distribute resources throughout primary care. Based on information from national censuses and on electoral geographic areas the index is calculated from national level official data associated with information collected by local GPs (233). The measurement was influential throughout the 1980s: it was added to the calculation formula used by the Resource Allocation Working Party (RAWP) after criticisms that RAWP was not accounting for social deprivation in its

decisions (234). The Jarman index was used as evidence to justify differences in public funding based on capitation in favour of areas *supposedly of most social need*: in theory directing more resources to the most deprived areas (234).

The use of a correlation between higher workloads for GPs linked with deprived areas has been described as lacking supporting evidence (235). Such a scoring system came under scrutiny by specialists after studies showed that its results did not necessarily highlight areas in most need of healthcare. In 1991 two studies did not recommended its use for planning healthcare or the distribution of resources (235, 236). In comparison with other deprivation indexes (Townsend's material deprivation index, the Scottish Development Department's index and the Department of Environment's basic index) the Jarman index was demonstrated to be the least likely to be linked with morbidity indicators (236).

II. Carstairs, Townsend and deprivation

Material deprivation is the focus of the work of Carstairs and Townsend. Both of their indexes are based on census data: the first was developed for small area measurements in Scotland while the latter was based on electoral wards of England (spatial units used to elect local government councillors in metropolitan and non-metropolitan districts). The Carstairs index is based on four variables taken from censuses: unemployment, house overcrowding, car ownership and social classes (237).

In the late 1970s before attempting to measure poverty with indexation methods the definition of poverty was itself heavily debated:

'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**' (238) p.31, (my bold emphasis)

Despite the common interchangeable use of the words *poverty* and *deprivation* they have different meanings and are not based on the same concepts (239). Poverty relates to the lack of financial resources to meet possible needs, whereas *deprivation* refers to the lack of all kinds of resources, not just financial. Again, Townsend in a later article clarifies that:

‘people can be said to be **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 (...)’ (226) p.131 (my bold emphasis)

Deprivation indicates unmet needs: social and material. The latter are easier to measure (clothing, housing, household facilities, etc) whereas the former are much harder to evaluate. Both embody the concept of *social exclusion*. Townsend’s seminal work lays down the foundational concept of *multiple deprivation* as an accumulation of single deprivations, their measurement is used to form IMDs. The findings of his research, based on individual deprivation, are applied to small area deprivation measurements in Northern Ireland, Wales, England and Scotland. The adaptation of his concepts of individual deprivation to small area-based approaches, generalising results, are a consequence of the limitations of data collection systems (240).

A main limitation of both Carstairs’ and Townsend’s indexes is that estimates are drawn from census data; consequently an update is available only every 10 years, which is the time interval between censuses in the UK.

III. Indexes of Multiple Deprivation (IMDs)

Availability, quantity and quality of data has much improved since the 1980s, but data are still not without limitations. IMDs (240) have the advantage of being updated annually while census data are updated only every ten years due to the complexity and costs involved (241). As previously mentioned, IMDs are an area based resource of measuring relative deprivation. To quantitatively classify specific areas as more or less deprived in comparison to others is helpful for national and local authorities, allowing better allocation of resources, or the development of specific policies aimed to reduce social inequalities within the population.

These indexes are in constant development and re-evaluation, as different weights are applied to its measurements in response to the local characteristics of each UK country (Table 4.1). There are also differences in data collection, availability of information and data sources which directly influence the measurements. The data sources are derived from official data by public bodies like Her Majesty's Revenue and Customs (HMRC), the Home Office, the Department of Health, the Department of Education and others. Only variables not available from the predecessor year are taken from Census data.

The *domains* of a deprivation index were proposed by Robinson, who divided such an index into *environment, education, income* and *jobs* (242). For Noble et al. (240) these are conceptual spheres from which indicators draw indexes rather than data *per se*:

'domains, for us, are area-level dimensions of deprivation which need to be measured as accurately as possible and which **aggregate to a measure of multiple deprivation**. Thus, each dimension is **measured independently** with the best indicators available to generate a score or domain measure for each aspect of deprivation' (p.173, my bold emphasis).

The domains approach allows separate analyses, such as analysis of *housing deprivation* or analysis of *health deprivation*. The matter of including or not including an income measurement rather than the ownership of specific goods (car, television, etc), or the lack of sociably perceived needs is highlighted by Gordon et al.(243). However, the measurement of income and employment is still central to multi-deprivation analysis in the UK – Table 4.1 (240).

Table 4.1 Domains and relative weightings of domains of IMDs – UK (230)

	England 2010	Northern Ireland 2010	Scotland 2009	Wales 2008
	Weight	Weight	Weight	Weight
Income	22.5%	25%	28%	23.5%
Employment	22.5%	25%	28%	23.5%
Health	13.5%	15%	14%	14%
Education and training	13.5%	15%	14%	14%
Access/barriers to services	9.3%	10%	9%	10%
Living environment/housing	9.3%	5%	2%	5%
Physical environment	0%	0%	0%	5%
Crime	9.3%	5%	5%	5%

There is a conceptual accordance between the four IMDs used in the UK. However, weights and the quantity of variables for each domain varies within countries. Factors that influence deprivation differ from country to country, so there is no common measurement like a single UK deprivation index (244). The variation of statistical weights of each domain follows statistical significance and specific characteristics of each country (245), hence the differences between domains and components presented on Tables 4.1 and 4.2.

Table 4.2 Components of IMD income and employment domains – UK

	England 2010	Northern Ireland 2010	Scotland 2009	Wales 2008
Income				
Income support	✓	✓	✓	✓
Pension credit	✓	✓	✓	✓
Jobseeker's allowance	✓	✓	✓	✓
Tax credits	✓	✓	✓	✓
Housing benefit		✓		
Asylum seekers' support	✓			✓
Employment and Support Allowance (ESA)		✓		
<i>Weighting of domain</i>	22.5%	25%	28%	23.5%
Employment				
Unemployment-related benefits	✓	✓	✓	✓
Employment and Support Allowance (ESA)	✓	✓		
Incapacity benefit	✓	✓	✓	✓
Severe disablement allowance	✓	✓	✓	✓
Carer's allowance		✓		
New Deal participants	✓	✓	✓	✓
<i>Weighting of domain</i>	22.5%	25%	28%	23.5%

As previously mentioned, data from a range of sources build up the IMDs, paradoxically increasing both the strengths and limitations of such measurements. A main limitation when considering only the UK is that the IMDs used by each country are not directly comparable, as they adopt diverse weights for each component aspect. As statistical weights and variables might vary, IMDs are not completely comparable over time. Another drawback is that of post code-based assumptions, which overlook individuals and their specificities. Despite its constraints, the wide range of data collection systems which compose the sources of information allow a large range of possible applications for IMDs in assessing social inequalities at small area levels (240).

IV. The Scottish Index of Multiple Deprivation (SIMD)

The Scottish version of the IMD divides Scotland into 6,505 small areas, named datazones, each comprising around 350 households with an average of 800 people. A relative ranking

system list these datazones from 1 (most deprived) to 6,505 (least deprived). The SIMD is primarily a diagnosis tool to identify zones where deprivation is concentrated, 'targeting policies and resources at the places with greatest need' (246 p.2).

The statistical method was primarily developed by the Social Disadvantage Research Centre at the University of Oxford, which was commissioned by the Scottish government to develop a framework of multiple deprivation analysis specifically for Scotland. Their report and methods were published in 2003 (247). Further publications in 2004, 2006, 2009 and 2012 by the Scottish government reviewed methods, weights and variables (246), always preserving the original basic approach developed by the Oxford group. Seven domains make up the index, each one comprising several indicators. The seven domains are:

- Employment
- Income
- Health
- Education, skills and training
- Geographic access to services
- Crime
- Housing

The National Health Service of Scotland utilises the SIMD data to link a multiple deprivation quintile to each procedure performed or paid for by the public sector. The previously ranked data zones are divided into quintiles, respectively from the most to the least deprived. As the SIMD index is area-based, and therefore linked to postcodes, a quintile value (from 1 to 5) is associated with the declared residence of the individual receiving care. When linking this information with the proposed discussion of access to healthcare, it is possible to verify the quintiles distribution of a specific procedure during a period of time, assessing if people living in deprived areas are receiving similar care to that received by those from the least deprived

areas. If that is not the case, it is an indication that policies targeting issues of access related to socioeconomics should be considered by health authorities.

Despite the limitation of ranking areas and not individuals (even if based on person-level data like income) using averages, IMDs such as the Scottish one support the development of target-based actions with evidence, theoretically improving resources allocation and narrowing social inequalities related to health.

4.3 A method of associating data on access to healthcare and socioeconomics for Brazil

Indexes of deprivation are an important tool for identifying disadvantaged areas within predefined geographic precincts. These measurements are particularly efficient in societies where economic inequalities are less perceptible, as the case of most developed countries illustrates (87). The socioeconomic picture of developing or late developed countries tends to present clear geographic and social boundaries, where urbanised areas are surrounded by deprived areas known as slums or, in Portuguese, *favelas*. These social gaps, when related to health in Brazil, are a consequence of mixing intense non-planned urbanisation with an equally non-planned two-tier health system, which divides the offer of care between a private and a public health system. The two-tier offer of care services at national level leans towards the inverse care law in which healthcare staff/services distribution tend to follow the most favoured economic areas, particularly where there are market forces (218).

As formerly mentioned, an IMD is a compilation of diverse pieces of information from numerous data sources. Reliable indexes are produced from a conglomerate of data, even though they come from a mix of different streams of information (248). These data identify social inequalities, either of access to care, education, distribution of income or general access to public services.

Although Brazilian primary routine data might lack reliability, sources related to an area-based Gini coefficient and HDI are considered accurate by international research bodies (249). The Gini data in Brazil is based on household surveys and estimates of the Brazilian Institute of Geography and Statistics (IBGE). For the past 15 years Brazil has remedied previous issues by implementing standards of routine national data collection, mainly performed by health workers of SUS. Despite such advances by the public sector, after more than a decade of setting up a similar public electronic platform for the private sector (22), no patient level data are available from the private health sector in Brazil.

There is agreement in the literature that wider social inequalities contribute to higher inequalities of health indicators at a population level (57, 250). The way that distribution/offer of care is organised throughout a health system can either narrow social differences or reinforce already existing divisions (199). The social theory called *income inequality hypothesis* is the framework of many inequality studies that considered comparisons between extracts of the same population: such hypothesis ascertains that income distribution in a population directly affects health outcomes of individuals. In this conceptual framework of associating differences in income with specific health indicators, data used to compare members of the same population tend to be less susceptible to differences of collection or other aspects which might hinder comparisons (251).

The method proposed in this section has the aim of overcoming some of the limitations of primary health data in Brazil. When generated, the routine data produced by SUS at patient level is not associated with any socioeconomic measurement, in contrast to the previously described SIMD in Scotland. Raw data from procedures performed by SUS are available to download at the Ministry of Health website together with the population count used to

estimate municipal rates of elective primary hip arthroplasties. The socioeconomic indicators for each of the 5,565 municipalities in Brazil are widely available on the internet, both for the Gini coefficient and for the four aspects of the HDI (aggregated, income, education, longevity).

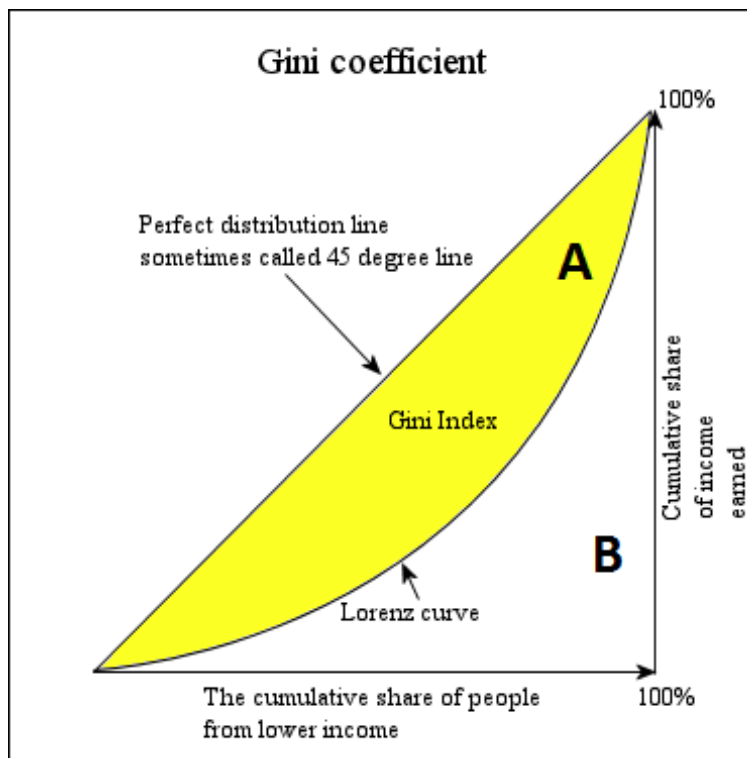
4.3.1 Gini coefficient and Human Development Index

I. The Gini coefficient

The Gini index or Gini coefficient was proposed by the sociologist Corrado Gini in a seminal paper (252) in 1912 and became the most widely used statistical measure of income inequality in the 20th century (253). His method was not originally intended as an income comparison technique as it only measures **the dispersion and frequency distribution of values**: such values can be related to variables other than income. Applying this distribution measurement to income per capita in a population, the 'values' correspond to the amount (fraction) of income that each individual in a population receives from the whole produced by society (total income/input of the population) and how this compares to other components from the same group.

Mathematically the ratio is based on the Lorenz Curve, which plots the total income of a population (Figure 4.1 – vertical *axis*) with the percentage of people from this population (Figure 4.1 – horizontal *axis*). The '45 degree' line represents perfect equality of income distribution; the Gini coefficient is the ratio of the area between the Lorenz Curve and the '45 degree' line: the shaded area represented by 'A' in Figure 4.1 (254).

Figure 4.1 Lorenz Curve and Gini index calculation*



*Adapted from various sources (20, 251, 254, 255)

The level of dispersion is measured from 0 to 1, where 0 would indicate a perfect equal distribution and 1 a perfect unequal distribution (one individual obtains all output produced) – both extreme situations are hypothetical. The smaller the Gini indicator is (i.e. the closer to zero) the more equally income is distributed within society. As an example, measurements were between 0.249 and 0.457, respectively, for Denmark and Mexico (both OECD countries) in 2012⁹. According to Gini, Mexico presents a higher level of inequality related to income than Denmark. The Gini coefficient has been widely accepted by economists and social scientists as a reliable income equity measurement. Nonetheless, it has also been criticized for measuring income and not wealth, in many societies this means that it only partly captures economic inequality, privilege and disadvantage (20, 256). In this study Gini values will be

⁹ OECD (2015), Income inequality (indicator). doi: 10.1787/459aa7f1-en (Accessed on 25 August 2015).

associated with the HDI of Brazilian municipalities; Gini's robustness is reinforced if used in combination with a second marker (20).

For cross-country comparisons regarding health and social inequalities the Gini coefficient attained importance in the efforts of Wilkinson (4, 257), who has shown a strong inverse correlation between inequality (measured by Gini) and life expectancy ($r = -0.81$, $P < 0.0001$). When analysing countries of the Organisation for Economic Co-operation and Development (OECD), Wilkinson found that the more unequal a society is in relation to income distribution, the lower is the average life expectancy of individuals in that society. A main criticism of this kind of association is that the sources of data vary across countries, hindering the validity of comparisons. However the same argument benefits within-country comparisons as primary data come from the same sources (258).

The Gini is one among many ways of evaluating income inequality and has been used mainly for cross-country or within-country comparisons. In studies of access to healthcare this index has usually been associated with other socioeconomic measurements as it measures only the dispersion of income, not taking into account any other variables. When Gini is associated with other socioeconomic variables, reinforces the causal relation between income inequality and health outcomes (256).

II. Human Development Index (HDI)

The HDI comprises three levels of data: longevity, standard of living and education levels. It was developed by Mahbub ul Haq, based on the seminal work of the Nobel prize winner Amartya Sen (259). HDI is the main evaluation outcome of *development of a nation* by the United Nations (UN). The social theory backing the index is that human development is not measured only by economic indicators; thus, the purpose of the index is 'to shift the focus of

development economics from national income accounting to people-centred policies' (259). In 2010 a second index was conceived, adding inequality-adjusted calculations. This was named the Inequality-adjusted HDI (IHDI). The HDI has increased the accuracy of human development cross-country comparisons (260). The measurement is considered to be 'the most well-known aggregate measure of well-being' (261 p.131). Data sources of the HDI are the United Nations Population Division (life expectancy), the United Nations Educational, Scientific and Cultural Institute for Statistics (mean years of schooling and expected years of schooling data) and the World Bank (Gross National Income per capita).

The data that compose the HDI are: **longevity (Life Expectancy Index)**, based on life expectancy at birth; **education level or attainment (Education Index)**, based on adult literacy and the expected years of school life; and **standard of living (Income Index)**, calculated by a ratio of the real gross national income (GNI) per capita adjusted for purchasing power.

$$1. \text{ Life Expectancy Index (LEI)} = \frac{\text{LE} - 20}{85 - 20}$$

LE: Life Expectancy at birth

LEI is 1 when Life expectancy at birth is 85 and 0 when Life expectancy at birth is 20.

$$2. \text{ Education Index (EI)} = \frac{\text{MYSI} + \text{EYSI}}{2}$$

$$2.1 \text{ Mean Years of Schooling Index (MYSI)} = \frac{\text{MYS}}{15}$$

MYS: Mean years of schooling (Years that a person 25 years-of-age or older has spent in schools). Fifteen is the projected maximum of this indicator for 2025.

$$2.2 \text{ Expected Years of Schooling Index (EYSI)} = \frac{\text{EYS}}{18}$$

EYS: Expected Years of Schooling (years that a 5-year-old child will spend in school throughout his life). Eighteen is equivalent to achieving a master's degree in most countries.

$$3. \text{ Income Index (II)} = \frac{\ln(\text{GNIPC}) - \ln(100)}{\ln(75,000) - \ln(100)}$$

GNIPC: Gross national income at purchasing power parity per capita

Income Index (II) is 1 when Gross National Income (GNI) per capita is \$75,000 and 0 when GNI per capita is \$100.

Finally, the HDI is the geometric mean of the previous three normalized indices (262):

$$\text{HDI} = \sqrt[3]{\text{LEI} \cdot \text{EI} \cdot \text{II}}$$

Source: The Human Development Report 2010 (262)

The final number is a figure between 0 and 1, where zero represents the lowest human development and 1 the highest development levels. The index has received criticism for giving too heavy a weight to literacy (263), for being volatile in historical comparisons (probably due to changes in primary data collections over time) (264) and for receiving a weight variable review proposed by a UN commission in 2010 (265).

The UN funds international and national reports based on human development. It has published international reports since 1990 (261, 263, 264, 266). Specifically in Brazil the UN Development Programme (UNDP), commonly known by its Portuguese acronym PNUD (Programa das Nações Unidas para o Desenvolvimento), publishes a yearly report with area-based HDI values, supporting local actions/policies for improving standards of living, education and life expectancy.

All HDI values and spreadsheets used for this study are available on the Brazilian PNUD website.¹⁰

¹⁰ <http://www.pnud.org.br/>

4.4 Methods

4.4.1 Scotland

Stage 1. Obtaining data from NHS Scotland

For data sources and the process of applying to obtain data from ISD Scotland refer to Chapter 4. Data from all elective hip arthroplasties in Scotland was obtained for the period 1993/94–2012/13.

Stage 2. Applying SIMD quintiles to raw data

The SIMD (2010/11) attributed to each patient by its postcode was applied. Data were plotted as absolute numbers to highlight possible trends over time (1993/94 to 2012/13).

Stage 3. Age and sex standardisation

The process of age and sex standardisation was described in Chapter 3. For this analysis the age and sex standardisation was extended to 1993/94 – in the previous chapter the data used was only for the period between 2009/10 to 2012/13.

Stage 4. Calculating age and sex standardised percentages per quintile

After age and sex standardisation, multiple deprivation quintiles were divided to their correspondent proportion (percentage) of the absolute standardised values. Data were plotted to highlight trends over time (1993/94 to 2012/13).

Stage 5. Highlighting changes

To account for yearly changes, age and sex standardised percentage differences were calculated from one year in relation to the previous and organised by the respective multiple deprivation quintiles. To stress trends in these data, the period of analysis was divided into 3

stages, presenting the average difference: from 1993/94 to 2000/01, from 2000/01 to 2007/08 and from 2008/09 to 2012/13.

Stage 6. Highlighting trends

To illustrate possible socioeconomic changes in the proportion of patients undertaking elective hip arthroplasties from both ends of the deprivation spectrum (quintiles 1–2 most deprived and quintiles 4–5 least deprived) the quintiles were grouped into standardised percentage bands. Quintile 3 was considered in a separate band and used as a dividing line between the most deprived and the socioeconomically better off patients. The period of analysis was the same as for previous stages (1993/94–2012/13).

4.4.2 Brazil

The following stages combine two widely used socioeconomic indexes with municipal rates of elective hip arthroplasties. These steps could be replicated with the rates of other procedures (267). The method is cross-sectional and has the aim of producing a national picture of access to elective healthcare in the public sector for a specific period. It is an attempt to overcome (even if only partially) the lack of primary socioeconomic information linked with routine data in Brazil. The objective of such a method is to analyse the hypothesis of a social gradient of access to elective hip arthroplasties in the Brazilian public health sector, following international trends already observed in other countries.

Stage 1. – Obtaining primary data

Files containing raw data of all authorisations for hospital admissions (in Portuguese *Autorização para Internação Hospitalar*) are available to download from the Ministry of

Health of Brazil through the DataSUS website¹¹. Files are grouped by state: Brazil has 26 states plus the Federal District, which amounts to 27 sources of raw information. For every year there are 12 raw files for each of these sources, a total of 324 raw files per year.

Stage 2. – Filtering the data

Using the freeware available at the DataSUS website (in Portuguese only) the data were aggregated and the specific procedures of interest¹² were filtered, producing Excel spreadsheets. The data used in this study were the total of all elective hip arthroplasties performed in the public sector in Brazil in the year 2010/11 and divided by the municipality of residence of patients.

Stage 3. – Calculating standardised rates

The number of procedures and the population of each municipality in Brazil (5,565 municipalities) was used to calculate directly standardised rates of treatment at municipality level.

Stage 4. – Obtaining Gini index and HDI of Brazilian municipalities

The HDI score of each municipality of Brazil was obtained in the Report of Human Development of 2010 from the United Nations Development Program (Portuguese acronym PNUD) (268), with four values – HDI, HDI income, HDI longevity, HDI education.

The Gini coefficient of each municipality of Brazil was given by the World Bank Data Report 2010 (45).

¹¹ <http://www2.datasus.gov.br/DATASUS/index.php?area=0901&item=1&acao=25>

¹² <http://www2.datasus.gov.br/DATASUS/index.php?area=060805>

Stage 5. – Aligning standardised procedure rates with socioeconomic indexes

Using SPSS Version 20, a statistical software package, a spreadsheet was created in which each line corresponded to a municipality in Brazil. The database was then filled with the information collected so far: name of the municipality, standardised rate of procedures (elective hip replacements), HDI (HDI1), HDI Income (HDI2), HDI Longevity (HDI3), HDI Education (HDI4); Gini coefficient; proportion of population over 60 years old (Pop_Ov_60) and proportion of population with a low income (Pop_Low) of less than £30/month.

The database looked like this:

1. Municipality X_1 – Rate X_1 – Gini Index – HDI1 – HDI2 – HDI3 – HDI4 – Pop_Ov_60 – Pop_Low
2. Municipality X_2 – Rate X_2 – Gini Index – HDI1 – HDI2 – HDI3 – HDI4 – Pop_Ov_60 – Pop_Low
3. Municipality X_3 – Rate X_3 – Gini Index – HDI1 – HDI2 – HDI3 – HDI4 – Pop_Ov_60 – Pop_Low
- |
- |
5563. Municipality X_{5563} – Rate X_{5563} – Gini Index – HDI1 – HDI2 – HDI3 – HDI4 – Pop_Ov_60 – Pop_Low
5564. Municipality X_{5564} – Rate X_{5564} – Gini Index – HDI1 – HDI2 – HDI3 – HDI4 – Pop_Ov_60 – Pop_Low
5565. Municipality X_{5565} – Rate X_{5565} – Gini Index – HDI1 – HDI2 – HDI3 – HDI4 – Pop_Ov_60 – Pop_Low

Stage 6. – Calculating Spearman’s correlations

In SPSS Spearman’s correlations were calculated between the standardised rates and the socioeconomic indexes, obtaining the association between utilisation of elective hip replacements with the Gini and HDI per municipality. The option for this specific type of correlation was due to the distribution of values between rates and the continuous values of Gini and HDI (between 0 and 1). Pearson’s correlations were tested with similar results, however presenting less accuracy.

Stage 7. – Building a zero-inflated Poisson (ZIP) regression model

A particular characteristic of the case of elective hip arthroplasties in the Brazilian public sector is that when the data are plotted by patient’s municipality of residence, there were no

procedures in a large amount of municipalities. Probably due to the size of some municipalities and the distribution of healthcare services towards large urban centres, from a databank of 5,565 municipalities, only in 3,070 did patients undergo elective hip arthroplasty.

In cases where a large part of the sample has zero procedures a zero inflated Poisson model is the most adequate statistical choice as the modelling splits the multilevel regression into two different processes (269): one driven by a Poisson distribution which generates counts predicting non-zero values; and a second one that uses a logit model to predict the occurrence of zero-value observations (1 = no procedures / 0 = at least one procedure) (270). In other words, the model 'separates' the prediction of a municipality of presenting or not zero values, and at the same time evaluates the effect of the variables in the municipalities that have non-zero values. If a classic Poisson model was applied, the fact that a large part of the sample present zero values would interfere in the balance of the statistical model, hindering its findings or estimates. The ZIP model is a version of the Poisson model and has been designed to have a better 'statistical fitting' with samples that present large numbers of zero values (271).

Using Stata statistical software, version 12, a ZIP model was fitted to variables available from DataSUS routine data collection; the number of elective hip arthroplasties per municipality of residence of the patient; and the values of the Gini and HDI for each city. For both Gini and HDI a standardised score was calculated (z-score) and used in the model to facilitate interpretation. The Vuong test was used in order to verify if the ZIP model was the most statistically adequate model, rather than a Poisson model (272).

The non-zero part of the model was fitted to five variables: Gini index, HDI, HDI related to education, HDI related to longevity and HDI related to income distribution. The zero part of

the model was fitted to two variables: proportion of population with low monthly income (less than £34)¹³ and proportion of elderly population (over 60 years old). Several alternative model specifications were tested; the choice of variables was given by a balance between the log likelihood being less negative (less than 0.7/0.8) and the relevance of variables to the issue of access to elective hip arthroplasties.

4.5 Sources of bias and limitations

There are many limitations when working with large databases of routine healthcare data and statistical healthcare models. If, on the one hand, the large number of cases (sample) contributes to narrowing the confidence intervals around the estimates, on the other hand the use of an elective healthcare procedure like hip arthroplasties as a proxy measure of access skews the prevalence of cases towards urbanised areas. Although complex health technologies are scarcely available in most small municipalities of Brazil and Scotland, geographic/travel distances in Brazil are a stronger influencing factor. Data in Brazil were divided by municipality, which represented a significant limitation; hence the need to use a ZIP model.

Specifically in regard to the issue of elective procedures it is necessary to highlight that an area-based measure does not take into account individual constraints/deprivation – it is estimated that around two-thirds of the most deprived people in Scotland do not necessarily live in an area classified as socioeconomically deprived (246).

¹³ Threshold of low income established by the Brazilian Institute of Geography and Statistics.

4.6 Results

4.6.1 Scotland: elective hip arthroplasties and multiple deprivation quintiles

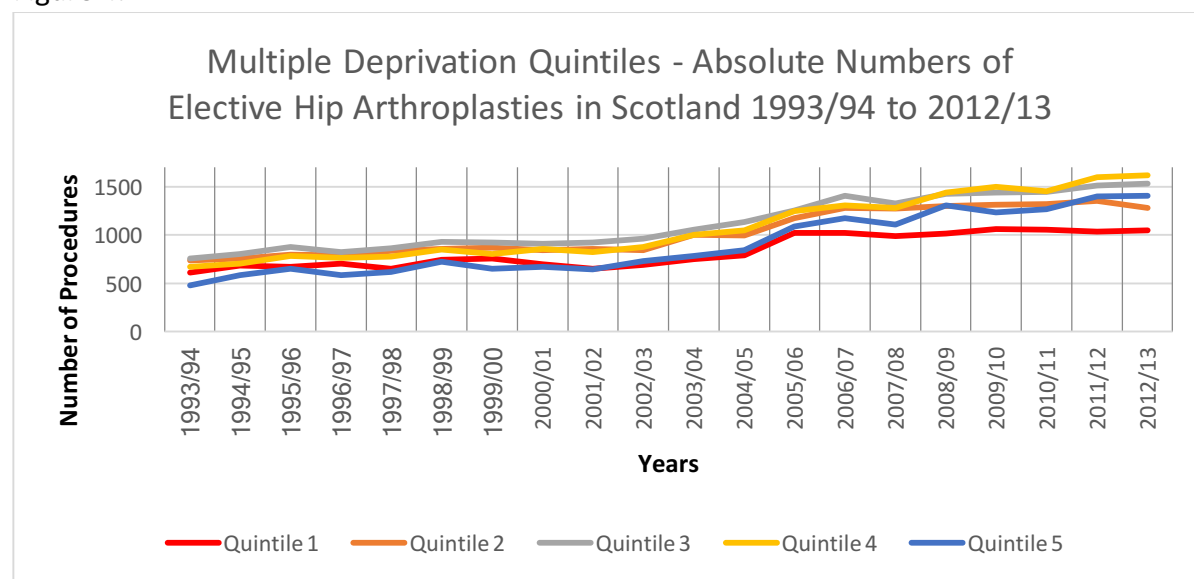
In absolute numbers elective hip arthroplasties more than doubled in the Scottish NHS from 1993/94 to 2012/13 (Table 4.3), starting with 3,279 procedures in the beginning of the 1990s and reaching 6,920 procedures by 2012/13. However, multiple deprivation quintile trends changed in the course. There was an increase of procedures in the first 14 years considered by this study, particularly between 2000/01 to 2006/7 when procedures rose from 4,012 in 2000/01 to 6,206 in 2006/07. The same period presents an increase in quantity for all quintiles, with slight variations of distribution within the social scale (quintile 1 for the most deprived and 5 for the least deprived). Distribution trends in absolute numbers start to change from 2006/7 onwards, when quintiles 3, 4 and 5 keep a steady increase (between 2006/07 to 2012/13): quintile 3 from 1,407 procedures to 1,533; quintile 4 from 1,308 procedures to 1,622 and quintile 5 from 1,173 procedures to 1,404. In the same time frame, quintiles 1 and 2, representing the lower end of the social scale, did not follow such increase pace (between 2006/7 to 2012/13): quintile 1 rose from 1,020 procedures to 1,047 and quintile 2 remained practically the same, going from 1,282 procedures to 1,280.

Table 4.3 Multiple Deprivation Quintiles – Absolute Numbers of Elective Hip Arthroplasties in Scotland 1993/94 to 2012/13

Year	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	Total
1993/94	612	737	754	672	479	3279
1994/95	684	758	802	704	585	3568
1995/96	672	797	875	786	653	3820
1996/97	701	789	823	763	587	3692
1997/98	652	840	862	777	616	3764
1998/99	746	859	929	850	726	4126
1999/00	756	871	922	806	652	4039
2000/01	699	842	913	860	668	4012
2001/02	654	860	926	824	647	3926
2002/03	692	842	964	874	729	4119
2003/04	749	1002	1057	1004	787	4615
2004/05	792	999	1135	1047	844	4831
2005/06	1023	1178	1252	1250	1090	5803
2006/07	1020	1282	1407	1308	1173	6206
2007/08	992	1271	1327	1279	1106	5990
2008/09	1014	1301	1428	1438	1306	6503
2009/10	1063	1316	1442	1500	1233	6578
2010/11	1057	1323	1449	1452	1266	6569
2011/12	1034	1353	1513	1597	1403	6920
2012/13	1047	1280	1533	1622	1404	6909

Absolute number trends over time are shown in Figure 4.2: from 1993/94 until 2004/5 both ends of the social scale (quintiles 1/2 and quintiles 4/5) present similar trend lines, all increasing over time. From 2005/6 onwards, in absolute numbers, quintiles 1 and 2 (most deprived) reach a *plateau* until 2012/13, whilst quintiles 3,4 and 5 maintain the similar increasing trend from previous years.

Figure 4.2



The annual increase rate in number of procedures is illustrated in Table 4.4 by the percentage difference in relation to the previous year. The fiscal years with the most overall increase in relation to previous years are 1998/99 (9.6% overall); 2003/04 (12% overall) and 2005/06 (20.1% overall). Whilst the number of procedures increased as a whole, the variation rate by multiple deprivation quintiles vary over time, eventually showing a reduction from the previous count (negative values), highlighting differences in utilisation of elective hip arthroplasties by social extract of the Scottish population.

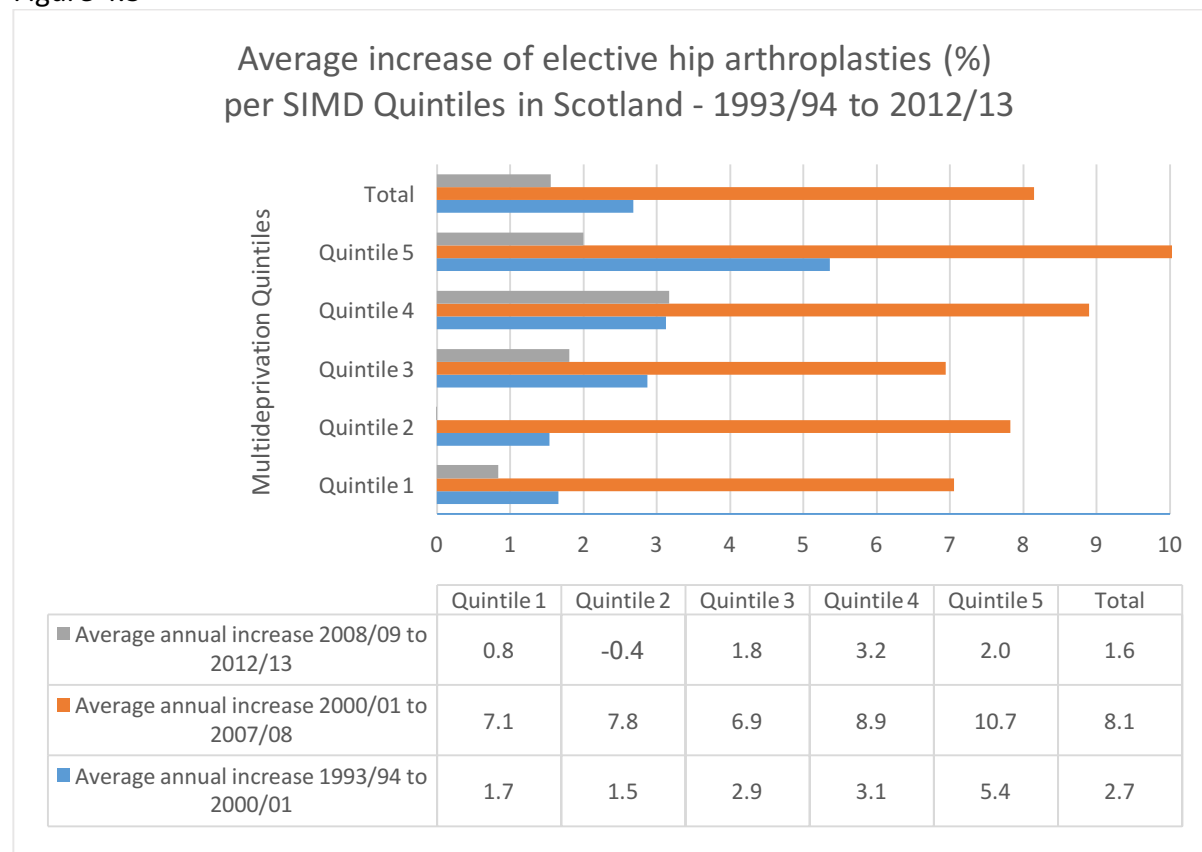
Table 4.4 Annual change (% from previous fiscal year) of elective hip arthroplasties by Multiple Deprivation Quintiles – Scotland 1993/94 to 2012/13

Year	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	Total
1993/94	--	--	--	--	--	--
1994/95	11.8%	2.8%	6.4%	4.8%	22.1%	8.8%
1995/96	-1.8%	5.1%	9.1%	11.6%	11.6%	7.1%
1996/97	4.3%	-1.0%	-5.9%	-2.9%	-10.1%	-3.4%
1997/98	-7.0%	6.5%	4.7%	1.8%	4.9%	2.0%
1998/99	14.4%	2.3%	7.8%	9.4%	17.9%	9.6%
1999/00	1.3%	1.4%	-0.8%	-5.2%	-10.2%	-2.1%
2000/01	-7.5%	-3.3%	-1.0%	6.7%	2.5%	-0.7%
2001/02	-6.4%	2.1%	1.4%	-4.2%	-3.1%	-2.1%
2002/03	5.8%	-2.1%	4.1%	6.1%	12.7%	4.9%
2003/04	8.2%	19.0%	9.6%	14.9%	8.0%	12%
2004/05	5.7%	-0.3%	7.4%	4.3%	7.2%	4.7%
2005/06	29.2%	17.9%	10.3%	19.4%	29.1%	20.1%
2006/07	-0.3%	8.8%	12.4%	4.6%	7.6%	6.9%
2007/08	-2.7%	-0.9%	-5.7%	-2.2%	-5.7%	-3.5%
2008/09	2.2%	2.4%	7.6%	12.4%	18.1%	8.6%
2009/10	4.8%	1.2%	1.0%	4.3%	-5.6%	1.2%
2010/11	-0.6%	0.5%	0.5%	-3.2%	2.7%	-0.1%
2011/12	-2.2%	2.3%	4.4%	10.0%	10.8%	5.3%
2012/13	1.3%	-5.4%	1.3%	1.6%	0.1%	-0.2%

Although the number of procedures present a global raise, the most deprived social extracts (quintiles 1 and 2) present a lower average increase in all years between 1993/94 until 2012/13 in relation to quintiles 3, 4 and 5. Between the years of 1993/94 to 2000/01 there was an average global increase of 2.7%, from 2000/01 to 2007/08 the same average was of 8.1% overall and from 2008/09 to 2012/13 the increase was of 1.6% overall. Quintiles 4 and

5, the least deprived, presented a higher average increase over time than all other three more socially deprived quintiles.

Figure 4.3



After age and sex standardisation, utilisation trends over time did not present proportional percentages of distribution. Quintiles 1 and 5 start with the lower proportion of procedures in 1993/94; nevertheless by the end of the analysed period quintile 5 is proportionally similar to quintiles 2,3 and 4 (2012/13) whilst quintile 1 decreases its procedures proportion from 2005/06 onwards.

Thereafter, standardisation results are similar to absolute numbers regarding distribution trends. There is an apparent inversion of positions between quintiles 1 and 5, again with clear differences from 2005/6 onwards. Over the period of 1993/94 to 2012/13 quintile 1

decreased in proportion from 18.7% to 15.2%; quintile 2 decreased from 22.5% to 18.5%; quintile 3 remained similar slightly decreasing from 23% to 22.2%; quintile 4 increased from 20.5% to 23.5% and, finally, quintile 5 increased from 14.6% to 20.3% in proportional terms of the whole elective hip arthroplasties performed by NHS Scotland (Table 4.5).

Table 4.5 Age and Sex Standardised Percentage of Multiple Deprivation Quintiles from Elective Hip Arthroplasties in Scotland 1993/94 to 2012/13

Year	Quintile 1 (%)	Quintile 2 (%)	Quintile 3 (%)	Quintile 4 (%)	Quintile 5 (%)
1993/94	18.7	22.5	23.0	20.5	14.6
1994/95	19.2	21.2	22.5	19.7	16.4
1995/96	17.6	20.9	22.9	20.6	17.1
1996/97	19.0	21.4	22.3	20.7	15.9
1997/98	17.3	22.3	22.9	20.6	16.4
1998/99	18.1	20.8	22.5	20.6	17.6
1999/00	18.7	21.6	22.8	20.0	16.1
2000/01	17.4	21.0	22.8	21.4	16.7
2001/02	16.7	21.9	23.6	21.0	16.5
2002/03	16.8	20.4	23.4	21.2	17.7
2003/04	16.2	21.7	22.9	21.8	17.1
2004/05	16.4	20.7	23.5	21.7	17.5
2005/06	17.6	20.3	21.6	21.5	18.8
2006/07	16.4	20.7	22.7	21.1	18.9
2007/08	16.6	21.2	22.2	21.4	18.5
2008/09	15.6	20.0	22.0	22.1	20.1
2009/10	16.2	20.0	21.9	22.8	18.7
2010/11	16.1	20.1	22.1	22.1	19.3
2011/12	14.9	19.6	21.9	23.1	20.3
2012/13	15.2	18.5	22.2	23.5	20.3

Aggregating both ends of the SIMD associated with elective hip arthroplasties a clearer trend emerges over time: quintiles at the top end (4 and 5) together in 1993/94 represented 35.1% of all procedures, increasing its proportion to 43.8% by 2012/13; at the other end of the social scale, quintiles 1 and 2 together accounted for 41.2% of all procedures and by 2012/13 were reduced to 33.7% of the number of procedures performed by NHS Scotland (Figure 4.4 and Table 4.6).

Figure 4.4

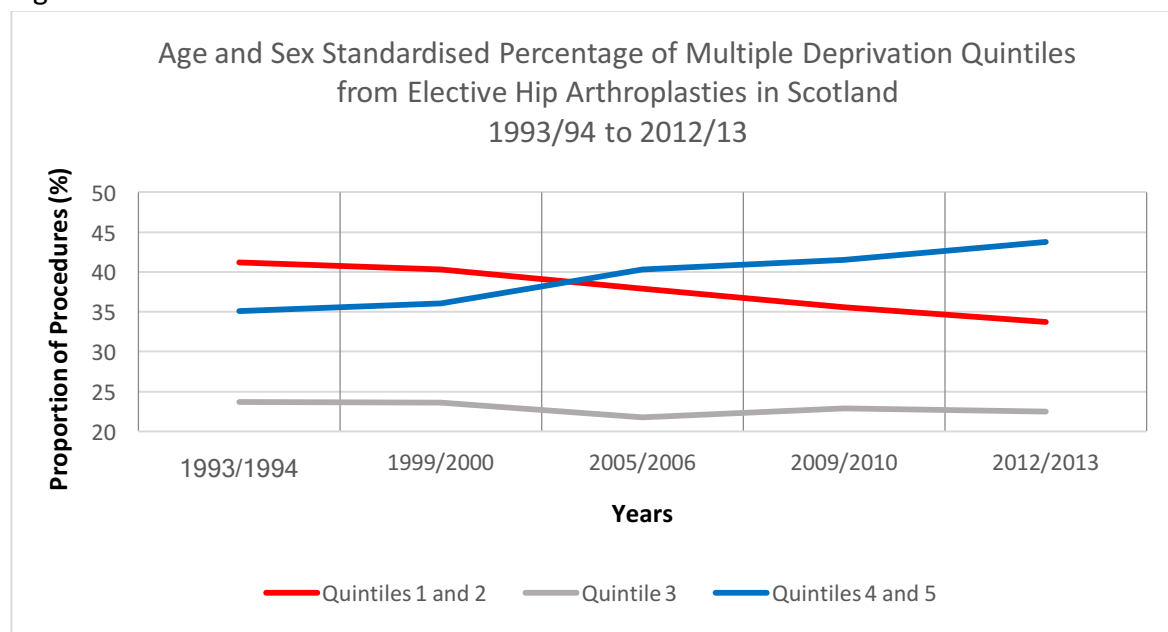


Table 4.6 Standardised percentage of multiple deprivation quintiles from elective hip arthroplasties in Scotland from 1993/94 to 2012/13

Quintiles	1993/1994	1999/2000	2005/2006	2009/2010	2012/2013
1 and 2	41.2%	40.3%	37.9%	35.6%	33.7%
3	23.7%	23.6%	21.8%	22.9%	22.5%
4 and 5	35.1%	36.1%	40.3%	41.5%	43.8%
All arthroplasties	100%	100%	100%	100%	100%

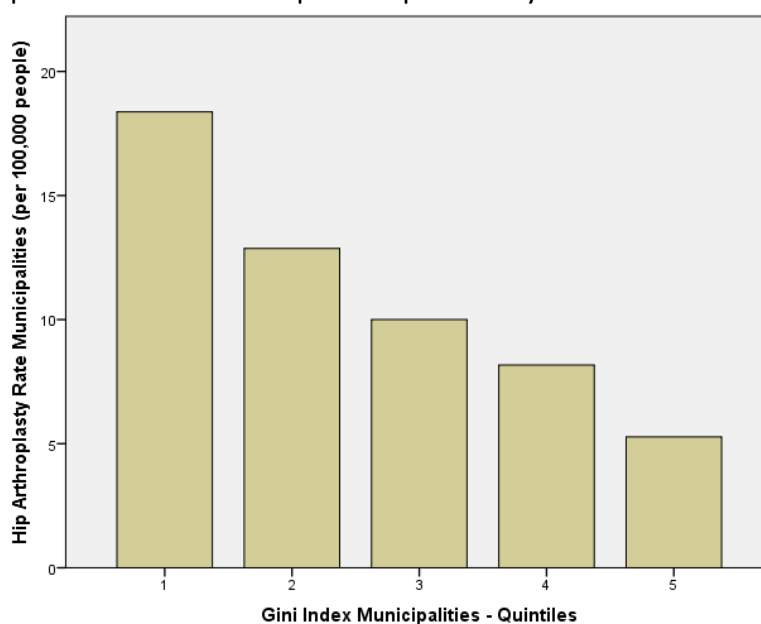
4.6.2 Brazil: standardised rates of elective hip arthroplasties by municipality associated with socioeconomic variables

a) Gini coefficient and elective hip arthroplasties

The Gini coefficient of the 5,565 municipalities of Brazil was distributed into quintiles. Quintiles 1 and 2 represent municipalities with more equality of income distribution as measured by Gini, quintiles 4 and 5 the ones with most inequality of income. Around 60% of the municipalities are in the mid-range quintiles 2, 3 and 4 – with values close to the national average for 2010/11, which was of 0.54; the OECD countries average was 0.31 for the same year (45).

When municipal rates of elective arthroplasties are associated with the respective municipal Gini coefficient (Figure 4.5), the distribution is concentrated in quintiles 1 and 2. The quintile with higher rates of treatment is quintile 1, where the Gini coefficient has the lowest value, closer to more equal levels of income distribution. Municipalities at the other side of the income distribution spectrum, with higher inequality levels within the population, presented lower rates of treatment at municipal level according to the Gini coefficient.

Figure 4.5 Municipal rates of elective hip arthroplasties by Gini coefficient – Brazil 2010/11*



*Mean distribution

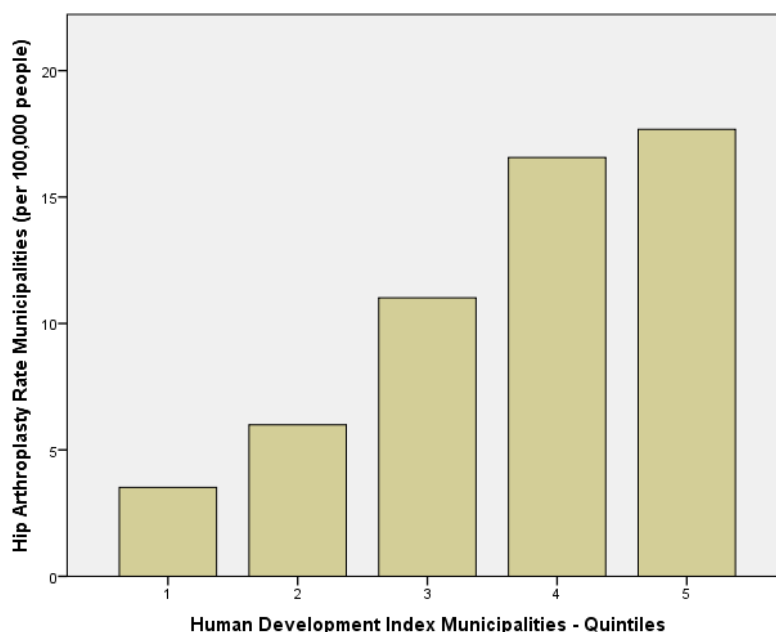
b) Human Development Index (HDI) and elective hip arthroplasties

The HDI scores of all Brazilian municipalities were distributed into quintiles. Regarding human development, most municipalities in Brazil are above the 0.6 mark, bearing that HDI has a positive gradation towards higher values. In relation to Gini Index values, regarding income distribution, human development scores present less variation within Brazilian municipalities.

Elective hip arthroplasty rates and municipal values of HDI are positively correlated. The indicator is more sensitive for higher values of human development, represented here by

quintiles 4 and 5. Quintiles 1 and 2, with the lowest indicators of human development (Figure 4.6), presented lower rates of treatment.

Figure 4.6 Municipal rates of elective hip arthroplasties by HDI – Brazil 2010/11 (5,565 municipalities)*



*Mean distribution

c) Spearman's correlation: Gini coefficient, HDI and elective hip arthroplasties

A negative correlation was established between hip arthroplasty rates at municipal level and the Gini index ($r=-0.226$). There was a positive correlation for the four variations of human development: general, income, longevity and education. The higher correlation was with income HDI and the lower with education HDI; however, all four ranged between $r = 0.35$ and $r = 0.39$ (significant at $p = 0.01$).

Table 4.7 Municipal elective primary hip arthroplasty rates in Brazil 2010/11 – Spearman's correlations with municipal Gini index and HDI * – all municipalities (5,565)

	Gini	General HDI	Income HDI	Longevity HDI	Education HDI
Hip replacement rate per 100.000 people	-0.226	.396	.399	.371	.353

* Correlation is significant at the 0.01 level (two-tailed)

IV. Zero Inflated Poisson regression and elective hip arthroplasties

The measurement value for both Gini and HDI is a number between zero and one. Table 4.8 describes the standardisation values of the Gini coefficient and HDI of all Brazilian municipalities. The large difference between minimum and maximum values illustrates the social inequalities within municipalities: the Gini coefficient present a minimum value (lower inequality) of 0.284 and a maximum (higher inequality) of 0.808; HDI does not present such a large variation, with minimum values (lower human development levels) of 0.418 and maximum values (higher human development levels) of 0.862.

Table 4.8 Descriptive statistics for raw and standardised Gini and HDI

	Sample	Mean	Std Dev.	Minimum	Maximum
Gini index	5565	0.503	0.066	0.284	0.808
Standardised Gini index	5565	-	1	-3.301	4.601
HDI general	5565	0.659	0.072	0.418	0.862
Standardised HDI aggregate	5565	-	1	-3.35	2.815
HDI income	5565	0.643	0.081	0.4	0.891
Standardised HDI income	5565	-	1	-3.011	3.074
HDI longevity	5565	0.801	0.448	0.55	0.894
Standardised HDI longevity	5565	-	1	-5.616	2.064
HDI education	5565	0.559	0.933	0.207	0.825
Standardised HDI education	5565	-	1	-3.773	2.848

The ZIP model was fitted to the sample of 5,565 municipalities. Of these municipalities, 3,070 had residents who underwent elective hip arthroplasties; 2,495 municipalities presented zero values regarding the procedure, justifying the use of a ZIP regression, as described in the methods section.

Table 4.9 Estimates from the ZIP regression model fitted to data from 5,565 municipalities

	IRR*	Standard Error	z-statistic	P-value	95% Confidence Intervals	
Num. of Arthroplasties						
Gini index	0.771	0.007	-27.3	<0.001	0.757	0.786
HDI general	1.559	0.160	4.34	<0.001	1.276	1.907
HDI income	1.213	0.495	4.73	<0.001	1.12	1.313
HDI longevity	1.111	0.343	3.54	<0.001	1.048	1.179
HDI education	0.643	0.342	-8.28	<0.001	0.579	0.713
Inflate						
Low income	0.526	0.005	10.2	<0.001	0.425	0.627
Over-60s population	-0.0004	0.0004	-11.07	<0.001	-0.005	-0.003
Vuong test			6.46	0.001		

* IRR is incidence rate ratio

According to the proposed ZIP model, for a one standard deviation (SD) increase in the Gini coefficient the rate of arthroplasties decreases by 23%. In relation to human development, for a one SD increase in HDI general, HDI income and HDI longevity the rate of arthroplasties increases by 56%, 21% and 11%, respectively. A negative effect was found for a one SD increase in HDI education, suggesting that the rate would decrease by 66%.

The second and binary part of the ZIP model indicates that the log-odds for the population of over 60s undergoing procedures is negatively associated with the outcome; the binary part of the model predicted the non-occurrence of hip arthroplasties (zero procedures). In other words, municipalities with higher proportions of over 60s in the population profile were more likely to present one or more procedures. The same binary log-odds were calculated using the proportion of the population on a low income, which is positively associated with the prediction of not accounting for residents undergoing the procedure (count zero).

4.7 Discussion: elective hip arthroplasties as a proxy measure of access to healthcare in Scotland and Brazil associated with socioeconomic data

4.7.1 Scotland

Data provided by NHS/ISD Scotland is associated with a socioeconomic variable (SIMD), attributing social deprivation quintiles based on the postcode of residence of individuals whom received elective hip arthroplasties. The index contributes to the understanding of differences in local utilisation rates, identifying variations of access to public health services within social groups divided by deprivation levels. The analysis here is concerned with the national picture of utilisation by each of the deprivation quintiles of the Scottish population, as regional rate differences were previously discussed in Chapter 3.

Probably due to the increase in complexity and availability of health technologies associated to hip arthroplasties, absolute numbers of the procedure increased over time for all multiple deprivation quintiles. Analysing Figure 4.4, no clear pattern emerges from the social extracts other than a global increase in utilisation over time. Another aspect is that, despite a considerable advance in non-surgical care for osteoarthritis related to physiotherapeutic interventions and pharmaceuticals, absolute numbers of procedures yet virtually doubled between 1993/94 to 2012/13.

The differences observed in Table 4.3 and Figure 4.2 illustrate how the global increase in access to elective hip arthroplasties is distributed within Scottish society following deprivation levels. Despite the fact that the increase was global, the average increase followed a socioeconomic gradient in all periods. The first period shown in Figure 4.4, between 1993/94 to 2000/01, was when the technology became more popular and widely indicated by clinical specialists, mainly to treat acute stages of osteoarthritis in the elderly population, hence the

increase in waiting times and waiting lists of Healthboards in Scotland over the 1990s (273, 274). The main consequence was an increase of waiting lists for the procedure, consequently widening inequalities associated to healthcare access: the so-called 'post-code lottery' phenomena (275), in which depending on the area of residence, citizens would receive care of different quality and at different time frames. The second period, from 2000/01 to 2007/08 shows the highest average increase, probably due to the implementation of the 'waiting list initiative' by the Scottish government which increased supply to elective hip arthroplasty across all Healthboards, partially dealing with the negative impact that rurality has on access and supply (92, 119, 276, 277). The third and last period, from 2008/09 to 2012/13, probably demonstrates the effect of the world economic crisis, with the average global increase down to 1.6% (from 8.1% in the previous period), the most drastic reduction observed in the analysed time span.

Percentage differences between years, the annual changes demonstrated in Table 4.4, are attributed to fluctuations of waiting lists and supply as no change of procedure codes was registered by ISD Scotland regarding primary elective hip arthroplasties (277).

When the two ends of the deprivation spectrum are compiled (most deprived quintiles 1 and 2; least deprived quintiles 4 and 5) a clear pattern emerges, as shown in Figure 4.4. Although from 1993 to 2014 quintile 3 did not present significant changes, the positions of quintiles 1 and 2 in relation to quintiles 4 and 5 were gradually inverted over this time period. The two quintiles with higher levels of deprivation steadily presented lower rates of hip arthroplasties in relation to the least deprived, which, by contrast, constantly increased their percentage proportion.

This finding suggests that the least deprived groups in Scotland have either more access to hip arthroplasties or gradually over time presented a an increased health need from 2005/6 onwards regarding osteoarthritis. At a same instance, it might claim that the most deprived quintiles either had had a diminished access to hip arthroplasties or a decrease in need from 2005/6 onwards also regarding osteoarthritis. An addition to the argument of increase in need by richer population extracts, is that life expectancy of people in quintiles 4 and 5 is higher (278), possibly augmenting need for hip arthroplasty as a complication of chronic osteoarthritis, a condition directly associated with ageing (64). A third suggestion is that more socially deprived extracts of the population tend to not consider incurring a large surgery as a possibility of health improvement, appealing to non-surgical treatments, usually considering that general painful symptoms and musculoskeletal stiffness are part of the aging process (67, 70). Quality of life related to mild sports practice, educational levels and scientific reliance in health technologies might be decisive for people in least deprived quintiles 4 and 5, accepting a hip arthroplasty as a possible improvement of general well-being (279).

The possibility of increase in healthcare needs associated with less deprivation is not mentioned in the literature of equity in access to healthcare: considering socioeconomic factors, the increase in need for hip arthroplasties has been associated with lower education levels and income (58, 98-100, 123, 280, 281). In other words, increase in need has been directly associated with higher deprivation and not the opposite. Although an increase in need on the part of the least deprived is not reported by the literature, inequalities of access have been previously associated with socioeconomic deprivation (63, 117, 118, 131). This finding reinforces the argument that rates of elective hip arthroplasties are a sensitive marker of health inequalities when associated with socioeconomic data. On this basis it seems that access to elective hip arthroplasties in Scotland tends to be in line with the international

literature on the theme, following a socioeconomic gradient: although universal care is available through the NHS Scotland, the most deprived social extracts generally present lower access rates to health services related to elective hip arthroplasties despite a global offer increase of the procedure.

4.7.2 Brazil

A mild however significant correlation was established between municipal rates of elective hip arthroplasties in Brazilian municipalities in relation to both socioeconomic indicators chosen by the study: the Gini coefficient (related to income distribution) and human development (HDI).

a) **Gini coefficient:** the negative correlation ($r=-0.226$) and the results from the ZIP model $IRR=0.771$ ($0.757-0.786$ 95% CI) indicate that higher Gini numbers were negatively associated with hip arthroplasty rates. The results suggest that a fairer income distribution would increase the odds of higher treatment rates of elective hip arthroplasties at municipal level. The opposite is also true, the higher the coefficient is (a more unequal income distribution) the more likely that municipal rates of treatment would present lower numbers.

b) **HDI:** the positive correlation between the four emphases of HDI and municipal rates of treatment indicates that as a municipality scores more highly in human development, the higher tends to be the local elective treatment rates of elective hip arthroplasty by the Brazilian public sector, SUS. The strongest correlation of HDI and treatments is with income HDI ($r=0.399$), in concordance with the Gini coefficient findings. Although slightly lower, the correlation persists with longevity HDI ($r=0.371$) and education HDI ($r=0.353$), indicating that elective hip arthroplasties are a sensitive indicator of other socioeconomic variables than income, as previously pointed out in the literature (59, 92, 117). This hypothesis is reinforced

by the results of the ZIP model: apart from the negative and unusual results for the HDI education variable, all other three positively influenced rates of hip arthroplasties. The strongest influence was for the HDI aggregate (general), suggesting that higher scores of human development as a whole are associated with higher access to hip arthroplasties in the Brazilian public sector.

The correlation and modelling of rates of hip arthroplasties at municipal level in Brazil, indicate a socioeconomic gradient of access to elective hip arthroplasties in the public sector. Such finding adds another issue to the already known limitations of access like funding and lack of material resources. Although performed by SUS, elective hip arthroplasties in Brazil, like in Scotland, follow a socioeconomic gradient towards richer extracts of the population.

4.7.3 Access to healthcare and equity

Wilkinson et al. (20) demonstrate that social determinants of health are directly linked with how equal a society is in socioeconomic terms. The Nordic countries (Denmark, Finland, Sweden, Norway and Iceland), where levels of inequality are low in relation to most OECD countries, have shown no differences in elective hip arthroplasty rates when socioeconomic variables were considered (52). In other societies, where racial differences are historically present, the race variable can have a greater influence than income distribution on access to hip arthroplasty, as depicted by the case of the United States (132).

In socioeconomic terms Scotland is a more equitable place than Brazil. The Gini coefficient for Scotland in 2009/10 was 0.35, whilst the same measurement for Brazil in that year was 0.56, an approximate twofold difference. As previously shown, in Chapter 3, regional and national rates of elective hip arthroplasties are much higher in Scotland than in Brazil. However, following the findings of this chapter, the socioeconomic gradient of access to healthcare

(when applying elective hip arthroplasty rates in the public sector as a proxy measure) is present in both countries. As proposed by Wilkinson et al. (20), in highly unequal societies differences in access to healthcare are easily perceived, whilst in more equal societies such discrepancies are less pronounced; nevertheless, they are still present.

4.8 Conclusion

This chapter presented a socioeconomic analysis of access to elective healthcare surgery by applying standardised rates of hip arthroplasties performed by the public sector as a proxy measure of healthcare access in Scotland (from 1993/94 until 2012/13) and in Brazil (for 2010/11). The analysis of the Scottish case was facilitated by the already existing social deprivation measurements (SIMD) associated with routine data collection by ISD Scotland, The analysis of the Brazilian case presented different methodological challenges, requiring alternative ways of performing a socioeconomic evaluation to link elective healthcare procedures performed by the public sector and socioeconomic figures.

The differences of data analysis between Brazil and Scotland were a consequence of the characteristics of the national databases of each country; also the limited analytical possibilities offered by the use of primary elective hip arthroplasties as a proxy for equity. Findings need to be considered carefully regarding possible inequities of access or supply.

In Scotland rates from the better off part of the population proportionally increased over time, whilst the worst-off showed a proportional decrease in rates from the fiscal year of 2004/5. Quintile 3 (the measure between the two tops of the social scale) remained with a similar proportion throughout the whole analysed period.

The Brazilian SUS presents not just low rates of elective hip arthroplasties as shown in Chapter 3, it also presents a significant socioeconomic gradient of access at national level. The findings of this chapter suggest that even in the most socially unequal countries like Brazil, the few procedures made available for the population by the public sector are not necessarily directed at geographic areas of most need in socioeconomic terms.

5. Elective primary hip arthroplasties in the public sectors of Brazil and Scotland: constraints to equity in healthcare

Findings and summary of this section at a glance

- ✚ 18 interviews were performed with key informants in Brazil and Scotland regarding access to elective primary hip arthroplasties;
- ✚ Interviewees were asked to comment on quantitative results presented in Chapters 3 and 4;
- ✚ Three major categories of issues emerged from the qualitative data: equity of access to healthcare, health systems and evidence based actions/policies
- ✚ There are fundamental socioeconomic inequalities between the North and the South of Brazil, directly influencing public healthcare provision;
- ✚ The influence of the private health sector is key to illustrate the Brazilian case of low rates by the public sector: whilst in Scotland private provision is virtually 'capped' by the NHS monopoly, orthopaedic surgeons/consultants in Brazil follow higher prices offered through private provision, an expected market behaviour in health economics;
- ✚ There is no management of priorities in the waiting lists either of Brazil or Scotland, however the waiting time is 2-4 years in the former and around 70 days in the latter;
- ✚ The constitutional right to health in Brazil has brought a growing wave of lawsuits regarding elective primary hip arthroplasties, it is an informal way of bypassing the queue for acute cases that need a hip arthroplasty, however the process takes around 360 days and has a knock-on effect in the waiting lists;
- ✚ Prices for elective primary hip arthroplasties have been kept with similar values since the 2000s in Scotland, in Brazil despite an initiative of raising public reimbursements through SUS the market 'adapted' and raised private prices too, maintaining a 4-7 fold gap;
- ✚ The geographic distances are an important issue for SUS regarding high complexity procedures: the distribution of medical doctors is uneven towards urban centres, as it is in Scotland, however the NHS funds travel costs for patients;
- ✚ Routine data has improved in Brazil, nonetheless primary data sources, collection and management have room for enhancement;
- ✚ Health Technology Assessments is a developing field of knowledge in Brazil, whilst Scotland has been using the methodology for decision-making processes since the beginning of the 2000s.
- ✚ Access to health and healthcare in both countries is a multifactorial issue linked with the macroeconomic setting and health systems, with different repercussions and consequences in both societies: issues shown by the Brazilian SUS are intensified by higher socioeconomic inequalities than in Scotland.

5.1 Background

Brazil and Scotland are not alike from a socioeconomic perspective. Both are committed to the value of healthcare as a right of its citizens. Albeit, each country embodies different regulatory and health systems, what is shared is the human, (consequently ethical and political) understanding that every person in the country stands equal where public health resources are concerned. However, is there equity of opportunities to enjoy these public resources? And if not, what are the social, political, ethical and organisational constraints that mediate such inequity?

As set out in Chapter 2 of this study, *need, demand* and *supply* in healthcare are influenced by culture, ethics, public/political pressure, economic status, social, educational levels of the population and others (144). The field of health technologies assessments is the *evidence based model* proposed by western international research to promote rational decision making processes, in theory allowing better resource allocation. Within the theoretical boundaries established by sections 3.2 and 3.3 of this thesis, the quantitative findings, its societal consequences and causalities are explored from another angle: the human perspective of health workers, policy makers and civil servants of Brazil and Scotland grounding the previous quantitative results of Chapters 3 and 4.

5.2 Objectives of the explanatory qualitative stage

1. To explore the main findings with key-interviewees in order to establish the constraints to achieve equity of access to elective hip arthroplasties in the public sectors of Brazil and Scotland;
2. To understand the socio-political context in which HTA is established in Brazil and Scotland, establishing differences and similarities;
3. To establish an analysis framework for equity in Brazil and Scotland, identifying possibilities for better equity of access to healthcare that can inform policy makers.

5.3 Methods

5.3.1 Data collection

A preeminent challenge of international comparative studies is to ascertain variables systematically comparable with each other and at a same time keeping limitations to a minimum extent (1). Insofar as this study established age and sex standardised rates of

procedures and examined socioeconomic variables related to access to elective healthcare, both considered as reliable quantitative methods of comparing data between countries (205).

Although international comparative studies are a well-established research field in social and political sciences (282), its methods remain a constant open space of theoretical debate (1).

While quantitative studies represent the world in a numeric way, through *logical* thoughts, ideas and inferences, qualitative studies share a different epistemology, representing the world with social symbols, chiefly of linguistic nature (283). Thus, qualitative research when applied in an international comparative study setting approximates research problems to *the real world* through concepts and methodologies grounded in social and political sciences.

Following the framework of explanatory mixed methods proposed by Creswell (55), this chapter corresponds to the third stage of the adapted research design. Accordingly, grounds its investigations (from establishing objectives, methods and analysis) in the already materialised products originated in the two antecedent stages of this research (Chapters 3 and 4). Why do people living in Brazil and Scotland not have equitable access to healthcare if in need of a total hip replacement funded by the public sector?

i. A framework of mixed methods research, searching for a common understanding of the previous quantitative findings

Constructivist epistemology understands that knowledge is produced and culturally agreed by scientists through models that try to explain natural phenomena (89). Although the natural world occurs in an autonomous way from the human mind, the knowledge about the world is a human social construction, thus directly linked with culture in its anthropological conception of shared understanding of reality (284).

The scientific episteme is a product of social interactions (285). Human beings, who share common agreements on how to represent natural phenomena through linguistic and non-linguistic symbols, socially construct knowledge itself. This symbolic communication traduces their observations, transcending over time and physical presence. Human relations in this case do not refrain from *real encounters*. The human relation in this case is the exchange and influence of such symbols and *common understandings of the world* into scientific episteme, agreed and commonly understood by human beings through language and culture production (286).

The methods for the qualitative data collection used at this stage adopted a constructivist framework as its main conceptual guideline when bringing the knowledge of experts around the issue of access to healthcare in the Scottish NHS and the Brazilian SUS. During the interviews the quantitative results obtained in the two previous stage of this study were presented by the interviewer; followed by open-ended questions, searching for possible explanations for the findings explored in Chapters 3 and 4.

ii. Use of key informants as data sources

The use of key informants in health research is described by Kleinman (287) as the 'translation of concepts from other fields into new ways of conceptualising and analysing health care problems' (p.540). In this framework the researcher is an essential part of the data creation process, not just collecting information, also by interacting with the research subjects as well. For Agar (288), this constitutes the essence of ethnography and social research; in addition, a study methodology backed up by quantitative findings not just contributes to a better understanding of the clinical issues involved, as also grounds quantitative findings into the real world. Using the researcher as its intermediate, 'neither subjective or objective (...),

mediating two worlds through a third' (p.19), the ethnographical and key informants framework approximate research subject and reality.

Crabtree & Miller (289) consider key informants as essential when understanding the planning of health care delivery in comparative studies. Such data source is based on 'individuals who possess special knowledge, status or communication skills, who are willing to share their knowledge and skills with the researcher, and who have access to perspective or observations denied the researcher through other means' – Goetz & LeCompte *in* Crabtree & Miller (289). The authors are clear that key informants cannot be used as the sole means of understanding a research problem, this method must be associated with field notes, in-depth interviews or **quantitative data**. As Spradley (290) said, in this case 'rather than studying people, ethnography means learning from people' (p.3).

5.3.2 Sampling the qualitative sources

The interviewees for this study are representatives of the many institutional aspects related to healthcare and access to treatment for the acute stage of osteoarthritis (elective primary hip arthroplasty) in the public sector, as with the technology assessment associated in the decision making process of prioritising certain health interventions in spite of others. Key interviewees were identified by their expertise and/or relation with the research theme. The sampling of individuals was finished when the researcher considered that information was saturated.

i) Brazil:

- Representatives of local technology assessment commissions in the city of Porto Alegre (2 individuals)
- Representatives of a national institute which develops Health Technologies Assessments: Institute for Health Technologies Assessments (IATS) (2 individuals)
- Representatives of the National Committee for Health Technology Incorporation (Conitec) in the Ministry of Health and Technology Departments (MoH) (3 individuals)
- Representatives of the Brazilian Orthopaedics and Traumatology Society (Sociedade Brasileira de Ortopedia e Traumatologia – SBOT) and the National Orthopaedic Institute (Instituto Nacional de Traumatologia e Ortopedia – INTO) (2 individuals)
- Representatives of the Ministry of Health linked with the elaboration and approval of the Brazilian National Health Technology Assessment laws of 2011 (3 individuals)

ii) Scotland

- Representatives of the Information Services Division (ISD) of the National Health System (NHS) of Scotland (2 individuals)
- Representatives of Scottish Health Technologies Group (SHTG) (2 individuals)
- Representatives of the Scottish Arthroplasty Project (SAP) (2 individuals)

Individuals were formally contacted and invited to be part of the research as the abstract of the study in the local language was included (Portuguese or English). Some of the findings and objectives of the research were handed over to each individual during the interview process which followed the open interview script.

All recordings were fully transcribed for analysis by the author of the study and followed an approved protocol of ethics in research with human beings approved in 23rd of April 2014 by the Queen Mary University Research Ethics Committee – Protocol Number QMREC1352d (Appendix 4); all informants received an information sheet, a full description of the study, signing a consent form prior to the interview process (appendices). All interviewees had the possibility of opting out or stop the interview or its recording at any given moment.

5.3.3 General script for interviews

Interviews were around one hour long and followed a general script:

1. The interviewer presents himself and the informed consent, which was read and signed by both, researcher and interviewee before the audio recording started;
2. The objectives and results of Chapters 3 and 4 were presented by the interviewer;
3. The discussion is focused on the area of expertise and work of the interviewee.
4. These questions were asked to all interviewees:
 - a. Is there a difference in technology use by the public and private sector in your country?
 - b. Do you believe that the clinical decision regarding the use of technologies such as hip arthroplasties by practitioners is solely evidence based? Is there a difference between public and private sectors?
 - c. To which factors do you attribute the findings of this research in your country?

5.3.4 Data collection summary

- 18 audio recorded Interviews
- Constructivist Framework – ethnographic collection, key-informant based
- Informed consent signed
- Ethical approval for research with human participants obtained in April 2014 through the Queen Mary & University of London Research Ethics Committee Protocol Number QMREC1352d (Appendix 4)

5.3.5 Data analysis

Stage 1. Transcription of interviews in full

All interviews were recorded using two concomitant audio devices. The playback was then fully transcribed and anonymised, labelling the files as 'Record 01 Institution/Work place 'X'', 'Record 02 Institution/Work place 'Y' and so on. Transcriptions were either in English language (6 interviews) for interviews performed in Scotland, or Portuguese language (12 interviews) for interviews performed in Brazil.

Stage 2. Translation of interviews from Portuguese to English language

The transcriptions of the interviews performed in Portuguese language were fully translated into English language, process that was externally assessed by a language consultant; text extracts were anonymised for confidentiality purposes.

Stage 3. Data coding for analysis: direct content analysis method

1) The interviews transcriptions were analysed using direct content analysis methodology. As the data collection was conducted in a pre-defined framework (exploring the previous quantitative findings) a conventional approach to content analysis would not be suitable

(291). Direct content analysis methodology is characterised by a pre-established theoretical framework and research findings which direct the first and more general coding of data into major themes (292). In this case, the theoretical framework was given by: a literature review on equity of access to healthcare using arthroplasties as a proxy measure; conceptualisation of need in health; review of health technologies method; and, finally, quantitative findings presented in Chapters 3 and 4. The major categories for further analysis: 'equity of access to healthcare', 'health systems' and 'evidence based actions/policies'. Record transcriptions were analysed at this stage, coding data extracts according to these major categories.

II) Each data extract was again analysed, at this stage as part of a major category, and coded following conventional content analysis: extracts were organised by sub-categories emerged from the data content itself (293). If a specific subject was cited for at least three different interviewees, a data sub-category was established for further analysis and labelled according to its contents.

III) Data coding categories were tested by two other researchers. Acting as external consultants, eventual discrepancies were debated adjusting codes when necessary. The major themes did not change over time, only more codes were included to account for eventual specificities of the data.

IV) Along the process of narrative construction another two iterations reviewing the elaborated codes were performed; no digital software was used for coding (manual coding), following Basit in the perspective that this choice was the most adequate given the expertise of the author, the size of the sample and the characteristics of this study (294). The benefits of choosing manual coding include better proximity with the data after transcription

increasing the possibility of findings relevant to the research question; it also follows the proposed interpretivist theoretical framework proposed by this research.

Stage 4. Narrative Construction

A narrative process grounded and oriented by a social constructivist framework was established. Following the distribution of categories and subcategories, the narrative process gives social meaning to each subcategory. Thus, exploring proximities, differences and possible explanatory hypothesis for the quantitative findings presented in Chapters 3 and 4.

5.4 Limitations

Limitations for this research were: the small number and the uneven distribution of interviews, compared to the complexity and size of Brazil and Scotland is a limitation; the use of one researcher only, performing the collection, analysis and written narrative was also a constraint.

5.5 Author's personal perspective

The author of this research is Brazilian and was a health worker of SUS for many years, thus his subjectivity and values were inevitably linked with the data collected; his biography is part of the studied phenomena. It was a constant exercise to detach his subjectivity from the data collection and coding, hence the need of external advisors and research supervisors; such 'detachment' is also bound by human limitations. This section reflects a process that, despite such limitations, is an important portion of the path involved in becoming a doctoral researcher. During the process of data analysis and writing up, the author deepened his perception of the values that underpin universal healthcare, SUS, NHS Scotland and primary care. After more than four years involved in the development of this research the author has

matured perspectives and his critical approach around equity of access to health and healthcare.

5.6 Results

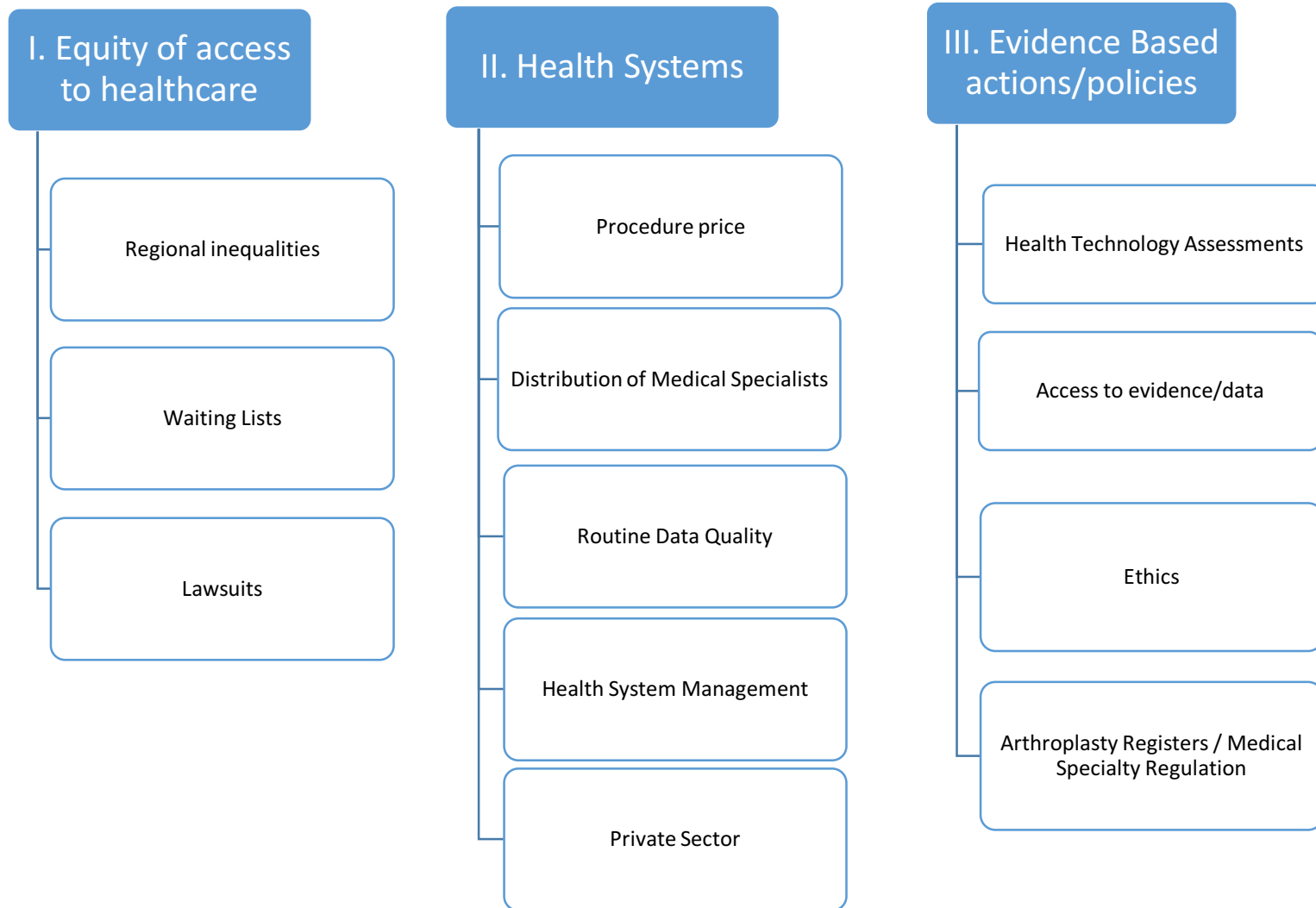
I. Data distribution

The 'Equity of access to healthcare' category presented the lowest frequency of mentions among interviewees with 32 extracts; 'Health Systems' had 45 mentions and finally, 'Evidence based actions/policies' received 41 mentions. Further subcategories emerged from the second stage of data analysis. The lowest mentioned subjects were 'Lawsuits' and the 'offer of medical specialists' with 3 extracts each. The two highly mentioned subjects were 'offer, supply and demand for/of health services' and 'health technology assessments', both with 20 mentions by interviewees.

Table 5.1 Categories and subcategories emerged from qualitative data and respective number of mentions by interviewees

Categories and subcategories	Frequency mentioned
I. Equity of access to healthcare	32 (all)
Regional inequalities	19
Waiting lists	10
Lawsuits	3
II. Health systems	45 (all)
Procedure price	9
Distribution of Medical Specialists	3
Routine Data Quality	12
Health System Management	8
Private Sector	13
III. Evidence Based actions/policies	41 (all)
Health Technology Assessments	20
Access to evidence/data	6
Ethics of Research and Policies	6
Arthroplasty Registers / Medical Specialty Regulation	9

Figure 5.2 Data categories and subcategories emerged from interviews performed in Brazil and Scotland exploring previous quantitative findings.



5.6.1 A narrative approach to access to healthcare: the case of elective primary hip arthroplasties in Brazil and Scotland

Elective hip arthroplasties have resulted in a fundamental change in the long term medical prospectus of people suffering from acute osteoarthritis. Physical disability decreases life expectancy (295) and increases mental health suffering (296). If osteoarthritis related, the disability is concomitant with local acute pain (297) and morning stiffness (298) episodes.

Chapters 2, 3 and 4 of this study have shown that the utilisation of hip arthroplasties: varies in relation to need, socioeconomic status and health system setting (Chapter 2); there are many differences in access between Brazil and Scotland both at national level and within their respective geographic regions (Chapter 3); there is a striking socioeconomic gradient despite the universal and public health system in each country (Chapter 4). Interviews with key informants were performed in a search for *reality based* arguments that could explain the previous quantitative findings, building meaning through a social constructivist perspective. The qualitative data gives meaning to indexes and rates, thus improving inferences (55).

Findings from these interviews are presented under three major themes: equity of access to healthcare, health systems and evidence based actions/policies. Intertwined with the qualitative data presented, a narrative is established with the scientific literature, proposing a rationale that seeks to ground possible study inferences regarding access to elective primary hip arthroplasties in Brazil and Scotland.

I. Equity of Access to Healthcare

The seminal concept of social equity is about unfair differences; not just in the public health field. Something that is unequal is necessarily different within itself: differences of mortality

rates, life expectancy, wages, and so on. Such differences can be socially constructed and become *inequities*, when elements of ethical/moral judgements are involved, including the aspect of social *fairness* in the debate (195). The concept of equity in health is grounded in the social justice field, a debate about unnecessary differences between individuals that share the same scope of rights (299) but not the same opportunities in life, affecting their health as individuals and communities. Differences of mortality rates or health outcomes become *social equity* measurements when associated with socioeconomic variables. This association has persistently shown that those most in need are the least likely to receive health or social care, a byproduct of an economically unequal society, unfair *per se* (195, 197, 299), manifest in this study as an ‘access gap’ to elective healthcare:

"The gap in access to elective procedures is already large in socioeconomic terms; and keeps growing through technological progress, aging and constantly increasing numbers of the population." (Record 04 – MoH Brazil)

In strict conceptual terms, health and healthcare can be considered as both: a human right or as a product which should be paid for (300, 301), affecting the equity of access to health. As concepts the two interpretations are self-excluding, meaning that in theory they could not coexist. A *right* is rooted in different theoretical grounds from a payable item or commodity (302). Rights are part of a humanistic conception of existence from which the *basic human rights* share its definitions and origins; as its words say, by the simple fact of being a human being you should be entitled to healthcare if needed – as you should not be a victim of torture, abuse, discrimination and so on (301). On the other hand, the *payable item* concept is based on liberal theories of individual choice, which presume that as we are all equal and rational (as human beings), everyone should have enough information and means to acquire a

product, in this case health and healthcare, following their individual best interest and choice capability (56).

"The patient does not have access to a specialist. When they do have contact with the health service, he is already in the A&E unit, in acute pain and with a fracture. Having sustained a disability for five years or more." (Record 10 – IATS Brazil)

Equity of access is the major category that serves as an umbrella for the following sub-categories: regional inequalities, waiting lists and lawsuits. Regional inequalities negatively affect access to health and healthcare (18), the waiting lists are a consequence of unmet needs (303) and lawsuits are the repercussion of the legal right to health stated in the law of Brazil and Scotland.

a. Regional Inequalities

As shown in Chapter 3, the difference in rates per 100,000 people for elective primary hip arthroplasties provided by SUS between the five geographic regions of Brazil in 2012 were: South 17.2, Southeast 9.1, Centre West 6.8, Northeast 3.3 and North 2.4 (p.104). There is a clear contrast between the north regions (Northeast and North) and the south regions (Southeast, South, Centre West):

"Something that certainly affects your data are the conditions for local delivery of services, these will vary greatly from one region to the other in Brazil. If you put together this low supply capability and the reduced economic power of some regions, that's it! Supply capacity is concentrated only in the main municipalities of the north and northeast, which are very few there. At the North and the Northeast it is just a very low socioeconomic status in general, of everyone. In the south development is widespread." (Record 04 – MoH Brazil)

Figure 5.3 The five geographic regions of Brazil



Source: adapted from the Brazilian Institute of Geography and Statistics.

The enormous geography of Brazil poses significant issues to a universal and public health, a challenge to the single national health system, SUS (304). Local systems based in regional differences would account not just for differences in the population profile and epidemiology but also for the management of available resources, which present remarkable differences (305). The five geographic regions of Brazil present not just diverse characteristics, they present different needs too (306). A possibility of improvement is the '*regionalisation*' of health care, with independent regional systems focused in local needs; the idea of autonomous 'regional health systems' is defended by Brazilian researchers as a solution for the management issues of SUS, responsible a vast and diverse territory (201, 307). The same public health policies that are applied in the urban area of São Paulo are also applied in the rain forest (the North) or in the Pampa (the South), regions of contrasting cultures.

The following map illustrates the comparison between the territory sizes of Brazil, Europe and the UK:

Figure 5.4 Geographic dimensions, Brazil and European States.



Source: adapted from the Brazilian Institute of Geography and Statistics and European Commission.

The legal responsibility for health services is divided between states and municipalities:

"A municipality cannot afford to manage the entire system by itself. So we need to discuss regional health systems. The municipality does not have to have everything, it has to work together with other municipalities in a cooperative manner." (Record 06 – INTO Brazil)

Another aspect that challenges the offer of universal healthcare in Brazil is the education of health professionals and its influence on the structure of primary care offered by SUS. Although in constant flux, most health related training courses are clinically based, around the diagnose of diseases and not on individual or population needs (308); so is SUS too:

"The structure of our system, especially primary care, is divided into specific population groups. Healthcare through SUS happens mainly very early in life or quite late in life. In adulthood our

primary care only follows if there is a specific pathology, prioritizing women groups." (Record 06 – INTO Brazil)

In reality the concepts of health as a *right* and health as a *product* do coexist in the same health system. Their relation is mediated through national and local laws which regulate (a sometimes blurred) line between the state interests and the health market; the first represented by governments, the population, health workers and the latter by the healthcare industry. The conceptual definition of this conundrum for economics is called *mixed economy of health*, in which market forces and central planning (governments) both play a role (309).

In Brazil primary care has been the main service offering via the public system:

"We want to have a SUS with quality , however the harsh reality is that we do not provide access to procedures beyond basic care." (Record 08 – INTO Brazil)

The socioeconomic divide between the North and the South of Brazil influences equity of access to health. The presence of industries and economic growth stimulates the private health economic sector, which in its turn attracts health workers, reinforcing regional differences:

"The regional difference of rates here in Brazil is because in the North and the Northeast regions, access to higher complexity services is much more difficult than in the south and southeast. In this regions patients are unable to access the system, ending up without care." (Record 08 – INTO Brazil)

If not regulated, the private health market presence can reinforce regional inequalities (209); that is not an exclusive issue for Brazil: around the world the regulation of health markets has been a socio-political issue (310). By the end of the 1980s, health services were provided by transnational companies; before that mostly goods were commercialised at national level between countries (13). Multilateral agencies such as the World Bank have been seeking to influence governments towards less regulation of health markets, with the intention of

making the private health sector more attractive for investors (311). In this sense, throughout the 1990s, public policies in Brazil were heavily influenced by the IMF and the World Bank (312), shaping its national health system as a mixed economy between the state and the private sector, directly affecting equity of access within regions:

"Access to health care for someone there in the rain forest, the Amazon, is much smaller than someone from in the extreme south, at Rio Grande do Sul for example. Although even there, primary care has arrived only in the periphery of most municipalities." (Record 03 – MoH Brazil)

Within the health economics concepts realm, a market is determined by its prices, products and consumers: the market relations between producers and buyers will be moderated by the actions of offer, supply and demand of/for products. The supply of products (in this case healthcare services) and the demand (not necessarily need based) for these products (healthcare) will (or should) influence prices in an ideal market setting, the so-called *perfect market theory* (169, 184, 203, 311). The issue here is *need*: can someone 'control' personal needs and exert choices if *in need* of healthcare? 'Choosing' between treatments or between having the condition treated or not; is it comparable to the 'option' of buying a good? In this study *health need* is represented by the possibility of a physical disability caused by chronic osteoarthritis and/or pain associated with physical mobility.

As explored in Chapter 2.2, although such theoretical concepts have always been in dispute and different evidences can be shown to justify one or other political view. The '*relationship between*' and the characteristics of *offer*, *supply* and *demand* directly influence choices and consequently the equity of access to health and healthcare in a population (313). Brazil and Scotland present two very distinct geographic settings, not just in terms of physical dispersion of services but also of socioeconomic differences within its regions.

The local presence of health technologies can increase demand, as a hip prosthesis is the final solution for acute cases of osteoarthritis, ultimately avoiding physical disability (137). However, it is not just the presence of human and technological resources that increase the availability of services; economic resources must be available too (203). The probable unmet need by the public health sector in Brazil is high, even in the regions presenting the highest treatment rates (South and Southeast); the best performing regions of Brazil do not compare with the worst performing region of Scotland; Glasgow & Clyde.

There is a national deficit of infra-structure in Brazil:

"What we face in the public sector is the lack of material resources in specific terms, such as the operating rooms for instance in a hospital as HCPA. If the Ministry of Health offered more money they would ask ... alright so what should I take off then? I also have a cataract waiting list, a waiting list for hernia'. We have a super skilled team here at the hospital, they have an hour block on Thursday mornings, operate two hip prostheses a week. So there is no 'I will pay more ". We would not have space here for example. We don't lack specialists, we lack surgical rooms. " (Record 10 – IATS Brazil)

Supply might be controlled, inducing or reducing demand. Demand is there, mainly represented by the waiting lists and correspondent long waiting times (two to four years between the first contact with a health service, the visit to a specialist consultant, exams and operation). The '*control*' of supply is actually shaped by the lack of resources and not through a managerial choice; also influenced by the private market through the offer of higher prices.

About supply, two aspects:

i. It does not follow *need*:

"To me the difference that you have found (among Brazilian regions) is a matter of supply of services ... because the system actually offer services according to their convenience and not according to the need of people (...), is not a matter of need, it is a question of how you get to keep that service running. The logic of the services in the south follow this idea, by controlling supply and not demand. " (Record 03 – MoH Brazil)

ii. Follows market mechanisms, such as offer of workforce:

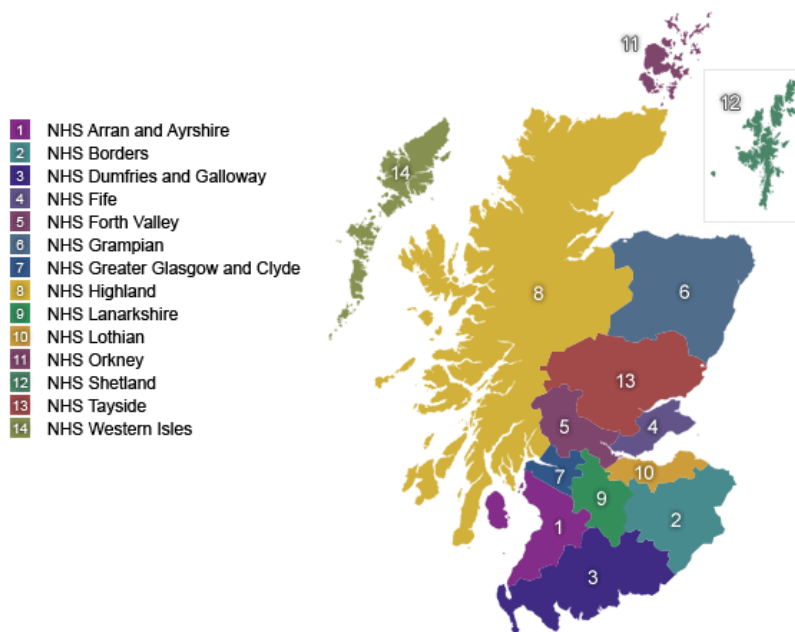
"There are two aspects to the demand, there is demand from patients and then there is demand that is supplier induced. Where you have more surgeons per head of population you

will have higher rates just because of the concentration of services." (Record 16 – SAP Scotland)

Differences of access are not an exclusive problem of developing countries like Brazil (63, 116, 122, 314). Although Scotland is a high income country, differences of access to healthcare within healthboards are present; to a lesser extent in comparison to Brazilian regions:

"All the healthboards are run individually, so they have their own budget and their own controls, so their processes are different and might impact on their results. You also have the differences of distribution of the population, Glasgow is one of the most dense in population, so they have specific issues that other healthboards don't have. So some healthboards will do better in their waiting times, regularly meeting their targets." (Record 13 – ISD NHS Scotland)

Figure 5.5 NHS Scotland health boards



The Brazilian rates of elective hip arthroplasties follow socioeconomic factors, as shown by the association between treatment rates with municipal HDI and Gini coefficient values presented in Chapter 4. The high indicators observed in the south region do not exempt its municipalities from presenting a social gradient of access to elective primary hip arthroplasties; and most likely this would be reflected in other indicators too.

" When we cross our data of access to health here in the city of Porto Alegre, which is one of the best in the country in terms of socioeconomic equality, we see that the values for HDI

follow access. Taking into account only SUS, where everyone should have the same access. "
(Record 10 – IATS Brazil)

As seen in the section 3.1 of the literature review, standardised rates of elective primary hip arthroplasties are a way of measuring access and inequalities throughout health systems. When applied in Scotland this same indicator is sensitive to socioeconomics, with poorer regions like Glasgow & Tyde providing less procedures than more affluent regions; the difference of rates was explored in Chapter 3. Despite the availability of the multiple deprivation index by, the deprivation measure has little or no influence in policy making regarding elective primary hip arthroplasties (315):

"For the Scottish Arthroplasty Project we could also look at deprivation but we don't have the time or the resources, the funding we get keeps going down every year from the Scottish government, so we don't have so much time to look into the research aspects and for sure this would be important for our system." (Record 13 – ISD NHS Scotland)

Besides the availability of the information, the Scottish Arthroplasty Project Report does not include the Multiple Deprivation Index in its analysis. The report does not consider issues regarding possible inequalities of access to elective hip arthroplasties:

"We didn't even considered using the deprivation quintiles in our report as it is only about volume and measuring how many procedures we are doing. Because the report is done once every two years we are more focused on the comparison over time." (Record 13 – ISD NHS Scotland)

The non-inclusion of health inequalities measurements in the Scottish Arthroplasty Project Report hinders the discussion of health equity in Scotland. Target oriented policies focused in diminishing gaps of access would be a possible outcome of the availability of a Multiple Deprivation Index associated with routine data; however that is not what has been occurring:

"There are constant changes to health policy in Scotland, however these changes are only minor, not major changes for the whole system. The difference between deprivation quintiles

that you present is what you would expect, these are things that I have seen in other researches already, just with other procedures or conditions. So that is not surprising at all."
(Record 15 – SHTG Scotland)

Another hypothesis for the inequalities observed in Scotland was related to differences in services supply, explored in Chapter 3. The reduction of beds observed in Scotland has been associated with better quality healthcare and improved health technologies, reducing the time needed for recovery and consequent hospital discharge:

"Certainly in Scotland when we build new hospitals the policy is to have fewer beds, to try keep people at home with shorter stays rather than having patients blocking beds, just lying in hospital beds in the same way they could be at home. So you can say that yes, there is a policy initiative in Scotland to gradually reduce the number of beds." (Record 16 – SAP Scotland)

Availability, supply and demand for health services in Brazil and Scotland are influenced by socioeconomic factors; uneven distribution of the population and health personnel in the territory; regulation of private health services; need and health systems management factors. The practical consequence of all this factors is reflected on the waiting times and sizes of waiting lists for elective primary hip arthroplasties, the next subject of analysis.

b. Waiting lists

The issue of waiting lists for elective procedures performed by public health systems is extensively discussed and approached through diverse perspectives in the health systems and public health literature (62, 115, 273, 303, 316, 317). From a wide range of aspects, some must be highlighted: waiting times, target funding for diminishing waiting lists (277), waiting lists used as demand control, competition from the private sector, waiting lists management. The waiting time for an elective hip arthroplasty in Scotland is of around two to three months; in Brazil the waiting time is between two to four years. Long waiting times and lists demoralise

and hinder the motivation of health workers, as it is the case of orthopaedics in the Brazilian SUS:

"There are professionals that we hear, especially in the orthopaedics area, who will say that 'the person is 'waiting the time you like (...), you decide how many years because we lost count already'." (Record 03 – MoH Brazil)

In Brazil, the management of public care is of legal responsibility of states and municipalities, however most of the funding is federal, through the Ministry of Health (25). As everything else related to local public policies, waiting lists for procedures are also managed by local authorities. Municipalities and states are accountable for the health care of its citizens:

"About the waiting time...The federal level (Ministry of Health) today know nothing about it. We have no data, it is all in the hands of the local health authorities. We assume that it is a lot, but we do not actually know the numbers, we do not have any a monitoring system for it. We have no knowledge about waiting times." (Record 04 – MoH Brazil)

The consequences are serious for the individuals who do not receive the expected healthcare. Painful symptoms during simple physical movements like walking, standing or seating; morning stiffness of knees and hips and, finally, physical disability can be mistakenly seen as a natural process of ageing (64). Another serious consequence is the increased risk of a femoral fracture, which in Brazil might mean bypassing the waiting queue through the A&E door:

Case 1.

"Often someone is on a waiting list and is 'emergencialised': a person who is already on the waiting list is admitted at the hospital via A&E due to the worsening of a previous manageable situation three years ago or more. Before, healthcare to this person was elective, not now after years in the queue." (Record 01 – Local HTA commission Brazil)

Case 2.

"In Brazil this type of elective procedure will be dealt by the system when it turns into a clinical emergency. In this cases usually a fracture of the femur happens, then the patient goes to an A&E and finally receives care. " (Record 10 – IATS Brazil)

The social frustration of SUS long waiting lists has its toll in its working force too, manifested by the high rates of burn-out syndrome and stress related sick absences of health workers (318). The available management tools do not allow for differentiation of clinical priorities between cases, which does not coincide with a rational way of managing scarce resources (319). A brief account of the referral process:

"The 'list management' process occurs simply by the person entering in the system with a referral, and the only thing I can do as a clinician is to write 'urgent' in the referral. And, honestly, it will not make any practical difference. And often the urgency of one is not the same as someone else." (Record 11 – Local HTA commission Brazil)

A possible solution would be a clinically based priority protocol (62):

"We need a prioritization protocol, otherwise this mess will continue. The need of the people is different from each other, and this must be taken into account... you cannot put everyone in the same boat." (Record 18 – Local HTA commission Brazil)

In Scotland, the popularisation and high success rates of health technologies related to elective primary hip arthroplasties increased the number of people in the NHS waiting lists; 'need' and demand increased. Waiting times and higher demand was targeted with relevant public health policies (277):

"We used to have a long waiting time, but the government focused on that, calling it 'treatment time guarantee' putting targets, different for every procedure." (Record 13 – ISD NHS Scotland)

"So we have this twelve weeks guarantee, you have to have your surgery and treatment done in twelve weeks. There was a budget put aside for the so called waiting list initiative, and this was for all over Scotland. It does cost, but the reality is that joint replacements in the private sector is twice the cost of the NHS. In the private sector is between £8,000 to £10,000 depending on the contract you get, and we spend in the NHS between £3,700 to £4,000. We have been able here in the NHS to cost permanently the same value for 25 years." (Record 14 – SHTG Scotland)

The private healthcare sector in Scotland has a small share in elective orthopaedic care, accounting for less than 5% of procedures (204). The fact that the public sector performs most of the care means that costs are controlled; the private sector is only complementary to the public services, not exerting competition, either for procedures or health professionals. In Brazil it is the opposite scenario, consultants only make use of the public sector to establish their career, gathering experience to compete with the established surgeons of the orthopaedic private sector. The private health sector in Scotland is capped:

"They do take some patients to off load the waiting lists, but this is not a massive part of their business plan, it's not something that they are counting on." (Record 12 – ISD NHS Scotland)

Waiting lists exist in both systems, the NHS and SUS. The significant difference is given by the waiting times: whilst in Scotland the target is 3 months (around 90 days) in Brazil the waiting period is of at least 2 years (730 days). The longer waiting time in SUS contributes to the aggravation of the condition, increasing the likelihood of bone fractures and physical disability; lawsuits are the consequence of unmet health needs in a country where health and healthcare are constitutional rights.

c. Lawsuits

Health in Brazil is a Constitutional right since 1988. The public and universal health system SUS officially started its activities in 1990. Nevertheless, healthcare is still not accessible to all, either for hospital treatment, prevention or pharmaceuticals, hence the growing private health sector in the country literally filling the gap of an unmet need (15).

The Brazilian state is legally accountable if health needs are not met. Such accountability is established on an individual basis, via personal court cases, the *lawsuits* against the state based in medical reports of treatment needs (320). In this process, health in Brazil has been

conceptually transferred from the social rights field to the individualistic realm, akin to liberal concepts of individual means and choices. This is a paradoxical position for a health system which is conceptually based in collective welfare but placed in a competitive mixed-economy setting and an example of the contradictions faced by public health systems based in late industrialised countries (321). The reality of unmet needs can be harsh for health workers and citizens:

"My patients who need orthosis and prosthesis, I have to forward straight to the courts, this patient will skip the whole system of queues... because the waiting system is very cruel. I have a patient that when I examined, the situation was so serious... It was a knee arthrosis, she was referred to the specialist... She received the appointment this year, my referral was five years ago, and this was just to see a specialist... so the system is very cruel. Who knows how long will you wait for the expert? Then the specialist will order tests, a cardiologist will ask for clearance for the operation. He will ask her to lose weight, then and just then, when you arrive at the end of this whole process she will go to the waiting list for surgery. So that's why when I have a patient who is already disabled, using crutches, weakened, with risk of falling, comorbidities, I need to 'judicialise'. I instruct them to make contact with a public defender, on my side I make a report. This still takes a while, but no more than a year... no more than a year. The judge forwards to a specialist who will agree or not with my clinical report; then if he agrees and indicates the intervention the judge will determine the local public health authority to pay for the surgery. To 'judicialise' ends up being the solution that we have found for the very acute cases." (Record 01 – Local HTA commission Brazil)

If on the one hand the action to 'judicialise' a patient saves a person from a life of painful symptoms and an almost certain physical disability, on the other hand it hinders the possibility of a public health response to the issue. The judicial phenomena is widespread across Brazil, court decisions based on individual need and not on the management of resources that should be directed to the whole population on the basis of need and clinical priority (320). An attempt was made by the Brazilian government to regulate the relationship between courts and the healthcare system:

"Despite the adoption of the Law, there was no effect in relation to the 'judicialization epidemic'. In other words the number of cases continues to rise, opening a debate between the health system and the judicial Brazilian system." (Record 09 – SBOT Brazil)

As health is legally considered as a constitutional right, the courts base their decisions on individual clinical needs of medical reports. It is not the legal role of a Judge to critically assess the capability of public resources that finance healthcare interventions.

"Applying the principle of right to health in a crude manner like this completely hinders the equity of the system, which is another theoretical pillar of SUS. It cannot be everything to everyone, at some point the rights of citizens will harm the right of other citizens because of a compulsory finitude of resources." (Record 18 – Local HTA commission Brazil)

The finity of resources is not an exclusive problem of the public health sector in Brazil (313). Heavily regulated on paper, thus in laws, the private sector in Brazil is not so firmly regulated regarding prices and market competition market, with many cases been decided in court too (322):

"The judicialization epidemic, which before only reached the public health system is now gradually imposed in the health insurance sector. As the supplementary health now covers about 50 million people, a quarter of the population, this brings serious financial sustainability issues. The private sector began to deny requests for some doctors, the pressure that was felt just in the public sector before began now to also reach the medical profession and their cooperatives." (Record 18 – Local HTA commission Brazil)

The issue regarding lawsuits is not observed in the Scottish NHS (204), hence the non-mention by any interviewee during the data collection process. Judicial cases are one of the main legal issues challenging SUS, associated with the lack of resources and competition with the private health system and producing a 'new kind' of inequity in health. It is, above all, a social process resulted from these challenges, that requires not only regulation, but also organisational cultural changes in the relation between the executive, legislative and judicial powers of Brazil; a review of the federalist arrangement itself (25).

II. Health systems

The Brazilian public health system follows the federalist state hierarchy: federal, state and municipal authorities. Based on the principle that health is a person's right and a duty of the state, the Unified Health System (Sistema Único de Saúde - SUS) was established in 1990, offering health (promotion and sanitary measures) and healthcare to all Brazilian citizens. Although a citizen's right, underfunding and fiscal incentives to private health enterprises since the 1970s constrains SUS from the early 1990s (312).

The National Health System of Scotland (NHS Scotland) is a public health system, established in the post second world war period, it was part of a welfare state for the whole United Kingdom. Until the end of the 1990s, the NHS was a single system for the whole UK. The system is state based, funded through taxation, it offers universal healthcare to all UK citizens with some exceptions like dentistry and elderly care. It has been the subject of constant administrative reforms since the end of the 1970s, influenced by a constraint of public revenues and the change to a reduced role of the state in offering public services as a provider. Since devolution in 1999, UK NHS has been divided (Northern Ireland, Wales, England and Scotland), with different implications for each of the Union's members (43). In Scotland the system remained based on public funding and provision of services, with little growth of the participation of a private health sector, except in specific areas such as cosmetics surgery and elective care (204).

This major theme underlines the following sub-categories of analysis: procedure price, availability of medical specialists, quality of routine data, health system management and private sector. Some of these subjects overlap with each other.

a. Procedure price

Funding public healthcare and social welfare has been seen as a constant challenge of contemporary democratic states (184). Historical increase of costs associated to a global loss of public revenue, mainly related to taxation, increased the financial hardship to fund public health services (203).

The Brazilian economy had positive growth indicators until recently, which were not reflected in public expenditure on healthcare (28). Fiscal waivers (deduction of income tax) have been offered to incentivise use of private healthcare providers (46). Public providers for SUS face difficulties, which are unique for that sector:

“In Brazil, the public system uses the ‘SUS reimbursement pricing table’ to pay public and private hospitals that perform procedures for SUS. All three layers of the state; federal, state and municipal authorities use the same tabulation of values. In this pricing list, there is what is called ‘compatible procedures’ with the reimbursement system, and ‘not compatible’ procedures. There is an overflow sometimes. For example, if a knee surgical procedure is defined as ‘using three screws’ and you end up using four or five, the hospital will be paying to put these two extra screws with no reimbursement. You cannot charge the health system the fourth and the fifth screws! If the surgeon used another two, these will be on the house. Might be clinically justifiable, but if it is not in the SUS reimbursement table, the local health authority will not pay because they will not have any reimbursement of that value from the federal layer.”
(Record 01 – Local HTA commission Brazil)

The historical debt of Brazilian public hospital institutions is a well-known and yet ongoing difficulty (323). Many hospitals in rural areas have been closed due to financial adversity (324). As funding alternatives, public hospitals are either linked to universities or offer services to the private health system (325). A further market distortion between public SUS and privately paid care is SUS reimbursement: public paid procedures present a large price deficit if compared with privately funded care in Brazil. Sometimes public hospitals perform procedures that are not reimbursed:

“There are procedures that we perform as ‘emergencies’ that are not in the reimbursement table of the Ministry of Health, so they end up appearing as hospital deficit in the balance sheets. We try to compensate the balance with other procedures, but sometimes that is just not possible and the hospital remains in deficit. It remains as a negative value in the hospital books.” (Record 18 – Local HTA commission Brazil)

The knock-on effect of low reimbursement prices in comparison to the private health market leads to a tacit phenomenon informally labelled as ‘two for one procedures’. The word ‘tacit’ here implies that this is a known controversy of the Brazilian public system. The issue has been partially dealt with in 2008 when the table of SUS procedures was largely updated, becoming 100% based on electronic records. As mentioned in the methods section of Chapter 3, these changes are the main reason this study did not explore SUS routine data before 2008.

‘Two for one’ procedures:

“The tabulated values are so far below the market price that managers do ‘two for one’ through tacit agreements. The system does not have reliable information. When the routine data collection is attached with money, in this case the reimbursement process, you will have this kind of interference. However if you do not attach the data production with the payment process you might end up with no information.” (Record 05 – Conitec Brazil)

Price difference between SUS and the private sector:

“SUS prices are extremely under-valued when compared with the private healthcare market. However, we would never know if it is the market that is inflated, or if the SUS pricing table that is outdated... possibly both.” (Record 06 – INTO Brazil)

Prices are signals produced by a market (203). If SUS reimbursement prices present a deficit, it is a symptom produced by an unbalanced market. The perfect market theory has been criticised when applied to health economics, however it remains as a theoretical mainstream to explain market behaviour (184). Roughly, such theory states that prices are signposts produced by the market relations of buyers and producers, through the supply and demand for products (203, 311). A high demand for ‘X’ would increase its price, signalling to producers that they can make more ‘X’s which will either *hold* prices (as more X is produced and

introduced in the market) or will *increase prices* if there is no more production (for example a primary commodity shortage) or a partial production (184, 203, 311). In the Brazilian case, there is a partial production of healthcare due to various factors (exposed along this chapter), which hold private market prices high, favouring the medical class economic interests towards insurance based systems or out-of-pocket payments.

On the Brazilian reimbursement system:

“Our reimbursement system emphasizes procedures and production, not health promotion or prevention. The very idea of AIH for example (AIH – Autorização para Internação Hospitalar, is the reimbursement instrument for hospital admissions), you can inflate the AIH with other procedures. So, most of the rationale is only about a billing system not related to health promotion or a clinical rationale; and this hinders the whole process of reimbursement.”
(Record 05 – Conitec Brazil)

Public procurement here is key. The fact that prices from the private sector are not unveiled like those in the public system (SUS table) leaves producers, both of services and materials, in a privileged position against ‘consumers’, the health economics definition for citizens. In the case of health, consumers do not have the knowledge needed for choice, depending on trust in the ethics of a medical professional and their relation with producers of health materials needed for care (184, 203, 311). Such market should be regulated by clear rules and open public instances of negotiation (169), which is not the case of the Brazilian market:

“To aggravate the problem between prices and prosthesis producing companies, from the public service point of view, it is all about central procurement and removing the price veils away. Usually the disparity of prices for the same product is huge because this market has too many externalities, radically changing prices without changing the product, following market opportunities.” (Record 14 – SHTG Scotland)

Another aspect of the reimbursement tables for SUS is that values suffer many one-off changes and updates. Not necessarily following a systematic rationality, the SUS table changes following specific demands from consultants or social groups representing patients (326, 327). Whilst primary care has been a priority in Brazil (41) and been provided by public

bodies, secondary and tertiary care remained attached to the private sector, been mostly outsourced with public resources but provided by private institutions (328). Public hospitals reflect this distortions in their organisational strategies:

“What do healthcare institutions to survive and remain in business? They prioritize high complexity care. Separating values between medium, low and high complexity, they are then able to renegotiate values with the government, sometimes through contracts which are not necessarily linked with the SUS pricing table. The private health companies managed to leave most of the high cost procedures such as cancer treatments and transplants to remain publicly funded in Brazil.” (Record 10 – IATS Brazil)

The Brazilian national constitution of 1988 directed administrative powers from the federal layer towards local and regional authorities. However, political scientists have refuted the thesis of a real decentralised state after more than 25 years of the new National Constitution (25). The conceptual difference between *policy making* and *policy performing* seems to be taking the lead of the Brazilian state. *Policy making* remains a ‘prescription’ given by the federal layer of the state through a set of national policies to states and municipalities. *Policy performing*, which has a constrained scope of decision making as it is based in a pre-set framework, is the responsibility of local authorities. Such conceptual control remains in place based on the fact that most public revenues are yet collected and managed by the federal government, a similar situation of the pre-constitutional period before 1988. The centralisation of financial resources narrows the scope of local innovation in the sector:

“While we keep talking about state decentralization we still have very centralized practices, especially from a financial point of view. After all, the biggest slice of the cake still comes as federal funding. So, when we try to induce new practices at a local level, we don’t have resources to diversify actions. We have to keep pace with the federal agenda, which is the one we receive money for performing.” (Record 04 – MoH Brazil)

Due to limitations of funding and political pressure from medical representatives, the public system is constrained through market mechanisms such as pricing and production control. One important aspect of this relationship is the offer of medical specialists, the next topic.

b. Distribution of medical specialists

The distribution of the medical workforce throughout Brazil has been subject of targeted government actions aimed at improving the uneven distribution of medical doctors (22). The Brazilian constitution establishes that the national health workforce should be distributed according to the needs of public health (7). This has never been achieved, distribution of health workers (mainly medical doctors) remains a challenge not only for Brazil as for most Latin-American and low income countries (329). Despite an increase of the number of medical doctors in Brazil in the past forty years, the most socially deprived regions have a low rate of doctors per head (212) as "the low incomes of the population have discouraged the settlement of doctors" (330). One of the consequences of a mixed economy health system:

"Most of the public services which are distant from major urban centres pay their orthopaedists very well. As there is no local specialist offer, he will hang in there and work for a while, but what he would like is to be doing these surgeries in the private sector at a urban centre. So this municipal part of the system will not work, will not offer continuity of care in the long run. The specialists will learn in the public sector and progress in their career going to the private sector, concentrated where there are more resources in the cities." (Record 08 – INTO Brazil)

SUS policies are based in primary care preventive actions, however medical schools in Brazil are predominantly Flexnerian¹⁴ schools; the medical associations of the country are resistant to a paradigm change (331). Such paradigm shift in medical education has partially happened

¹⁴ Flexner made recommendations in 1910 for the American government, remaining yet influential in some countries after so many decades: for him medical schools should teach and graduate specialists, based in the scientific knowledge of diseases. Such understanding, although partially valid, excludes social, psychological and interpersonal factors that influence the illnesses intercourse of individuals and communities.

in the UK, not without resistance from the medical profession (332). Thus, the rationale in South America is rather economic than epidemiological, as medicine is a socially prestigious profession there, associated with individual expectations of a high income (308). The market division brings ‘niches’ of medical specialties:

“The guy who does knees, will only do knees, the guy who does hips, does only hips and so forth. Then you have the guy who does trauma and only this, the guy who does spine same thing. Most of our orthopaedists are overspecialised nowadays. The guy who does shoulder, the one who does hands . This also generates a specific supply issue for the market, bringing a constraint to the offer of care, even for the private sector.” (Record 01 – Local HTA commission Brazil)

Brazilian medical education is distant from the social needs of the population; medical schools use SUS only as fieldwork for practice based learning, not just at university hospitals but also at community level, with very few exceptions (308). A small number of medical residents are linked to practice base learning in the private sector, the majority learn in the public sector – with socially deprived patients; in order to offer services to those covered by healthcare plans, insurance or able to afford out-of-pocket payments (330). The more senior a consultant becomes, the greater is the distance from the public sector (308):

“We treat diseases that sometimes have very little social impact, you will often spend a fortune on these.” (Record 18 – Local HTA commission Brazil)

The problem of uneven distribution of healthcare workforce in Brazil is due to the restriction of financial resources of the public sector, economic concentration in large urban centres and geographic distances. However, as seen in Chapter 3, rates of medical doctors per head of population are not so distant from the ones presented by the United Kingdom. Most probably the higher level of social inequality in Brazil and the mixed economy setting of the health system directly contribute to the smaller offer and overpricing (20). To evaluate the ‘state of

affairs' of a health system is essential to have reliable comprehensive information, the next sub-category.

c. Routine Data Quality

Routine data are the information produced in a daily basis either by a ward, a health institution or a health system (333). The term 'routine' has its origins on the information produced by hospitals as institutions, with daily routines which are repeated (334). Routine data can also be named as 'administrative data', although sometimes referring to different kinds of information (333). Such data are not attached to specific research purposes, it is (or should be) part of the *ethos* of any health system, thus to be used as information source for services evaluation and planning (249). Systematically organised routine data can be translated into useful evidence, improving health actions and evidence-based planning or policies (335). The routine data in Brazil has yet to improve:

“We know that the indicators which we upraise here in the Brazilian Ministry of Health are limited by the information system itself because it's tied to funding. These indicators end up being very low profile in terms of credibility, in addition the primary data in its sources definitely has problems. Our routine data is weak and we know it.” (Record 03) “This allowed large biases, especially the historical analysis point of view. The focus was only to reimburse, linking essential data such as age, address, or something else also clinically relevant just lost importance. Or never had any importance at all.” (Record 04 – MoH Brazil)

Most healthcare systems produce routine data as a consequence of administrative needs, usually with information from reimbursements between funders and providers (either public or private) (333). Reimbursement methods may even generate the information system. In other words, routine data is produced to enable management of resources (333).

The quality of data generated by the sources (services) reflects the quality of the health system itself (51). A well organised and defined health system will necessarily produce useful

data; an administratively disorganised system will produce problematic information, hindering a loop process of knowledge production based on the daily routine of health services:

“We have problems with the production of our primary data in Brazil. Most indicators are over or underestimated, depending on the situation or indicator.” (Record 03 – MoH Brazil)

Aiming to improve its records system, an enormous challenge for a health system that covers more than 200 million people, the Brazilian government invested resources into an electronic record system named ‘SUS Card’. It was not an initiative of establishing individual electronic records, the aim was to ‘give visibility to essential data which feed the national information systems’ improving management and planning of resources (336). Another issue to address was the duplicity of records and relatively loose control prone to reimbursement frauds: procedures which were double billed or never performed. Yet this system has room for improvement:

“There are people who have more than one card.” (Record 01 – Local HTA commission Brazil)
 “Brazil is still in its infancy in having a health system information that is reliable.” (Record 04 – MoH Brazil)

The poor quality of routine data has long term implications for health technologies assessments, hindering evidence-based guidelines tailored to national needs. A clear symptom of this entanglement is the constant use of international guidelines of treatment, instead of nationally developed orientations which would suit specific needs of the Brazilian population and the particular national health system setting (337).

“A huge problem of the Health Technologies Assessments in Brazil is the production of data. The raw data has very little quality. We have a lot of people in the Ministry of Health now doing economic evaluation based on the standards of the British NICE but with bad quality data sources.” (Record 02 – IATS Brazil)

Another aspect is the capability of historical series in demonstrating weaknesses and effectiveness of health policies (334). Routine health data in Brazil passed through an improvement process in 2008, not without difficulties:

“During the exchange of data systems in 2008 a lot of data was lost, mainly because people were not trained to collect and record the information of the new collection system for SUS.” (Record 04) “It is well known that we have problems in relation to historical data, exactly because the main focus has been only in the reimbursement methods.” (Record 04 – MoH Brazil)

In Scotland the routine data gap is related to the lack of information from the private sector. Data from this sector is given only if the procedure is publicly funded but performed by a private entity. There are two practical consequences of not receiving such information when related to elective primary hip arthroplasties: the population is exposed, relying only in the medical ethics to evaluate need; and there is no available information about mortality or infection rates (quality of procedures, materials and surgical teams):

“If a patient goes to a private hospital we won’t have any statistics on his stay. We will only have data if any NHS money goes to treat a patient in a private hospital, then we should get that information, but only because it is NHS money. But if they pay personally or through one of this healthcare companies like (omitted) and a lot of these places offer hips and knee surgeries... and we won’t get that data. There is no legislation in Scotland to require that information and this is a gap in our routine data system.” (Record 12 – ISD NHS Scotland)

In comparison with Brazil, the number of procedures performed by the private sector in Scotland is low (204). It is estimated that the private sector in Brazil performs around three to four times more elective hip arthroplasties than the public sector, whilst in Scotland this number is lower and statistically not significant. However the gap of information exists:

If you have a known gap of information, does not matter how small it is... it is still a gap. It is fairly well known that a lot of the patients, mainly when we had a bigger waiting time, a lot of those patients requiring hips and knees (surgeries) went to this private companies... to have them done quicker, rather than being in pain for so long.(...) But if the private hospitals are doing a lot of hips and knees these procedures are not been captured by our data as part of the Scottish population, we don’t have the numbers.” (Record 12 – ISD NHS Scotland)

Another specific issue for data collection in the NHS Scotland is the population size: most of its statistical models are based and originated in England (33), increasing error margins; nonetheless not in a statistically significant manner.

“We have a problem also standardising our data because our population is so small and most of our models are based on the English population, which decreases a bit our accuracy.”
(Record 13 – ISD NHS Scotland)

The collection of information is essential for the improvement of a health system, as it is based on this evidence that managers, policy makers and the population can improve conditions for equity and access to healthcare. Despite the above discussed limitations of data provision, there is room for improvement in the management of SUS and NHS Scotland with the available routine data. Health systems management is the next category of analysis.

d. Health Systems management

Public management or, in Portuguese, "gestão pública", relies not only on a democratic and flexible political agenda to be efficient; educational levels of the population also influence the management dynamics of the state (310). A country that proposes decentralising its public sector towards its municipalities as a constitutional directive, relies on the local levels of education (21). The interpretation and performance of policies, even though acting as prescriptions made by the federal level as defended by Arretche (25), depends on local actors to be performed. In the UK, higher education is achieved by just above 40% of the population, whilst 99% have basic literacy levels (338). The same indicators for Brazil are 7.9% for higher education and 91.7% for basic literacy levels (268).

After the 1988 National Constitution reform, public administrative power was directed towards municipalities; the responsibility of interpreting, understanding and performing the

management of public services and administration within the law parameters was gradually transferred to local authorities. Such commissioning was partially followed by self-sufficiency of public revenues:

“The system is very complex from the point of view of the municipal administration, and probably most managers do not understand some actions or policies of the Ministry of Health. Often the money is not used by the local authority for simple incompetence or lack of know-how, probably both. (Record 03 – MoH Brazil)

The public health system, based in a 'delayed' state bureaucracy is immerse in a globalised and, most of all, highly technological world regarding health and healthcare (336). Although cases like the Cuban health system illustrate that primary care and prevention do drive basic health indicators up; the increasing longevity of the population and scientific knowledge allied to innovative treatments brings an *increasing need* for health technologies in secondary and tertiary care; above all associated to elderly care (189).

“We estimate that we have a delay in the public health system in terms of administration, management, hospital organization and primary care of at least 30-40 years when compared to the Spanish health system for example, with whom we have made a consultancy process here at the Ministry of Health. The problem is that this delayed system is subject of the current clinical thinking, scientific and technical innovation.” (Record 04 – MoH Brazil)

The issue of health technologies availability in Brazil has many sides and influential factors, however, two are of most importance for health systems management:

- i. The role of the private sector in exploring health technologies, either through private transactions (health schemes, out of pocket payments or insurance) or public funded contracts (23, 339);
- ii. The incipient scenario of health technologies assessment been used as a tool for decision making for public health policies funding allocation (326, 340).

Most health technology is sub-contracted to the private sector in Brazil:

“Often the problem is not only of supply, coverage and management. We face the problem of access to technology. There is a shortage of available technology, either in terms of equipment or services. Today part of the procedures offer, whether laboratory or other tests such as mammography, CT scans, etc., it is all privately contracted. All contracted with the private sector.” (Record 06 – INTO Brazil)

In this scenario, of technology and education shortage, the Ministry of Health of Brazil has been investing in Health Technologies Assessments (HTA) as a tool to improve decision making within the management of services (341). A new bureaucratic body has been created, Conitec, to deal with approvals of new health technologies to be incorporated into SUS, pharmaceuticals included (340). There are also actions to spread HTA knowledge: commissioning of HTAs by the government to research institutes (mainly universities); public funded courses to encourage local health authorities to use HTA as a public management tool, improving decision making by using local evidences. This is all inspired by the British National Institute for Health and Care Excellence (340). International guidelines place HTA as a tool to improve efficiency; its results should be used as information sources for evidence-based decision making (186), however its use does not necessarily imply better equity of access to healthcare via SUS:

“If the Ministry of Health brings HTA as a lifesaver for the system it will only kill the method, in a very unfair way.” (...). What is decided in Brasilia does not reach the local health services, complicating everything. There are many things before the HTA; it is not the HTA that will reorganize the system. HTA only realizes the rational incorporation of technologies, with many important limitations. The HTA can lubricate the system, improve the use of funds; however it does not matter if I buy the most effective pharmaceutical, the most cost-effective, if the medicine will remain stuck on a shelf and the population cannot access the GP to get that prescribed, then there is no use for HTA. (...) If they put HTA in the role of giving a rationale to the system, they will kill and condemn a method that was not made for this.” (Record 10 – IATS Brazil)

Scotland faces considerably fewer challenges in health system management. Educational levels are higher, the population is smaller, as is the geographic territory covered by the NHS. After the political devolution of the NHS to local authorities, NHS Scotland gradually became differentiated when compared with the English NHS:

“An important piece of context is that NHS Scotland is very different from NHS England now. Health is a devolved responsibility of the Scottish Parliament, there has been a move away from localised commissioning, with a more centralized planning in the Scottish NHS. So it is quite different from the NHS England.” (Record 16 – SAP Scotland)

Although 'easier to monitor', some routine data produced are not necessarily used in policy making. It has been shown by Curtice (44) that the most deprived areas of Scotland do not receive proportionally higher funds to diminish social health gaps:

“In the more affluent areas there is less morbidity, but the level of funding as you get more morbidity and more need for healthcare... the funding does not go up. And that’s quite interesting, as we have good deprivation information in Scotland. One of our aims here in Scotland is to improve exactly that, but it is not working yet.” (Record 15 – SHTG Scotland)

Improving the management of SUS is a greater challenge. Not only based in the socioeconomic differences, the size of the system and the amount of resources needed for planning, providing and manage the administration needs is not proportionally comparable in this case. For Brazilians, the regionalisation of its health system is a prospect of change in this respect (305), however such modifications do not succeed without adequate financial resources. Some of the public health spending is directed to the private sector, through contracts for services; this sector is the next topic of analysis.

e. Private sector

The Brazilian health system is a public (SUS) and private mix; although covering 100% of the population SUS has been chronically underfunded since its inception in the early 1990s (342). The Scottish NHS is a state led health system that has the monopoly of the health market; private providers are kept out of competition, only allowed to offer elective services if needed (204). The private healthcare sector in Scotland:

“About healthcare Scotland is essentially a socialist country in my opinion. At least in relation to the private health sector. Either Labour or the Scottish National Party share the same interest of not necessarily getting rid of the private sector, but to keep them kind of low down. They want to keep the health system public, which does not impede people who have sufficient funds to go private if they want.” (Record 12 – ISD NHS Scotland)

The use of the private sector in Scotland has been fairly static overtime, even with some changes in comorbidity caused by the ageing population. (Record 15 – SHTG Scotland)

The population in Scotland has the option of using the private health market for elective procedures if they do not wish to wait in the treatment queue, which has a waiting time of around 2-3 months. The essential difference between the SUS and the NHS is regarding need: in Scotland when one has no means to pay for a procedure, his health need will be somehow fulfilled by the system; in Brazil, for the ones who rely only on SUS, a waiting time of 3-4 years is the exclusive option, worsening health conditions.

In Scotland:

In Scotland everybody has a primary care practitioner and he is the point of access, the gatekeeper. So ideally you have equal access to your GP, some services may require you to wait. My perception and understanding is that the use of the private sector in Scotland is comparatively rare and is a niche on screening services, hip and knee replacements. People use them when they don't want to wait for three months, they want next week and are prepared to pay £12,000 for it. So they can access the service quickly and bypass the waiting lists. (Record 17 – SAP Scotland)

In Brazil:

Although we have the distribution of 50 to 52% of supplementary health in Brazil as a whole, thinking in terms of health system with the public and private subsystems, we know that the area of specialties, and especially orthopaedics is a quite 'dodgy' world' here. In this case the market is much more promiscuous, especially when it involves prosthesis. The patient, weakened by the disease, whom cannot access the public system, will have to be subject of the supplementary health, in other words the private sector. If you really need it, you will pay, if you have to sell your car, your house, get a loan, whatever, you will do. We see this in the everyday life of the system. In the case of Arthroplasties over 80% of the procedures are done by the private sector in this country. It's not that the person had access to the health insurance, is that the access to the public system was denied in the first place. (Record 10 – IATS Brazil)

Social inequality levels in Scotland are lower than in Brazil (20, 268). The Brazilian case is not a matter of historical lack of resources of a developing country. The resources are there, concentrated among a small percentage of the 200 million inhabitants of Brazil (343). The private health system in Brazil reproduces socially historic divisions, continuously present in centuries of colonial and republican history (312, 344). Health needs are only partially met, let alone individual decision making. A basic precipitous of a market is the possibility of choice, which is ruled out if the individual does not have the resources which would make him able to exert choices (345). In Scotland there is a *choice* when using the private sector:

From my experience of living in Edinburgh and with a specific cohort of friends who had their hips done, about half of them will go and have them privately through some health insurance scheme, through their employer. They don't need to, because they could have it done through the NHS, but sometimes I know that they will decide to have it done by a particular consultant. When they go private they can just choose." (Record 15 – SHTG Scotland)

The Brazilian population is partially exposed regarding the financial interests of the private health market (344). The use of healthcare insurance or out of pocket payments is incentivised through income fiscal waivers (28). When a job is on offer, usually a private health insurance scheme is part of the package of benefits to attract candidates. Private health was constitutionally defined as 'supplementary' to the universal public system, however, it has been socially defined as a 'system for the poor' (346):

"The comparison between the public and private subsystems and Brazil is very complicated. My hypothesis is that when you look at these 25% of the population covered by private healthcare insurance and the distribution of income in Brazil, it is possible to see that these 25% of the population, as the income is highly concentrated, **many people in this group who have health insurance could not actually afford to pay for the service if the price was real.** Private insurance will catch people of lower income classes, up to R\$2,000 or R\$3,000 (£500 to £750). If we were really aiming a sustainable SUS, this person had to be at SUS, depending from it. Economically speaking for this person to be covered by a private health insurance that has the obligation to pay for every health need, the company would have to have a contribution much higher than the price this person pays." (Record 05 – Conitec Brazil)

The private healthcare political lobby is strong in Brazil (312, 344). To maintain a restrained access to health, mainly in profitable areas such as elective procedures, is of great commercial interest (344). With restricted access to the public sector, prices can remain high, demand is constant and with no significant competition between medical doctors. The industry competes for doctors that will use their products, offering between 15% to 25% of the base value of the prostheses for surgeons; such cases affect the private and the public sector and have been constantly in the Brazilian media¹⁵. It is a matter of medical ethics but also of market dynamics:

“Since 2011 we have been providing on average 600 million Reais (£150 million) a year with the intention of municipalities to increase access to healthcare.(...) There are around 700 different surgical procedures, virtually all elective and of medium complexity which we have included in this budget, (...) always aiming to expand access. What happened was a slight decline since 2010, the price was increased for the procedure via SUS, was made equivalent to the value paid in the market, **and then the market increased its value**, nothing beyond that. The increase in the amount paid by the Ministry of Health was absorbed as a simple reduction of the price gap, and the market raised the price again. The gap between the public reimbursement and the market just remained, now between higher values. (Record 04 – MoH Brazil)

The price gap between the public and private sector in these cases remains, largely due to limited access to SUS. Medical doctors that practice in the public sector also work to the private sector, so they are producers on both sides of the ‘competition’. Consequently, the observed price phenomena is only a market mechanism that would fluctuate maintaining the proportional gap anyway, despite the increase on the reimbursement value by SUS. This

¹⁵ Links in the Brazilian media about the illegal kickbacks received by orthopaedic surgeons:

1. <http://g1.globo.com/fantastico/noticia/2015/01/mafia-das-protese-coloca-vidas-em-risco-com-cirurgias-desnecessarias.html>
2. <http://impresalivres.blogspot.co.uk/2015/01/mafia-das-ortese-e-protese-parte-01.html>
3. <http://zh.clicrbs.com.br/rs/noticias/noticia/2013/11/mp-investiga-mais-de-70-cirurgias-feitas-com-autorizacao-judicial-em-pelotas-4336058.html>
4. <http://www.correiodopovo.com.br/Noticias/Policia/2016/05/588536/Preso-proprietario-de-tres-empresas-acusadas-na-mafia-das-protese>

market behaviour is linked to health economics concepts (184), and political actions of the

Ministry of Health:

Elective primary hip arthroplasty surgery is within the current policy that we have since 2011, within the elective surgeries policies of medium-complexity, which is nothing more than an attempt to increase access by increasing resources available for this type of surgery. However elevating the prices was not reflected in a supply increase, the amount of procedures itself remained the same, only more expensive. (...) We concluded that there was no improvement of access despite the increase of value per procedure, there was an improvement in payment only, not translated in a higher offer of care. (Record 18 – Local HTA commission Brazil)

Orthopaedics, together with cosmetic medicine, are the two most profitable areas in the western medicine (185). Both involve a high demand, one related to social aspects (cosmetics) and the other related to physical disability. The issue regarding price of reimbursement in Brazil is a consequence of lack of data by the private sector and loose regulation. In countries with strong regulatory systems, such as most of the western European countries, information is essential, as represented by the national joint registers (52, 90, 127, 347). England has the most complete National Joint Registry (NJR) in the world, with information about patients, hospital admissions and, most of all, prosthesis quality and surgical approaches (59). Scottish orthopaedists decided, so far, to not submit their data to the English NJR:

“Things like the National Joint Registry are now considered as pure businesses and treated as such, being outsourced and not kept under the true NHS auspices, outsourcing in the last instance collection of data. Privatisation is more expensive than anything else, but that’s the way the NHS in England is taking. As a business they need to maximize their income, so when you reach the limit of your income you outsource in order to increase income. In relation to data this happens selling data to services, to research.” (Record 14 – SHTG Scotland)

The private sector and market mechanisms influence, in one way or another, the availability of elective primary hip arthroplasties by the Brazilian SUS. Such phenomena is not observed in Scotland due to heavy regulatory and market control mechanisms; also directly related to the fact that the surgeons are mainly working only for NHS Scotland.

III. Evidence based actions/policies

The third and last major category of data analysis focus on the evidence based actions or policies, unveiling implications for equity of access to healthcare in the Brazilian SUS and the Scottish NHS. Starting with the sub-category of Health Technology Assessments, it continues with access to evidence/data, ethics and, finally, explores arthroplasty registers and medical regulation.

a. Health Technology Assessments

A bill regulating the incorporation of Health Technology by SUS has been approved in Brazil in 2011 (348). It establishes a network of collaboration for health technology assessments to be managed by the Brazilian Network of Health Technologies (REBRATS), supplying health technology assessments of public health interest by research institutions of the country. Prior to this 'health technology network' a broader scientific research strategy was established in 2008; scientific fields represented and lead by senior researchers of a broad range of specialties were invited through an open bid process of funding, aimed to establish new research institutes. The National Institutes of Science and Technology (INCTs) initiative, made possible the establishment of an Institute of Health Technology Assessments (IATS). In general terms, the initiative is embedded in the evidence-based scientific movement, such as the National Institute of Health and Care Excellence (NICE) in the UK and International Network of Agencies for Health Technology Assessment (INAHTA).

Prior to the analysis of how health technologies are incorporated by SUS in Brazil, lays a conceptual discussion. The so-called 'SUS principles' were established by the Constitutional text of 1988 and are the 'conceptual pillars' or 'doctrinaire principles' for all policies and regulations of the Brazilian Unified Health System. These are: *universal health*, *equity*, and

'integrality' (in the sense of comprehensiveness). Health technologies fall into the realm of the last principle, regarding the comprehensiveness of the system: to what extent should the system financially stretch to achieve universal and comprehensive cover? The colloquial way of posing the question is: is it everything to everyone? How does the system guarantee health cover if resources are always limited? The regulation of such questions was not quickly followed by the institution of universal healthcare in 1988 (349). The regulatory legislation, expressing in practical terms what was intended in the constitutional text, occurred only more than 20 years after the establishment of health as a right in Brazil. The final regulation happened through years of negotiation in the federal Senate:

“Only in 2007, two senators of the republic had projects related to the *'Integrality'* principle. Both projects were in the Senate proposing to regulate the incorporation of technologies in this country. But the projects were completely different (...) **the idea was to somehow regulate *'Integrality'*, which is one of the conceptual pillars of our Health System. The concrete result of the non-regulation is that when there is a lawsuit for a drug, device or whatever, the judge does not have a legislation to support a rational decision, he resorts to the Constitution and, by the Constitution is everything to everyone, without discretion.** (...) Both projects run in the senate between 2007 and 2010, and what was approved was a negotiation between these two projects. The legislation provided the creation of Conitec, which should work according to the laws governing the administrative process - deadlines, transparency and public hearings, all new duties, mediating the incorporation of health technologies in SUS.” (Record 09 – SBOT Brazil)

Lawsuits related to healthcare became an issue in the past 10 years. As previously discussed, the lack of a regulatory framework for the national healthcare law pertain to a multifactorial deadlock about the practice of a universal right to health involving the Brazilian justice system, government and society (320, 322, 350).

As it is the case of most developing or late developed countries, HTA *'scientifically justify'* decision making, a *'rational way'* of managing scarce resources (178). HTAs have been eventually used in the developing world to diminish already limited budgets (182), and the SUS in Brazil is not an exception:

“The first evaluation of health technology itself was about a Ministry of Health project in 2001 or 2002, which was called ReforSUS (meaning ‘reinforce SUS’). A cooperation between Ministry of Health and the Inter-American Development Bank had as a conditionality the need of applying decision-making processes based on HTA. I believe you can consider this as an embryonic evaluation before developing health technologies in the country. HTA here began to be relevant only in 2004/2005, when the growth curve of technology spending in Brazil grew exponentially.” (Record 09 – SBOT Brazil)

In practice, SUS has been covering the healthcare of Brazilians since the beginning of the 1990s, so health technologies were already in place and somehow explored at local level. What was missing until then was a regulatory framework for the process of choosing between different technologies in the public sector, mainly related to innovative treatments. After the regulation, local committees of HTA were established in some institutions:

“We started a local commission to incorporate technologies in 2011. Then in 2012 a committee was assembled and wrote the project to establish our local committee here. (...) They opened a call to start local assessment technology groups, so we applied and won the bid. We had spent some time afterwards already with a commission but without physical structure, virtually no structure at all. (...) We had broad demands from the Ministry of Health, based on the needs of SUS, but for our local technology issues we had nothing.” (Record 01 –Local HTA commission Brazil)

Despite the federal regulation and the presence of a local committee of health technologies, HTAs were not observed at local level other than specific commissioning by the Ministry of Health. Decision making processes regarding health products remain attached to each institution ‘administrative processes’ regarding decision-making:

“It would be amazing if we could do real Health Technologies Assessments for ourselves too. For now, what we need to know yet is effectiveness and safety. When our staff ask to incorporate a technology these are the questions to be answered... is it effective? And is it safe? Well, there's a cost.” (Record 18 – Local HTA commission Brazil)

With a restricted scope for action and planning, HTA as a scientific methods is limited to the act of incorporating a new technology in Brazil. There is no continuous process of reevaluation, mainly due to lack of administrative resources:

“Our dream is to have someone doing local economic evaluation. We incorporate a lot of technologies, a lot that we do not know if it was an improvement or not. (...) **The technology is incorporated and gets lost in the system, we have no control today if it is producing the impact we expected, which is something I think is important also for the incorporation of technology.** Not only evaluate when incorporating a technology, keeping this evaluation as an ongoing process.” (Record 01 – Local HTA commission Brazil)

As mentioned, the deadlock between lawsuit decisions that assume ‘integrality’ as a full comprehensiveness of the system and the matter of limited resources hinder health policy planning (350) in Brazil. The media and disease-centred patient interest groups also play an important role in the social control of the system, directly influencing management and decision making:

“It’s often the case that treatment technology will give a longer 'disease-free' condition, however not necessarily the individual will live more. That does not mean a good life, with quality, and the matter is so subjective that has no way to generalise to everyone.(...) The family feel and has the hope that the medicine will save the person, and it will not. The person will die, no matter what, even young. In these cases in which the person will die in 24 weeks increases the drug for 36 weeks, but survival is zero. Since the financial increase is huge, about R\$900,000 (around £222,700) per year. (...) **The treatment was evaluated and incorporated by Conitec. And that's where the problem is, if you look at the report discussion. It does say that there is no increase in the survival of the individual. But then there's the pressure of the population, pharmaceutical industries. A famous reporter used, publicising the fact, turning into a popular demand. The report discussion says that for these patients there is no survival increase, and then at the end says it has to incorporate. Increases the lifetime without disease but not globally, it is very expensive and has been incorporated into our SUS. All this money, if placed into primary care, we cannot even compare with the treatment of a few people, it is just not rational.**” (Record 18 – Local HTA commission Brazil)

The pharmaceutical industry fills a great share of the health technology incorporation agenda in Brazil. This phenomena is common place in the HTA scenario of other countries, where it has been observed a growth in the number of agents that would ‘vote for’ the incorporation of specific pharmaceuticals (351).

“The main thing that takes our time in terms of market access are pharmaceuticals, and this is the same either here, in Australia or in the British Nice. What is more time consuming is the drugs work. There is where the pressure is, always the drug. Here and everywhere in the world.”
(Record 07 – Conitec Brazil)

The pharmaceutical industry, despite the regulatory framework, does not support research that has little or no market effect (352). The case of off-label use of pharmaceuticals is a concrete example of the situation (353).

Off-label use is a common practice in SUS. Especially in relation to older drugs. The laboratory has no interest in registering the use for anything else because sales will be the same, they would only spend with studies that have some kind of market effect. (Record 07 – Conitec Brazil)

Despite the HTA bill that established Conitec as a National body for Health Technology Incorporation, the institution is proportionally small for a health system that has the aim of offering comprehensive healthcare to 200 million citizens. A small team with a great responsibility:

Altogether, taking into account the external consultants, we are 35 people. At least half the team deals only with the administrative demand, so it's a small technical group. And besides the evaluation of technologies we coordinate the development of clinical protocols. Some of the reviews that we do here we need to delegate to educational institutions and teaching hospitals. (Record 07 – Conitec Brazil)

Although HTA processes should give weight to rational decisions towards cost-effectiveness, the Brazilian Conitec seems in practice to mainly act as a market entrance door to the public health system for 'innovative' products, mostly pharmaceuticals. Its recommendations are conditional on price; it means that depending on the price, the health product becomes cost-effective or not; and the price is always negotiable following market demand:

Many reports of Conitec are conditional on price, before closing a final recommendation usually the Office of the Secretary negotiates the price. The Conitec recommends depending on the price offer, only then it will be cost effective or not. This recommended value is agreed through negotiation with the Secretariat for Technologies of the Ministry of Health and producers. (Record 07 – Conitec Brazil)

The HTA Law places Conitec as an 'assistant' organisation of the Ministry of Health to make recommendations about technology incorporation and clinical guidelines:

“The executive secretary of Conitec is in the MoH, the voting chamber consists of 13 different entities (...) the law establishes that Conitec should assist the Ministry of Health in the incorporation of technologies and development of clinical protocols. It does not say that the Conitec is a decision-making body, the decision maker is actually the Ministry of Health, no matter who is the elected administration.” (Record 07 – Conitec Brazil)

Such situation is conceptually considered as an adaptation of HTA and not the real step-by-step processes observed in other countries (178, 186, 189). Following international research standards, Brazil only legitimated the use of HTA as a market entrance door for imported health products to its public health system, as decisions are not associated with the focus on primary care and prevention indicated by the SUS legislation:

“Evaluation of health technologies would be excellent. It is the idea and planning of the Ministry of Health but is far from our reality, especially, to act in the regulation of the market and the rational incorporation of health technologies. The HTA is part of a group of actions that would help to improve access, but is not the only solution and is definitely not the top action.(...) If it is only to establish what is expensive and what is not expensive, then do not call it HTA. (...) The other aspect of this problem is that HTA has been used as an improvement implemented to control costs, as saying 'I will not incorporate this technology because it's expensive' – then no need for doing HTA, right?” (Record 10 – IATS Brazil)

HTA is a tool for decision-making processes (178). It orients the decision making processes in policy health planning, consequently influencing access to healthcare through the allocation of limited public resources. Evidence-based decisions are more likely to be effective in the real world, at least in theory.

“The benefits of health technology assessments are to help you to make choices, comparing one intervention with another intervention; one area of healthcare that you want to put more resources than another one. What a health technology assessment will do is to give you more information to help on how to make that decision, but of course that decision depends on a whole bunch of social, political and financial factors that are involved in this decision making process. So it is just a tool that can help the decision making bodies to make a decision on where to put specific resources.” (Record 15 – SHTG Scotland)

The presence of HTA is, however, part of a global movement directed towards the management of resources; in other words, rationing (182). After the oil crisis of the 1970s and

the exponential growth of technologic related interventions, healthcare costs soared (354). Despite cases like the Cuban health system and consistent evidence that the most effective interventions are related to low cost preventive primary care, the ‘innovation industry’ push the argument of elevated costs and growing ‘health needs’ (185). Elective primary hip arthroplasties are part of this growing ‘need’:

Health technology assessment is a way of saying no to health technologies because they create a threshold. For example NICE emphasize the threshold for cost effectiveness and many of the health technologies that they look at don’t meet that threshold. And that is a way of managing the resources in the healthcare system without a doubt. I would argue that this is a more equitable approach to the population covered by this healthcare system. The difficulty that this creates is that some health technologies now seem to be inevitable, society thinks that, **creating need**, in which case the rules are deviated from the original idea, harming equity. (Record 15 – SHTG Scotland)

The only way to prevent overtreatment is the availability of reliable patient-level information (3). The establishment of a transparent and accountable National Joint Register is the first and most crucial step towards regulation when evaluating primary elective hip arthroplasties (347). Private providers can influence the market in mixed health systems, with no routine data available about the efficacy of their products, as it is the Brazilian case of hip prostheses. National arthroplasty registers need also to be regulated:

Joint replacements now in terms of health technologies assessments are driven by the data from national registers. Very rarely, we will opt for the latest gadgets, we prefer to rely on data already established. Another problem with HTA is who does it. Unfortunately sometimes who performed the HTA can be biased towards the industry. (Record 14 – SHTG Scotland)

The equity dimension of HTA has been gradually receiving less attention (355). A ‘movement’ that is yet to arrive in Brazil is the use of ‘rapid review methodologies’ of HTA. In order to bypass lengthy processes that involve qualitative aspects, also known as social aspects, decision makers are shifting towards ‘rapid reviews’ (180). Evidence based information

regarding safety and cost-effectiveness is the focus, thus excluding social consultations or debate arenas:

Looking at full health technology assessments they should encompass international definitions of four key dimensions: clinical effectiveness, cost effectiveness, organisational issues and patient issues. Most of the patient issues are related to equity of access, funding issues or relative access. All these are captured by the patient dimension. However, I believe that the international methods are moving away from those full health technology assessment methodologies to more rapid review methodologies. (Record 17 – SAP Scotland)

Health technology assessments are a developing field in Brazil. Whilst in Scotland the methodology has been used to base decision-making processes of management, in Brazil HTA has been used to justify resource allocation in some cases and, in others, to justify the incorporation of new pharmaceuticals pushed by the so-called pharma-industry. Equity and social processes involved in HTA have been losing ground in Scotland towards rapid review assessments, less time consuming but also less concerned with the social implications of new health technologies. Social implication is also linked with availability of evidence/data, the next topic.

b. Access to evidence/data

Access to data is essential for public procurement, accountability and governance in public health (333). The relationship of health systems, healthcare providers, governments and society is directly influenced by the availability of information about their actions, interests and objectives; an open and publicly accountable relationship (356). The Scottish Arthroplasty Project (SAP) is a concrete example of how information can be used to not just regulate, but also to monitor the quality of procedures and performance of health workers and institutions¹⁶. The SAP provides feedback to surgeons based on routine data, verifying rates

¹⁶ The Scottish Arthroplasty Project website: <http://www.arthro.scot.nhs.uk/>.

of success by consultants, recovering times, infection and mortality; offering expertise help to low performing services/consultants (357):

“About the Arthroplasty project, basically the data comes as SMR data which is a national dataset, the Scottish Medical Records. We use SPSS and pull out everything we want for arthroplasties, everything has been designed by a data analyst using the codes for arthroplasty, filtering this information from the national dataset. So we extract that and aggregate to analyse. The reports are published every two years, we are trying to publish every year but this might happen only in the future and not now.” (Record 13 – ISD NHS Scotland)

Although the private healthcare sector in Scotland is not obliged to offer patient-level data about performed procedures, it is a requirement to feedback data if the funding is originated from a public source; in other words, NHS funds. The private sector has been eventually hired to decrease waiting lists of procedures, so Healthboards are able to meet established targets (277) and also evaluate equity based on the deprivation levels of access:

“We get data from the private sector, about 10% which is not a bad figure but we just report on it, we don’t use it for anything else. Sometimes if you have specific situations with a Healthboard like having too many people on their waiting list for arthroplasty, to meet their target they use the private sector with NHS money. There are certain targets, for example a person must be seen and treated within 18 weeks from the moment they get referred from a doctor to the moment they have the arthroplasty, about four and a half months.” (Record 13)

“So when the data goes to the file, other data is added to it also, and that is what the analyst will use to produce figures. So all this is done when the information comes to the door. So each individual record will be packed with deprivation levels and other information all based on the postcode. All information is tagged to the record as soon as it comes in, so there is no additional work required for this.” (Record 12 – ISD NHS Scotland)

The market share of procedures performed by the private sector of Scotland is minimal in comparison to NHS numbers (204). The public system is not dependant on the private sector for facilities or healthcare personnel, exactly the opposite situation of the mixed health system of Brazil, which heavily relies on the private sector (23, 339). The result of the ‘artificial’ competition between public and private healthcare services in Brazil, as previously exposed, is a non-controlled price system, skewed towards higher prices due to profit margin

seeking behaviour, constant demand and lack of competition between producers (surgeons/consultants). In Brazil the supply control is based on the private sector, hence the indifference when the public sector raised its prices in an attempt to increase supply. The private sector only 'compensated', also rising its prices and keeping supply tilted towards profit gains; an expected health market behaviour when it is loosely regulated (169, 184, 311). In Scotland, due to the 'profit control' exerted by a virtual market monopoly of the NHS, private services are shifting from procedures supply to sectors with higher profit margins, also an expected health market behaviour of profit seeking (169, 184, 311):

“We have several private companies that are now offering services of data collection within the NHS for specific reasons, on this case for the orthopaedic companies, not just for elective procedures but for trauma or other orthopaedic issues. Some of them are actually changing from providing care to providing only the organisational information to the NHS as there is more money to be made there.” (Record 14 – SHTG Scotland)

Although less prominent in Scotland, the market effects can be perceived in the administrative sector of the NHS, so far not affecting supply of services (204); differing from NHS England, where services supply have been already diminished (209, 358). The so-called 'austerity cuts' are a widespread phenomenon after the 2007 financial crisis in the EU countries (16, 17). In Scotland this has been reflected in job cuts and rising workloads, mainly in the administrative sectors of the NHS (359, 360):

“I was on a meeting today that was said that for the next year's budget 2015/16 we will 'loose' four or five people and won't replace them. But we are sending back a message that 'that's it', there are no more cuts we can make. More cuts will mean reducing of jobs, meaning reduce of services and less things for yourself (the Scottish government).” (Record 12 – ISD NHS Scotland)

Another effect that has been observed in NHS England is the outsourcing of data services (361). Routine data has been adjusted to fit on the private supply and competition framework proposed by the 2012 Healthcare Act (361). The changes in data collection are controversial,

as the charge for data supply (362). The issue of financial sustainability and charging for public health data has been discussed in Scotland:

“We never considered charging fees for obtaining data, it has been 13 years that I am here and it’s the first time that we are really considering it... because money is short now. Our main client is the government and we would not charge the government... but the private sector, big pharmaceutical companies, or anyone else that might use this data. Universities too or other data users that are not regarded as of ‘public health core customers.’” (Record 12 – ISD NHS Scotland)

The outsourcing of services related to routine collection, production and management of data has implications for the impartiality of such information produced by public bodies (356). Information of vital importance for the public interest, if produced 'for profit' might harm the public interest, equity and other values regarding the right to health. Another aspect is the fragmentation of information and data bases (361). Such aspects turn the analysis to the ethics debate, the next sub-category of analysis.

c. Ethics

This study is dedicated to understand and evaluate the equity of access to healthcare in Brazil and Scotland using the case of elective hip arthroplasties as a proxy measure. Entangled with the matter of access and equity there are multiple influencing factors. Ethics are the field that establish the 'rules of the game' (363); something considered 'ethic' do not necessarily means more equitable, fairer or directed towards reducing health related social gaps (364). Equitable access to health and healthcare is part of the Brazilian constitutional text and a responsibility of the State, but not necessarily within the conceptual realm of ethics:

“We know that our system is not equitable, this is a reality of working at SUS. So when we talk about fairness within the SUS we are talking about the Brazilian state responsibility to act about this. And to be more equitable we need to consider individual clinical vulnerability, social determinants of health and the social vulnerability. Only then you can start talking about a system that might produce equity of access to health.” (Record 06 – INTO Brazil)

Sometimes policy mechanisms, like the public bidding for providing health products might negatively interfere in the quality of the service supplied (185). Health products are regulated by the National Agency of Sanitary Vigilance (ANVISA) in Brazil, the public body that gives market approval to all health related products (365). What is relevant to this study about ANVISA is that the effectiveness of the prosthesis that come into the Brazilian market is not tested by ANVISA; the ultimate responsibility of effectiveness, in other words ‘if the prosthesis work’, is the surgeon who indicates and applies the product in his patients:

“There should be a minimum standardization of prosthetics. We have prostheses that have an increased dislocation percentage, which is a huge clinical complication. (...) But then the public bidding law requires you to buy the cheapest, the law says it has to be the product that offer the lowest price in a public bid. To disqualify the lowest price, its technical justification has to be very grounded and this makes the whole process much more difficult than already is.” (Record 08 – INTO Brazil)

As mentioned before, surgeons bear the responsibility of performing procedures, either in the public or private sectors, controlling supply. There is a common understanding between medical professionals that the values in the list of public procedures is under-priced, thus some local surgeons just refuse to perform hip arthroplasties in the public sector. The surgeons of the National Institute of Orthopaedics organise eventual ‘joint efforts’ with local health authorities, doing arthroplasties in places of high demand and long waiting lists of SUS:

“When we do the ‘joint efforts’, doing lots of procedures in a weekend where there is high demand or less accessible places, meaning that there you will have people in the waiting lists sometimes for more than five years, our surgeons are always badly received by local colleagues. They often say ‘we can do this procedure here without you, but if it is to earn this little money that the SUS table pays, I just will not do it, the effort is not worth it!’” (Record 08 – INTO Brazil)

Such behaviour is encouraged by a scenario of a loose regulatory framework:

“When experts analyse their own procedures or of colleagues you have an inevitable bias. And that is just not good for the whole regulation process, even more if the ultimate goal is equity.” (Record 02 – IATS Brazil)

The internal relationship of the medical workforce, its associations and also within the Brazilian government reflects the social class differences of the country, particularly related to economic inequalities. Remote regions of the country are not a popular destination for health professionals in Brazil, specially medical doctors, at the 'Cuban doctors case' illustrates¹⁷ (366). There has been disagreement with medical associations and unions as the government has been gradually 'breaking down' the market hegemony of the medical workforce in Brazil, not without retaliations by the media and the healthcare industry itself:

“Then yes, you can press the market if you have cohesion and especially the medical workforce on your side; you need to bring together partners who will be the future decision makers. **The political orientation of the current government, the Workers Party (PT) pulled out the medical profession of the decision arenas; however, in the end of the day is still the medical profession that has the legal right to prescribe.** So you need to bring them on your side and that is not what the current government is doing, in a matter of fact they are doing exactly the opposite.” (Record 10 – IATS Brazil)

Not all medical associations were 'pulled out' of the debate arena (367). Most health researchers support the policies promoted in the period, including epidemiologists and other medical doctors (368). In Scotland, specialists are also close to the healthcare industry. However other values drive this relationship, not without the need of heavy regulation, hence the mention of previous financial incentives 'probably' entangled with the purchase of specific implants. In Scotland there is a 'lack of space' for a free market to act with prices dispute or more incisive 'market strategies':

¹⁷ The so-called 'Cuban doctors case': the government presented a socially progressive agenda by allying policies of income redistribution to primary care actions; also by bringing foreign medical doctors to reinforce the workforce of the most needed regions, which was heavily criticised by most of the Brazilian medical associations.

“We have a close working relationship with the representative of the companies because they provide a lot of surgical support. If we need certain bits of equipment they will ensure that arrives on time, that is everything there and working. They provide training for the nursing staff too, usually not for the surgeon. **They use to provide monetary support for researchers, which was not tied to the purchase of implants, but in reality probably it was.** Nowadays that doesn’t happen in Scotland. You can have some money for research but is separate from the kind of implant you will use. (...) So yes, we are fairly close to the representatives, however they don’t sell us anything, they provide a service, and by providing a good service they sell us things.” (Record 08 – INTO Brazil)

The relationship of medical doctors, their associations and, consequently, their interests, must be regulated by the state together with the civil society (356). In the public health sector, social inequalities entangle these relations into disputes that mix market interests with social rights, harming equity. Medical regulation and arthroplasty registers is the next category of analysis.

d. Arthroplasty Registers / Medical Specialty Regulation

It is well documented in the scientific literature the social and political hardship of regulating medical doctors and medical practices (369, 370). The Scottish Arthroplasty Project (SAP) has the main objective of improving the quality of arthroplasties offered by NHS Scotland. Monitoring indicators of each surgeon and NHS Healthboards, the steering group of the project individually contacts each professional, providing a performance feedback:

“We also send a complications list directly for the consultant, for every arthroplasty consultant individually. I believe that we have around 200 consultants. So it’s quite a manual job, we pulled the information of clinical complications out and post to them. Just recently we started also sending them by e-mail. They use this information for their reviews with their line manager, we don’t get involved in this. We just send them the information and ask ‘that this is what we have on the system, do you agree or not?’ If they agree they send it back saying ok. In the end it’s completely down to them to deal with any issue or to do something about it.” (Record 13 – ISD NHS Scotland)

The quality control managed by the SAP substitutes, in a practical sense, a National Joint Register. All procedures performed by surgeons of the NHS Scotland are added; medical

doctors are not able to influence indicators in any other way than performing well or, improve standards if needed:

“The way we keep quality under control in Scotland, we are slightly unique on this sense, the surgeons have no choice in relation to which data is collected as we do it centrally through the ISD. **Everybody’s data is entered, you cannot hide, as surgeon you can’t interfere to enter other information.** Every patient that is admitted to hospital and has an illness or a procedure is coded, and those codes are send down to the ISD. **As specialists we can’t feed the system and we have no control over it, which is a very good thing. So, on the case of hip replacements, we monitor complication rates of each individual surgeon on a yearly basis and 5 years complication rates of Healthboards.** Today we have better models than a decade ago, so a problem like the metal on metal implants¹⁸ (371) that took 2 to 3 years to be detected, we would have done in 6 months now.” (Record 14 – SHTG Scotland)

The Joint Registry model is useful if not industry led, which is a difficult administrative balance to achieve (372). The sustainability and reliability of the model depends on industry resources if not funded by a public budget (347). This inevitably brings a paradoxical relationship between the health products industry, post-market surveillance, patients and regulatory bodies.

“If you look at the NJR (National Joint Registry Model), it is run by a charity at the moment, on a five year bidding process on who runs it. So inevitably, or it is not guaranteed that the same charitable organisation that runs at present will keep taking over in the future. And if you look at England, there are many registers now in England, the NJR is just one of them. There is a business, a value in running this and outsourcing them to be run also by private companies.” (Record 14 – SHTG Scotland)

The market value of the information hold on Joint Registers must be used to benefit patients and not to increase the potential of profit margins (347). These data is of extreme public relevance as it reveals the quality of implants by brand and type, empowering citizens to

¹⁸ Metal on metal implants are recognised as deficient in relation to other kinds of implants. Evidence is still mounting but there are indications of toxic metal levels in some patients after years after the implant. Patients with these kind of implant are advised to yearly monitor blood samples and look for help if joints are swelled or painful. The wear of the implant can potentially cause deterioration of the bone and tissue around the hips.

decide together with their surgeons what is best for their individual needs. However, shared decision making is not the forte of orthopaedic consultants (373):

“It allows you to identify the sales by brand, who are the top 5 or six in terms of performance, the lowest failure rate; it allows identification of failures, and the newer systems are looking to identify failures earlier. (...) So this information is part of the story on what money is to be made from this. The other part is the whole safety and quality outcomes for the Healthboards as well, they require this information to intervene and maintain quality of care in relation to possible complications of specific implants.” (Record 13 – ISD NHS Scotland)

The SAP is a practical example that is possible to regulate medical consultants in a cooperative manner, effectively improving practices. Surgeons that have outlier results are notified and can use this information to improve processes on their own NHS Healthboard, justifying a query for better resources or specific health needs actions by local public health managers:

“So what happens is, we send a notification to the person, the surgeon with outlier complication rates. (...) In this form there is a list of complications and a list of patients along with a statistical plot of the complications. So they need to send a breakdown of what happened to those specific patients, if there was a problem, what the problem was; they also identify if the ISD codes were correct or not, because if the codes were wrong they might have not failed. They have to have these whole thing signed by a head of department, showing that he shared the issue. (...) If they don't reply at all, it is sent again, if they still don't reply or keep replying on an inadequate fashion than the head of the committee contacts someone higher up in the hierarchy chain, like the chief executive or the head of risk management of that specific Trust.” (Record 17 – SAP Scotland)

As SAP present a cooperative approach, the public interest is preserved, producing a 'common good', a virtuous circle (374):

“The interesting thing is that the surgeons don't mind the control, they are frightened to get the letter about complication rates and talk to us sometimes but as soon as they realise that we are there to help they are not frightened anymore. The only thing we can detect are complication rates and the outliers surgeons regarding them, so revision, infections.” (Record 16 – SAP Scotland)

A common comment by stakeholders regarding the SAP is that it ‘only works because it is a rather small community of surgeons’. As their invigilating actions are based on cooperation and not penalties, the number of surgeons does not necessarily influence its achievements:

“I don’t agree with the idea that this system only works because it is a fairly small community of orthopaedic surgeons in Scotland, we have in the NHS around 180. **I believe that this works because it is non-confrontational, helps them to reflect on their practice.** (...)All surgeons are competitive and they want to perform well, they don’t want to perform badly. **Also because this is not a blame culture and we don’t expose them to the general public, the general purpose is to improve the service.** (Record 17 – SAP Scotland)

Ultimately, it needs to be considered that every surgical procedure is unique as it reunites a patient with single characteristics, a surgeon and a healthcare team all formed by unique individuals. In other words, a surgery is a human procedure, carrying the characteristics of those involved either performing or undergoing it:

“A surgery is something human performed, the complication rates of the average surgeon will tend to be higher than the surgeon that developed the implant or coordinated the study of the new technology. A great surgeon can make a bad implant work, whereas a bad implant into the hands of ordinary surgeons tend to fail.” (Record 13 – SHTG Scotland)

There are similarities between the regulation of the medical profession in Brazil and Scotland. What provokes and reinforces differences that harm equity is the higher social inequality present in Brazil, associated with a mixed economy health systems setting and the lack of funding for SUS. The confluence of inequality and the health systems setting of Brazil influences market and price behaviour: embodied in the figure of surgeons who provide services for both, the private and the public sectors.

5.7 Conclusion

The three major categories emerged from the data collected are a reflection of the multiplicity of subjects involved in the analysis of equity of access to healthcare in public

health systems. Such complexity demonstrates that there is no objective definition that encompass all implications that inequity of healthcare imposes to a society, either in Brazil or Scotland. The categories and subcategories explored by this chapter were an effort of exploring these implications.

As any social phenomena, access to healthcare in the case of elective primary hip arthroplasties could be approached through various aspects. This chapter aimed to illustrate how the difference in national and regional rates associated to a social gradient of access to healthcare impacts as multiple social waves the health systems setting; both as causation and as a consequence.

Health inequalities between Brazil and Scotland (and within its own geographic boundaries) are not explained by only one variable/factor; multiple layers of complex and intrinsic reality elements shape, keep or are designed intending to change the scenario of health related social differences. This chapter offered an account of these multiple reality layers forging the issue of health disparities, in contempt of both universal health systems SUS and NHS.

The interviewees were exposed to the data presented in chapters 3 and 4, which demonstrated differences of access to healthcare translated into numerical rates, offer of services and socioeconomic variables regarding the public health systems of Brazil and Scotland. As social actors, they offered an interpretation of these quantitative findings, grounded in their personal experiences and their 'place in the world'. Their understanding was influenced, as in any human relation, by the interviewer, with whom meaning to the quantitative data was built up, bringing the numerical rates and indexes previously presented to another level: the reality of health inequalities and its consequences to citizens, health workers and policy makers.

Brazilian interviewees were not surprised by the results of chapters 3 and 4. They highlight that such differences between the North/Northeast regions when compared with South/Southeast are linked with historical socioeconomic differences, been expected and present in most basic health indicators. Despite the presence of SUS since the early 1990s, primary care was most targeted by redistribution of resources, while secondary and tertiary care remain concentrated at large urban and industrialised areas of the South/Southeast of the country. The fact that the South region presented nearly double rates in relation to the national numbers, reinforced the argument that higher equality levels likely follow better access to healthcare, as the South present the highest equity levels in the country. The social inequity and access to health phenomena is more evident in cases such as the Brazilian one, where social disparities are much larger than in most European societies.

6. Discussion of results against research objectives, public health policy recommendations and conclusion

The purpose of a mixed methods research design is to answer a research question based on close-ended (quantitative) and open-ended (qualitative) evidence, **reaching an answer that none of the evidence would be able to provide on their own account** (53-55, 89, 198). If only quantitative results were considered (Chapters 3 and 4) a considerable difference measured by metrics would indicate that treatment rates are higher in Scotland than in Brazil and more equitably distributed, despite the presence of some regional differences. The qualitative data (Chapter 5) were collected by presenting the quantitative results as part of an interview (interviewees were asked to interpret the quantitative findings using their expertise), leading to results that would not be possible to reach using solely quantitative or qualitative methods. In this final chapter the findings of this research are discussed prompting a set of public policy recommendations for Brazil and Scotland.

This chapter is also a process of reflection over the objectives and many limitations of this study, mainly in relation to the broadness of the concept of equity in health and healthcare and a sometimes incongruent affiliation with access to health technologies.

The research question of this work was:

- **Do people living in Brazil and Scotland have equitable access to public funded healthcare if in need of an elective primary hip arthroplasty?**

The term equity of access to health implies a 'social fairness' that can be partially explored utilising standardised rates of treatment associated to socioeconomic indexes, *describing* the issue and providing an although simplistic, nevertheless objective answer: *yes* or *no*. In this

case, **NO** is the answer. Based on the findings presented in chapters 3 and 4, **people in Brazil and in Scotland do not have an equitable access to healthcare if in need of an elective primary hip arthroplasty funded by the public sector.**

This finding does not mean that the inequities explored by this research reach all sectors of the national health services of Brazil and Scotland. There is a need to clarify that this research is based on data of **one elective procedure only** and the concept of a 'healthy individual/population', with access to health goes much beyond a person being able to access care to osteoarthritis and utilising a primary hip arthroplasty to avoid physical disability. In an ideal scenario, if such health need was always fulfilled and everyone had complete and equitable access to the procedure in question, **it would not necessarily mean that the NHS Scotland or SUS would be universal and comprehensive services regarding equity of health access.** However, the findings of this research give a glimpse of possible regional inequalities of access to health in Brazil and Scotland and explore some of the issues and limitations of both health systems in offering comprehensive universal health care by using elective primary hip arthroplasties as a case study. Another aspect that offers a further limitation to this research is that the quantitative data regarding utilisation of elective primary hip arthroplasties was not adjusted for case mix or severity of the disease, a common limitation of big populational studies and datasets.

The objective answer of the research question does not fulfil an understanding of the issue of **equity to access to elective hip arthroplasties.** Why such health inequity happens, to what extent and how citizens and health workers of both countries experience it; in other words, how such inequity is 'translated' into reality. Previous studies of social determinants of health have emphasised through large amounts of evidence, that the social gradient of health occurs

in all western societies despite social hierarchy positions, manifested in treatment and mortality rates, life expectancy and other variables (19, 20, 57, 225, 313, 375). What varies from country to country is the 'steepness' of such gradient, which is directly associated to social inequalities. Only poverty, as manifested on low economic indicators observed in poor countries regarding income, do not necessarily mean a restriction of access to health; differences within the same society, the 'social gaps' represented by levels of social inequality do (18).

6.1 Discussing the research objectives

Objectives 1 and 2: to compare age and sex standardised rates of elective primary hip arthroplasties between Brazil and Scotland in the public sector between the period of 2009/10-2012/13 and the contribution of health services availability (physicians and beds including public and private sectors) to differences in treatment rates

There was an eight-fold difference of age and sex standardised treatment rates at national level between Brazil and Scotland between 2009/10-2012/13, with the latter presenting the highest treatment rates. There were also differences within regions at national level in both countries: the most populated area of Scotland, Glasgow has shown the lowest rates whilst the north and northeast of Brazil also presented low numbers in comparison with the national average; in all three cases the regions are known by their historical socioeconomic inequalities. Partly explaining the gap of utilisation between Brazil and Scotland lays a two-fold difference of hospital beds and the presence of an independent private sector competing with SUS; it is however essential to highlight that access to complex technologies is not a synonym of equity of access to care (79). Overall, there is a significant difference of standardised treatment rates between the two countries regarding the same procedure and

period; the fulfilment of these descriptive objectives was the first step to compare access to elective primary hip arthroplasties between Brazil and Scotland.

Objective 3: to examine whether there is a socioeconomic gradient of access to elective primary hip arthroplasty treatment rates in Scotland (2009/10-2012/13) and Brazil (2010/11)

Considering the Brazilian case, availability of data was the greatest challenge to fulfil this research objective, hence the reduced period of analysis, 2010/11. Although the use of one year only to analyse SUS and the socioeconomics of access to elective primary hip arthroplasty being an important limitation of this research, the proposed method approaches a well-known problem in Latin American countries and their public health systems: the limitation of datasets and availability of historical evidence (376), despite significant improvements in Brazil (377). In Scotland data from the multiple deprivation index (SIMD) were made available by ISD from 2009/10 to 2012/13; despite its statistical limitations and generalisations, the SIMD is a recognised effective tool to analyse socioeconomic inequalities within NHS Scotland diverse services, regions and ascribed populations (378-380).

In Scotland, all SIMD quintiles had a fairly proportional growth in the number of procedures (elective primary hip arthroplasties) until 2005/06 when the poorest quintile (1) started not following the general growth trend of quintiles 2,3,4 and 5 (less deprived); proportionally quintiles 4 and 5 increased their share in relation to the more deprived quintiles (1 and 2) over time. Considering these findings only, it is possible to consider that at national level the access to elective primary hip arthroplasties varies following socioeconomic differences in the country.

In Brazil, where there are no multiple deprivation index data available, municipal rates of treatment were analysed together with municipal values of the Gini Index (which measures the level of inequality in income distribution per capita) and Human Development Index (HDI – which measures human development as proposed by the UN evaluating income, educational levels and life expectancy). Treatment rates of elective hip arthroplasty were linked to a fairer distribution of income (lower values of Gini) and higher levels of human development. In order to develop a deeper statistical analysis, the same municipal rates were modelled with Gini and HDI in a Poisson Regression which, due to the characteristics of the sample was applied as a Zero Inflated Poisson Regression (ZIP). The statistical modelling demonstrated that better income distribution and higher levels of human development would likely influence treatment rates respectively in $\pm 23\%$ and $\pm 56\%$ at municipal level for each standard deviation of Gini and HDI. There are many limitations in this statistical approach, as there are with most statistical calculations based in probabilities; these findings are not natural laws (constant in time and space) and are only likelihoods, in other words, they indicate a way were public policies should be directed too: more equitable income distribution, literacy and life expectancy at birth would **probably have positive consequences for citizens regarding health**. The findings of the Brazilian case reinforce the social determinants of health hypothesis that socioeconomic gaps influence decisively in health outcomes (57, 256, 313, 381); and it is in these gaps that lays the importance of this international comparison between such different countries.

Despite local inequalities, the difference within regions of Scotland, a high-income country, is not as great as it is in Brazil; a much larger country in geographic terms and also a low-middle income country. Cases such as the Cuban healthcare demonstrate that the key to better health indicators is not necessarily linked with economic resources, when primary and

preventive care are prioritised need and demand are also influenced in conjunction with health outcomes (382, 383). In other words, **by only increasing the number of treatments (elective hip arthroplasties) available to the Brazilian population (utilisation) it would not necessarily mean better health and healthcare for citizens**, as equitable healthcare is broader than considering the utilisation of curative treatments only (383).

Objective 4: to analyse the issues regarding access to elective primary hip arthroplasties in the public sectors of Brazil and Scotland by undertaking interviews with civil servants, policy makers and health professionals focusing on findings of objectives 2 and 3

After establishing a link between regional and national differences in rates of treatment, health services availability and socioeconomic variables through metrics (countable data), this study turned to an interpretative framework. Interviews were performed in both countries exploring the previous quantitative findings and discourse analysis was used to identify common themes and levels of information. From this process, three major categories emerged: equity of access to healthcare; health systems; evidence based actions/policies.

I. Equity of access to healthcare

Interviewees attributed regional socioeconomic differences within Brazilian and Scottish regions to explain differences of access to treatment and highlighted that waiting times are a constant challenge for elective treatments. Higher levels of utilisation were related to better 'economic development', however no interviewee established the link that between income, development and distribution among the population, a major factor of social inequality and known to harm equity of access to care (57, 315). A possible resulting contradiction of the inequitable development of the Brazilian regions is a growth of lawsuits that seek to condemn the government to pay for healthcare curative treatments, extenuating resources that could

be applied in a more effective way in preventive care; despite the fact that primary and preventive care have been the focus of federal policies in Brazil with considerable improvement of health indicators (41). Lawsuits in this case are likely to be the expression of the tension between individual demands and the application of a public health rationale focused on preventive care.

It was also mentioned by interviewees that another important factor in the comparison of Brazil and Scotland was the geographic distances and country's size, affecting management of resources and equity at national levels. Scottish interviewees highlighted that local authorities (healthboards) are able to manage waiting times and lists within established national targets (around 3 months from clinical indication to surgery); the same stands for local authorities in Brazil, with the difference of not counting with additional resources from the federal level. Brazilian interviewees attributed the issue of longer waiting times (between 2 to 4 years) with lack of resources and with a 'negative influence' of the private sector when in competition with a public service as SUS. No mention was made regarding a possible 'overuse' of health technologies by the private sector, despite national media coverage of corruption scandals and a loose regulatory framework of the prosthesis market in Brazil (384).

II. Health systems

SUS and NHS Scotland are comparatively similar when regarding universal and comprehensive care as their cornerstones and also by placing primary care as their foundation. From a market perspective, NHS Scotland has virtually the monopoly of health services (despite a small share of private sector participation) whilst SUS is exposed to competition with the Brazilian private sector, a distorted and unequal competition: prices are higher in the private sector, attracting human and material resources that follow reimbursement/profit shares. In this case prices

are only signs of the market distortion, as observed by one of the interviewees, when the public budget increased payments values aiming to diminish a historical reimbursement gap between the private and public sectors, prices only adjusted and the gap remained similar as before.

In both countries, there is a lack of data provision by the private sector that leave citizens unprotected to over clinical-indication by medical specialists; harming health system regulation initiatives. At national level Scotland has the advantage of a smaller geographic area, which interviewees indicated that can facilitate management issues when in comparison with Brazil. Also pointed by interviewees, a possible solution for the Brazilian challenging geographic size is the regionalisation of SUS, which could account for regional differences.

III. Evidence based actions/policies

As both NHS Scotland and SUS are universal health systems, the comprehensiveness of care has been a matter of concern. In Brazil the regulation of health technologies incorporation is based on international standards, but yet a field that is being implemented at national level; interviewees highlighted the legal imbroglio between health technology incorporation, rational use of resources and comprehensiveness of care, which in Brazil is named '*integrity*' (in Portuguese: "integralidade") and is one of the three principles of SUS together with *universality* and *equity*. According to our interviewees, in Scotland the method of health technologies assessment for health technology incorporation has been 'loosing ground' towards rapid assessments, which relegate social impact as something harder and longer to evaluate than cost-effectiveness, being ultimately not part of most assessments.

6.2 Public health policy recommendations

a. For Scotland:

I. Adoption of the Scottish Index of Multiple Deprivation in the Scottish Arthroplasty Project (SAP) annual report

At present, the SAP report focuses on descriptive factors such as rates and absolute numbers; their scope of action is the communication with consultants regarding procedure effectiveness (mortality and infection rates, hospital length of stay) by NHS healthboard. This study suggests the use of SIMD analysis per healthboard and at national level related to primary elective hip/knee arthroplasties. This would introduce an 'equity of access to arthroplasties' section at the report, which should be explored with healthboard authorities aiming for actions to increase access. The difference of access to healthcare between Glasgow & Clyde healthboard to Dumfries & Galloway healthboard has been historically associated with socioeconomic inequalities (31, 44, 277, 359).

What this study brings to light is that the differences of rates of elective primary hip arthroplasties, when related to social deprivation of all healthboards, are gradually leaning towards the least deprived quintiles of the Scottish population, harming equity. In other words, people do have better access to elective primary hip arthroplasties in Scotland rather than in Brazil, *but* (and it's a social determinants of health 'but') the level of access also follows a socioeconomic gradient. Since 1993/94 rates of treatment have been increasing at a faster pace for the less deprived quintiles (4 and 5) than the more deprived ones (1 and 2).

II. Inclusion of data from the private sector to the Information Services Division (ISD) routine data collection, even when not publicly funded

At present, the private sector in Scotland only provides data regarding procedures funded through the NHS. The ISD in Scotland has no information regarding privately paid hip arthroplasty procedures (out of pocket, insurance based). This study recommends the adoption of a compulsory system of routine data collection by ISD to the private sector, as a regulatory mechanism, evaluating effectiveness in the same way that it is performed at NHS healthboards through the SAP.

The aim of this data collection would be to gather information of citizens that undertake elective primary hip arthroplasties in the private sector, giving the opportunity to researchers and regulatory bodies to evaluate aspects of private care such as infection and mortality rates, clinical indication and length of hospital stay. At present all this information is not public and not evaluated.

b. For Brazil:

I. Regulation of the private sector regarding routine data provision

At present, the private sector in Brazil is not obliged to provide information regarding hip arthroplasties performed by private consultants. There are no official numbers regarding how many procedures are undertaken at national level, how is the performance of the surgeon or hospital and how need was taken into account before the procedure. This study suggests reinforcing the public regulation of the private sector, especially regarding elective healthcare. As part of such regulation, a publication of annual reports and an electronic database to be updated on a monthly basis, available for researchers and the general public

with anonymised data as the already in use DataSUS. The availability of such information from the private sector in Brazil is essential for an effective regulatory framework based on transparency and with the ultimate goal of protecting citizens from an unfair health market exposure.

II. Implementation of a priority system or clinical classification of acuteness, with a threshold to undertake a hip arthroplasty procedure and national databank of waiting lists

At present, waiting lists for elective healthcare in Brazil are managed by local health authorities, without the need to report information on these lists to either the community or the county/federal government. Waiting lists should be a priority in terms of regulation and funding in a universal health system as SUS. This study suggests the implementation of an electronic databank specifically for this lists at county and federal level, aiming to establish evidence based priorities; also to negotiate a time limit threshold for treatment with local health authorities, in other words, a maximum limit of time for receiving elective healthcare.

This work has demonstrated the relationship between social inequality and levels of access to public healthcare regarding utilisation of elective primary hip arthroplasties. The difference in treatment rates of the South and the Southeast regions of Brazil illustrates the case: the Southeast is a well-known region for its industrial capacity and wealth generation, it is the richest of the country, also the most unequal in socioeconomic terms; the South, in its turn, does not produce so much wealth, it is a mixed economy of industry and rural production, **with the highest levels of social equity in the country.** The South has a nearly **two fold higher** (17.2/100,000) rate of elective primary hip arthroplasties than the richest Southeast (9/100,000); considering the same national health system, SUS.

Another aspect from the study was to explore these quantitative findings through interviews with key informants, searching for a social meaning of the results aforementioned. In this data collection other aspects of the 'no equity of access to healthcare' in Brazil and Scotland were unveiled. There are waiting lists for primary elective hip arthroplasty in both countries, however in Scotland one has to wait around 70 days from medical indication to intervention, in Brazil this waiting time lies between 2 to 4 years. The long waiting period in Brazil provokes the health lawsuits phenomena, where the constitutional right to care can bypass the waiting lists, reducing the waiting time to around 1 year for the beneficiary; at the cost of a knock-on effect on the waiting lists for the ones who do not appeal to the judicial system.

III. Negotiation with the judicial system regarding the lawsuits and the constitutional right to health

At present, there is no institutional interaction between the judicial power (courts) and the executive power (government) regarding health lawsuits. Individuals who seek public courts to obtain health treatment are attended following legal procedures, not according to need or clinical priority, bypassing the waiting lists and creating a knock-on effect for the public health system. This study suggests that directives regarding such lawsuits should be agreed between the two powers based on clinical priorities and available resources, mediated by the already established local health councils (social control). The social health gradient in Brazil was demonstrated using municipalities as the units of analysis. At first, it was shown that higher inequality of income distribution (Gini Index) follows lower rates of elective primary hip arthroplasties; higher Human Development values follow higher rates of the same treatment. Modelling the municipality rates, Human Development and Gini Index in a ZIP model (considering also municipalities presenting zero values, 44.9% of the sample of 5,565

municipalities) presented results that relate utilisation of elective hip arthroplasties and socioeconomic indicators. The zero inflated Poisson model shows that one standard deviation increase of income inequality (Gini) would represent a decrease in 23% of the rates, whilst the same increase in human development would increase the rates in 53%. The same model demonstrated that municipalities with higher proportions of their population falling into the 'low income category' were more likely to present zero values of treatment rates by SUS.

6.2 Conclusion and future research

The cases of Brazil and Scotland were a challenge in many ways. Above all, the methodological hurdles have proven to be the biggest ones. To choose the proxy measure (arthroplasties) and to explore the possibilities of this first choice where matters to sort at the beginning of the research path, and for some periods they seemed further from the objective of investigating equity in health. The different frameworks for data collection, retention and management were the most puzzling difficulties to overcome. However, when performing the qualitative data collection through the interviews in both countries, the *real meaning* of this study came to light, embodied by what both nations have in common: people in need of healthcare, and a system that has the legal duty to provide for their needs.

Although it might seem at first sight, **this study is not a suggestion that by only increasing utilisation of a specific procedure people would have better health**; such suggestion, "the more interventions (arthroplasties), the better" would be to oversimplify a complex and multifactorial issue as equity and access to health and healthcare. It would be out of the scope of a *real* public policy proposal for Brazil, but if this work could, it would recommend 'more socioeconomic equality within society and increase of funding for public healthcare'. To expect to cover 200 million inhabitants with universal healthcare by making available

around 3,7% of a middle income country's GDP is nothing else but an unachievable try. High income countries that offer public universal healthcare spend at least 8% of its GDP to achieve the intent (12, 40, 385, 386). As shown in the proposed statistical model presented in Chapter 4, for each Standard Deviation of Human Development Index, treatment rates would likely increase by over 50% in Brazilian municipalities, if income was better distributed (as measured by Gini) rates would increase by over 20%; this is an important finding considering the size of the sample of 5,565 municipalities. In other words, socioeconomic equity also brings public health access equity.

As for future research, in the lack of a Multiple Deprivation Index based on routine data as in Scotland, the proposed statistical model could be applied to other elective treatments, being adjusted to non-elective treatment rates too. With further statistical development, these measurements based on available data of Gini and HDI could be applied on reduced geographic areas than municipalities (e.g. postcodes), and then associated not only to primary elective hip arthroplasties but to a set of treatments (elective and non-elective), becoming a stronger measure of equity within the SUS.

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Appendixes

Appendix 1. Studies included in the comprehensive
literature review – Chapter 2.1

Appendix 1. Studies included in the comprehensive review – Chapter 2.1

I. Inequality in the provision of Hip and Knee replacement

Ref. ID Author(s) (Date of Publication) Years Covered Country	Study Design Population (denominat.) Overall Study 'N' (nominat.)	Proc. Specific Data Source (Private or Public)	Aim	Methods	Analysis	Findings	Limitations
80 Lohmander et al (2006) 1996-2000 Denmark, Finland, Iceland, Norway and Sweden	Ecological 25,478,000 (2000 Census) 98,195 Arthroplasties	Hip National Hip Registers	<ul style="list-style-type: none"> Age- and Sex standardized annual rates of THR Types of implants used 	<ul style="list-style-type: none"> Annual rates per 100,000 Age-standardized using the WHO European standard population 	<ul style="list-style-type: none"> Rates Kind of Implant 	<ul style="list-style-type: none"> Rate of THA varied between 73 and 90 per 100,000 WHO age-standardized annual incidence (all ages) varied between 61 (Finland) and 84 (Iceland). For the ages 50–89, comprising 94–98% of all THRs for OA, annual incidence varied between 217 (Finland) and 309 (Iceland). For Norway, the sex ratio (women/men) was 2, and for the other countries it was between 1.1 and 1.3. The use of uncemented and hybrid replacements causes differences in provision and practice of THR in different countries, regions and groups 	<ul style="list-style-type: none"> Little information on factors that influence THR in Nordic countries Accuracy of the data and conclusions might be limited by errors in the diagnostic coding entered into the registry
1 Dixon, T et al (2006) 1991-2000 England	Ecological 49,233,300 (2000 Estim.) 47,932 THR 35,939 TKR	Hip Knee Hospital Episode Statistics (Public)	<ul style="list-style-type: none"> Regional variations of provision of TKR and THR 	<ul style="list-style-type: none"> Age-standardized procedure rates Univariate associations assessed using Pearson's correlation coefficient. 	<ul style="list-style-type: none"> Rates Supply Population Distribution 	<ul style="list-style-type: none"> Age and sex-standardized surgery rates vary by 25-30%. For both hip and knee replacement, rates are highest in the South West and Midlands and lowest in the North West, South East and London regions. In the case of knee replacement, there are also marked differences in the sex ratios between regions. Variable that explained most variation in THR rates was the proportion of older people in the region. In the case of knee replacement, the number of NHS centres offering surgery in the region was the main explanatory variable, with regions with fewer centres having the highest provision rates. 	<ul style="list-style-type: none"> Absence of data from the private sector Individual surgeon enthusiasm for the procedure Variations in the willingness of people to consider surgery
13 Peltola, M et al (2010) 1998-2005 Finland	Ecological 5,200,000 (2002 Estim.) 34,642 Arthroplasties	Hip National Hip Register	<ul style="list-style-type: none"> Geographical variation in the incidence of primary THA Variables associated with this variation 	<ul style="list-style-type: none"> Logistic regression analysis generalized linear models Association of potential explanatory factors for the variation in incidence 	<ul style="list-style-type: none"> Economic Deprivation Supply of Specialists 	<ul style="list-style-type: none"> Rates of THA varied from 1.9- to 3.0- times during the study period. A high ratio of primary THA was associated with OA THA ($P < 0.001$). Neither average incomes nor morbidity was associated with higher rates of THA. Socio-economic status had no apparent effect on THA rate Surgeon decision-making related factors influence THA rates when there are only a few surgeons responsible for performing THAs in a region 	<ul style="list-style-type: none"> No information on waiting times was available No information on patients or surgeons preferences or local guidelines
34 Bang, H et al (2010) 1996-2005 United States	Ecological 295,520,000 (2005 Census) 54,088 THR 95,871 TKR	Hip Knee Nationwide Inpatient Sample (Private)	<ul style="list-style-type: none"> Rate trends overtime Racial and economic disparities 	<ul style="list-style-type: none"> Logistic regression examined associations between disparity factors and each outcome Regressors included age, sex, race, regional income, hospital, payer, comorbidities, and obesity 	<ul style="list-style-type: none"> SES Insurance Type Comorbidities Weight 	<ul style="list-style-type: none"> Arthroplasty rates have increased, revision rates only minimally Racial disparities were larger than income disparities Racial disparities were not confined to the elderly or to low-income populations 	<ul style="list-style-type: none"> Large amount of missing race data Underreporting of comorbidities Limited number of variables in the NIS database Not including knowledge and expectations about the surgery or distance to healthcare provider
42 Singh, JA et al (2010) 1969-2008 United States	Ecological 124,000 2742 THR 3488 TKR	Hip Knee Rochester Epid. Project Database (Private)	<ul style="list-style-type: none"> rates of THR and TKR during the past 4 decades 	<ul style="list-style-type: none"> Rates of use by age- and sex-specific person-years at risk Poisson regression to assess temporal trends by sex and age group 	<ul style="list-style-type: none"> Temporal and Gender Trends 	<ul style="list-style-type: none"> The age- and sex-adjusted use of THA increased from 50.2 (95% confidence interval [CI], 40.5-59.8) per 100,000 person-years in 1969-1972 to 145.5 (95% CI, 134.2-156.9) in 2005-2008 TKA increased markedly from 31.2 (95% CI, 25.3-37.1) per 100,000 person-years in 1971-1976 to 220.9 (95% CI, 206.7-235.0) in 2005-2008. For both procedures, use was greater among females, and the rate generally increased with age. TKA and THA use rates have increased steadily since the introduction of the procedures and continue to increase for all age groups 	<ul style="list-style-type: none"> Difficult to determine the 'correct' use of THR or TKR Some patients did not provide authorisation to review their records (321 patients) Larger percentage of white residents when compared with other parts of US

16 Francis, ML et al (2011) 2006 only United States	Cross-sectional 45,447,043 257,892 TKR 109,616 THR	Hip Knee Elective proc. Medicare beneficiary	<ul style="list-style-type: none"> Rural and urban access to elective procedures 	<ul style="list-style-type: none"> Logistic regression adjusting for age, sex, race/ethnicity, median household income, average house value, mean poverty ratio, and state of residence Multivariable analysis 	Ethnicity Household income Poverty ratio	<ul style="list-style-type: none"> Rural Medicare beneficiaries were more likely to undergo a broad array of surgical procedures 30% for knee replacement surgery (OR=1.30; 95% CI, 1.28- 1.31) 19% for hip replacement surgery (OR=1.19; 95% CI, 1.17-1.21), 	<ul style="list-style-type: none"> Inability to adjust for unmeasured variables Cannot assess/control for comorbidities of all Medicare individuals (denominator)
58 Judge, A et al 2002 only England	Cross-sectional 49,679,300 n.a.	Hip Knee Hospital Episode Statistics	<ul style="list-style-type: none"> Inequalities of provision of arthroplasties Small-area estimates of provision 	<ul style="list-style-type: none"> Multilevel Poisson regression by socio-demographic, hospital and distance variables GIS software estimate road travel times and create hospital catchment areas 	Deprivation Quintiles Residence Rates per Region	<ul style="list-style-type: none"> Rates of joint replacement increased with age before falling in those aged 80p Women received more operations than men. People living in the most deprived areas obtained fewer hip, but more knee operations. Those in urban areas received less hip surgery, but there was no association for knee replacement. Controlling for hospital and distance measures did not attenuate the effects. Geographical variation across districts was observed with some districts showing inequality in socio-demographic factors, whereas others showed none at all. Evidence of inequalities in the provision of joint replacement surgery 	<ul style="list-style-type: none"> Private operations not included in HES data Lack of individual data like social class and obesity Ethnicity underreported Completeness and accuracy of data
35 Culliford, DJ et al 2010 1991-2006 United Kingdom	Cross-sectional 6,500,000 27 113 THR 23 843 TKR	Hip Knee General Practice Research Database	<ul style="list-style-type: none"> Temporal changes in rates of THR TKR Age at operation Female-to-male ratio 	<ul style="list-style-type: none"> Poisson Regression 	Standardised rates overtime Mean age by age group	<ul style="list-style-type: none"> The rate of performance of THR and TKR had increased significantly ($p < 0.0001$ for both) during the 16-year period and was greater for TKR, especially in the last five years. The mean age at operation was greater for women than for men and had remained stable throughout the period of study. The female-to-male ratio was higher for THR and TKR and had remained stable. The data support the notion that the rate of joint replacement is increasing in the United Kingdom with the rate of TKR rising at the highest rate. The perception that the mean age for TKR has decreased over time is not supported. 	<ul style="list-style-type: none"> No details on the indication of each procedure by the database
3 Kim, A et al 2008 2002-2005 South Korea	Cross-sectional n.a. 47,961 TKR	Knee Health Insurance Agency database	<ul style="list-style-type: none"> Incidence of TKR by age and sex Trend for TKR utilization 	<ul style="list-style-type: none"> Age- and sex-specific rates with age-standardized risk ratios A TKR registry containing clinical information differences in clinical features between men and women compared 	Rates Body Mass Gender Rates	<ul style="list-style-type: none"> The rate of TKR has increased over the 4 years and was much higher in women than in men. Compared with men, the age-standardized rate ratios for TKR in women ranged from 7.4 to 8.0. The single-centre registry data revealed that there was no difference in age, disease duration and the Kellgren–Lawrence grade at the time of surgery between men and women. The rate of TKR increased steadily from 2002 to 2005 in South Korea. 	<ul style="list-style-type: none"> Coding errors or disease misclassification of the database Lack of a detailed analysis of regional differences, income level or other risk factors due to limitations of the database
28 Borrero, S et al 2006 1999 only United States	Cross-sectional 1,968,093 5,370 TKR 2,709 THR	Hip Knee Veterans Adm. Database	<ul style="list-style-type: none"> Gender differences in rates of total knee/hip in the Veterans Adm. System 	<ul style="list-style-type: none"> Patients younger than 50 years were excluded χ^2 and t-tests performed 	Adjusted Odds of patients undergoing total knee/hip arthroplasty	<ul style="list-style-type: none"> For women, 2-year adjusted odds of undergoing total knee or hip arthroplasty were 0.97 (0.83 to 1.14) and 1.00 (0.79 to 1.27), respectively. Among patients potentially at risk for the procedure, men and women in the VA system were equally likely to undergo knee/hip arthroplasty 	<ul style="list-style-type: none"> Study limited to the Veterans population, mostly male No information on disease severity The denominator of people with OA included the disease in any joint
32 Wang, Y et al. 2009 2001-2005 Australia	Cohort 39,023 541 TKR 468 THR	Hip Knee Melbourne Cohort Study	<ul style="list-style-type: none"> Rates of primary joint replacement for osteoarthritis for Italian and Greek migrants 	<ul style="list-style-type: none"> Participants aged 27 to 75 years, born in Italy, Greece, Australia and the UK Primary THR and TKR for osteoarthritis was determined (self report) Two stages follow up prospective cohort 	Physical Functioning Score Hazard Ratios using Cox Models	<ul style="list-style-type: none"> Participants born in Italy and Greece had a lower rate of primary joint replacement compared with those born in Australia (hazard ratio [HR] 0.32, 95% C.I. 0.26 to 0.39, $P < 0.001$), independent of age, gender, body mass index, education level, and physical functioning. This lower rate was observed for joint replacements performed in private hospitals (HR 0.17, 95% CI 0.13 to 0.23), but not for joint replacements performed in public hospitals (HR 0.96, 95% CI 0.72 to 1.29). 	<ul style="list-style-type: none"> Possible bias due to Diverse population characteristics in the volunteer cohort No data prior to 2001 No possibility of giving population estimates with this cohort

36 Hausmann et al 2010 n.a. United States	Prospective Observational n.a. 457 candidates to surgery	Hip Knee Primary Data	<ul style="list-style-type: none"> • Whether surgeons are less likely to give TJR to African-American (AA) compared to white patients • Whether there are racial differences in the receipt of TJR within six months of study 	<ul style="list-style-type: none"> · Self-surveys that assessed socio-demographic and clinical variables · Orthopaedic surgeons' notes reviewed to determine whether patients had been recommended for TJR · Whether they underwent the procedure within 6 months 	Race used as Primary Predictor for Surgery Multivariable Models	<ul style="list-style-type: none"> • Rate of TJR recommendation was 19.5% • Odds of receiving a TJR recommendation were lower for African-American than White patients of similar age and disease severity (OR=0.46, 95% CI=0.26–0.83; P=0.01) • The difference was not significant after adjusting for patient preference for TJR (OR=0.69, 95% CI=0.36–1.31, P=0.25). • Overall, 10.3% of patients underwent TJR within 6 months • TJR was less likely for AA patients than for white patients of similar age and disease severity (OR=0.41, 95% CI=0.16–1.05, P=0.06), but this difference was reduced after adjusting for whether patients had received a recommendation for the procedure at the index visit (OR=0.57, 95% CI= 0.21–1.54, P=0.27). 	<ul style="list-style-type: none"> • Limited sample • Only disparities between African-American and White patients considered • Limitation of medical notes used in the primary data production
38 Ibrahim, T et al 2010 1991-2004 United Kingdom	Cross- sectional 3,900,000 26,281 THRs 23,606 TKRs	Hip Knee Trent Regional Arthroplasty Study record	<ul style="list-style-type: none"> • Temporal trends of prevalence of primary THR and TKR 	<ul style="list-style-type: none"> · Data from the regional register were examined · Three diagnostic groups were used (Osteoarthritis, Rheumatoid OA and Trauma) 	Incidence Rates Poisson Regression Models	<ul style="list-style-type: none"> • Females had an increased incidence rate ratio (IRR) for both primary THR (IRR = 1.29; 95% CI 1.26–1.33; $P < 0.001$) and TKR (IRR = 1.17; 95% CI 1.14–1.20; $P < 0.001$) • Patients aged 74–85 years had the largest IRR for both primary THR (IRR = 6.7; 95% CI 6.4–7.0; $P < 0.001$) and TKR (IRR = 15.3; 95% CI 14.4–16.3; $P < 0.001$) • Prevalence of primary TKR increased significantly over time whereas THR remained steady 	<ul style="list-style-type: none"> • No evaluation after 2004, when the National Joint Registry was established • Might have bias due to patients choosing to receive the procedure elsewhere
50 Ravi, B et al 2012 2001-2007 United States and Canada	Cross- sectional 308,7millionUS 12,8millionCan n.a.	Hip Knee Healthcare Cost and Utilization Project	<ul style="list-style-type: none"> · If rates of TKR and THR have increased in North America 	<ul style="list-style-type: none"> · Crude rates of THA and TKA in both areas for four calendar years (2001, 2003, 2005 and 2007) · Age- and sex-standardised rates of THA and TKA in both areas for each time period 	Descriptive Statistics for Rates χ^2 Test Logistic Regression	<ul style="list-style-type: none"> • Crude and standardised rates of THA and TKA increased over time in both the US and Ontario • Crude rates of THA were higher in the US in 2001 and 2003, but were not significantly different from the rate in Ontario in 2005 and 2007 • Crude rates of TKA were consistently higher in the US for all time periods. • The US consistently had more THA and TKA recipients in 'younger' age categories (<60 years of age). • Age- and sex-standardised rates of TKA were greater in the US in all time periods, the relative increase in rates from 2001 to 2007 was greater in Ontario (US – 59%, Ontario – 73%). • For both the US and Ontario, there was a significant shift in the demographic of THA and TKA recipients to younger patients ($p < 0.0001$) 	<ul style="list-style-type: none"> • Administrative Data to determine rates • Data limited to 2007 • Not able to compare fee-for-service and managed care plans • No data from the Veterans Affairs system, underrating elderly rates

II. Inequality in the need for THR and TKR

Ref. ID Author(s) (Date of Publication) Years Covered Country	Study Design Population (denominat.) Overall Study 'N' (nominat.)	Proc. Specific Data Source (Private or Public)	Aim	Methods	Analysis	Findings	Limitations
57 Judge, A et al 2009 n.a. England	2 stage cross-cohort 28,080 Somerset Survey 11,392 Ageing Survey	Hip Knee n.a. Somerset Survey of Health and Longitudinal Study of Ageing	<ul style="list-style-type: none"> Model need of THR or TKR for the English population 	<ul style="list-style-type: none"> Measure of need for hip/knee replacement using the New Zealand (NZ) score National survey to explore inequalities in need for hip/knee replacement Multilevel Poisson regression modeling to estimate rates of need 	Poisson Multilevel Regression	<ul style="list-style-type: none"> Rates of need for hip/knee replacement increase with age and are lower in men than in women (rate ratio [RR] 0.7, 95% confidence interval [95% CI] 0.6–0.9 for hips; RR 0.8, 95% CI 0.7–1.0 for knees) Those of lowest social class have greater need. Need was greatest for people living in more deprived areas Individual ethnic group did not predict the need for surgery For hip replacement, there was no rurality effect; for knee replacement, those in town and fringe areas had greater need. Obesity was a strong predictor of need for surgery (RR 2.3, 95% CI 1.9–2.8 for hips; RR 2.4, 95% CI 2.0–2.8 for knees). evidence of greater variations of inequalities in need for hip/knee replacement than previous studies 	<ul style="list-style-type: none"> Diverse methods to evaluate the severity of joint disease Willingness to seek the procedure Arbitrary cutoff measure to determine whether a person need or not a joint replacement
31 Steel, N et al 2008 1998-2004 England	Cross-sectional 14,807 over 60s n.a.	Hip Knee Health and Retirement Study	<ul style="list-style-type: none"> Need for joint replacement Subsequent receipt of a joint replacement by those in need 	<ul style="list-style-type: none"> Need for hip or knee joint in 1998, 2000, and 2002 and receipt of needed surgery 2 years later. 'Need' classification was based on difficulty walking, joint pain, stiffness, or swelling and receipt of treatment for arthritis 	Logistic Regression Models Odds Ratios	<ul style="list-style-type: none"> Need in 2002 was greater in participants who were older than 74 years (vs 60–64: adjusted odds ratio 2.06; 95% confidence interval, 1.68–2.53), women (vs men: 1.81; 1.53–2.14), less educated (vs college educated: 1.27; 1.06–1.52), in the poorest third (vs richest: 2.20; 1.78–2.72), or obese (vs non obese: 2.39; 2.02–2.81). 168 participants in need received a joint replacement, with lower receipt in black or African American participants (vs white: 0.47; 0.26–0.83) or less educated (vs college educated: 0.65; 0.44–0.96) Differences were not explained by current employment, access to medical care, family responsibilities, disability, living alone, comorbidity, or exclusion of those younger than Medicare eligibility age. After taking variations in need into consideration, being black or African American or lacking a college education appears to be a barrier to receiving surgery, whereas age, sex, relative poverty, and obesity do not. Disproportionately high levels of pain and disability in disadvantaged groups 	<ul style="list-style-type: none"> Classification of need relies on self-reported pain and disability No radiological or clinical examination Not possible to estimate absolute need for surgery at population level
53 Steel, N et al 2006 n.a. England	Cross-sectional n.a. 7101 over 60s	Hip Knee Primary Data Interviews	<ul style="list-style-type: none"> Compare prevalence of existing THR and TKR with need in population groups 	<ul style="list-style-type: none"> Participants were asked about both receipt and need TKR/THR socio-economic status and comorbidity, both need and receipt were estimated 'Need' was based on hip or knee pain and difficulty walking 	Binary Logistic Regression Model	<ul style="list-style-type: none"> Prevalence of receipt was 6% [95% confidence intervals (CI) 5, 6], lower in the North than the South [adjusted odds ratio (OR) 0.72, CI 0.53, 0.96]. Prevalence of estimated need was higher in the North (OR 1.27, CI 1.03, 1.58). Need was greater in women than men (OR 1.30, CI 1.09, 1.53), and showed an increasing gradient from the wealthiest to poorest quintile (ORs 1.00, 1.52, 2.18, 2.49, 3.23). Receipt did not differ significantly by sex or socio-economic group 	<ul style="list-style-type: none"> Estimate relies on self-reported pain and disability No clinical or radiographic examination

III. Inequality in clinical outcomes of THR and TKR

Ref. ID Author(s) (Date of Publication) Years Covered Country	Study Design	Proc. Specific Population (denominat.) Overall Study 'N' (nominat.)	Data Source (Private or Public)	Aim	Methods	Analysis	Findings	Limitations
18 Peltola, M et al 2011 1998-2008 Finland	Ecological	n.a.	Hip Knee Discharge Reg. Finnish Arthr.	•Regional and hospital-level differences in length of stay (LOS), costs and complication rates of TKR/THR	· LOS, length of uninterrupted institutional care (LUIC) · complication rates and other parameters of treatment by region and hospital	Risk Adjusted Rates	•LOS and LUIC following THA and TKA diminished during the follow-up •In 1998 average LOS after THA and TKA was 9.9 and 10 days. In 2008, these had shortened to 5.2 and 5.3 days, respectively. •There was a 5.0 and 7.5 percentage point difference in revision rate between regions in THAs and TKAs, respectively, performed during 2005 _ 2007 and followed to the end of 2009.	• Surgical approach cannot be statistically adjusted • Lack of clinical data of national joint registers
41 Pai, V et al 2010 One Year New Zealand	Cohort	100 54 THR 36 TKR	Hip Knee National Register	•Differences in outcome between Maori and Caucasian patients submitted to THR or TKR	· American Society of Anaesthesiologists (ASA) score · Preoperative comorbidity, length of hospital stay, complications, and pre- and post-operative outcomes in the 2 ethnic groups	Descriptive Statistics	•Maori patients were more likely than Caucasian patients to be obese (body mass index of >30 kg/m2) [37% vs. 15%], diabetic (15% vs. 5%), and smokers (32% vs. 13%) •Postoperative complication rates and the lengths of hospital stay in the 2 groups were not significantly different • The ASA score correlated positively with the length of hospital stay; higher ASA scores predicted more prolonged recovery • Maori patients were more likely than Caucasian patients to have preoperative comorbidities, but their postoperative length of hospital stay and complication rates were not significantly different	• Small sample • No statistical standardization method • Lack of clinical information
45 Lavernia, CJ et al 2011 n.a. United States	Cross-sectional	1749 793 THR 1010 TKR	Hip Knee Local database records	• Influence of race and ethnicity on well-being, pain, and function after total joint arthroplasty • Whether race, ethnicity, sex, influences function and pain after total joint arthroplasty	· Assessed patients preoperatively and at a minimum of 2 years (mean, 5.1 years; range, 2–16 years) on perceived well-being, function, and pain, as well as clinical assessment tools · Assessed the behaviour of dependent measures between groups over time	Covariance Analysis Multivariate Regression Analysis	•Preoperatively both TKA and THA candidates, African American patients presented with worse scores • Postoperatively all patients had substantial improvement, yet African Americans who had TKA or THA continued to have worse scores on some measures • Both TKA and THA, women had worse scores • Racial and ethnic minorities undergoing hip and knee arthroplasty appear to have worse patient perceived outcomes (well-being, pain, and function) when compared to whites. This discrepancy is most pronounced for African Americans	• Patients were predominantly white • Large number of exclusion cases due to uncompleted records • Potential misclassification of race (self-reported)
79 Ellis, HB et al 2010 n.a. United States	Non-Syst. Review	n.a.	Hip Knee n.a.	• Discuss the disparity of outcomes associated with THR and TKR	· Non Systematic Review · Theoretical Discussion	n.a.	• An individual's socioeconomic status, typically based on income and educational level, has been shown to have an effect on the outcomes of total joint arthroplasty	• Methodological limitations • Non Systematic • Not clear about exclusion criteria
11 Hollowell, J et al 2010 2004-2005 England	Cross-sectional	655 patients n.a.	Hip Knee Local database	• Associations between deprivation and aspects of the inpatient episode for patients undergoing THR or TKR	· socioeconomic variations in preop. surgical risk, postop. morbidity and length of stay · orthopaedic version of the POSSUM scoring system; postoperative morbidity survey; · Index of Multiple Deprivation adjusted for age, sex, surgical site and primary vs. revision surgery.	Multivariable modelling adjusted for age and sex	• Modest and clinically insignificant socioeconomic gradient in preoperative surgical risk and no socioeconomic gradient in postoperative morbidity • Strong socioeconomic gradient in length of stay, but only for patients undergoing TKR, due to deprived patients being more likely to remain in hospital without morbidity following TKR • Differential selection of healthier patients for surgery • Hospitals serving deprived communities may have excess, unfunded costs because of the increased length of stay of socioeconomically disadvantaged patients	• Single hospital site • Not possible to generalize results

14 Cookson, R et al 2011 2001/2-2007/8 England	Cross-sectional n.a. 274,679 THR	Hip Hospital Episode Statistics – NHS	<ul style="list-style-type: none"> Assess magnitude of new selection incentives in the case of hip replacement 	<ul style="list-style-type: none"> Relationship between length of stay and small area income deprivation modelled allowing other patient characteristics (age, sex, number and type of diagnoses, procedure type) and hospital effects. 	Regression Analysis Models	<ul style="list-style-type: none"> Patients from the most deprived tenth of areas stayed just 6% longer than others in 2001/2, falling to 2% by 2007/8. Patients aged 85 or over stayed 57% longer than others in 2001/2, rising to 71% by 2007/8, Patients with seven or more diagnoses stayed 58% longer than others in 2001/2, rising to 73% by 2007/8. Blair/Brown reforms did not give NHS hospitals strong new incentives to select against socio-economically deprived hip replacement patients. 	<ul style="list-style-type: none"> Methodological limitations due to the use of simple Regression Analysis models
2 Hinman, A; Bozic, KJ 2008 n.a. United States	Retrospective Cohort n.a. 224 THR	Hip Local data – Medicare, Medicaid and private patients	<ul style="list-style-type: none"> Determine if Medicaid patients undergoing THR differed from Medicare and commercial-payer patients regarding socioeconomic factors 	<ul style="list-style-type: none"> Retrospective review of subjects who received THR Stratified by insurance type Baseline clinical and demographic information and functional outcomes were compared between Medicaid, Medicare, and commercial payer patients 	X ² Analysis Analysis of Variance	<ul style="list-style-type: none"> Medicaid patients had lower preoperative (P b .0001) and postoperative (P b .0001) Harris Hip Scores Medicaid patients travelled twice as far to receive treatment (66.0 vs 38.3 miles) Decreased access to health care and increased time to presentation may account for the decreased functional scores and poorer clinical outcomes 	<ul style="list-style-type: none"> Selection Bias due to retrospective cohort Limitation of database
23 Martin, CT et al 2012 n.a. United States	Cross-sectional n.a. 293 patients	Hip Knee Local data – Medicare, Medicaid and private patients	<ul style="list-style-type: none"> How patient characteristics differ between insurance types 	<ul style="list-style-type: none"> reviewed 293 consecutive primary total joint arthroplasty patients with 12-month follow-up and stratified them based on insurance type 	Descriptive Statistics X ² Analysis Multiple Pairwise Comparisons	<ul style="list-style-type: none"> Medicaid patients travelled an extra 160 to 170 miles for access to care Iowa Care and Medicaid were more than 3 times more likely to be current smokers Iowa Care and Medicaid had lower preoperative and 12-month postoperative 36-Item Short Form Health Survey and WOMAC outcomes scores Payer type was a significant predictor of 36-Item Short Form Health Survey physical function at final follow-up in a multivariate analysis Significant disparities exist between patients with different insurance payer types in total joint arthroplasty 	<ul style="list-style-type: none"> Retrospective and not randomized study giving significant bias in univariate analysis Fewer Medicaid and Iowa Care patients Small sample Bias due to self-reported status
27 Rosenthal, BD et al. 2013 n.a. United States	Retrospective cohort 1695 patients 112 TKR	Knee Local data – Medicare, Medicaid and private patients	<ul style="list-style-type: none"> Effect of payer type on clinical outcomes in TKR 	<ul style="list-style-type: none"> Retrospective cohort analysis Baseline demographics, resource utilization, and outcomes compared by insurance type 	ANOVA procedure Tukey post-hoc tests	<ul style="list-style-type: none"> Medicaid patients were younger (P b .0001) and had lower preoperative Knee Society Scores than Medicare and private patients (P = .0125). Medicaid postoperative scores were lower than those of private patients (P = .0223). The magnitude of benefit received by Medicaid patients was similar to Medicare and private patients. Medicaid patients had a higher number of cancelled (P = .01) and missed (P = .0022) appointments relative to Medicare and private patients. Medicaid patients also had shorter average follow-up periods compared to private patients (P = .0003). Access to care and socioeconomic factors may be responsible for these findings. 	<ul style="list-style-type: none"> Retrospective design Large number of excluded patients Short term follow-up No controlling for age in the statistical analysis Inconsistency in selecting cohorts
49 Lovald, ST et al. 2013 1997-2009 United States	Cross-sectional n.a. n.a.	Knee Medicare database	<ul style="list-style-type: none"> Cost and health outcomes between Medicare patients with OA who undergo TKA and those who avoid the procedure 	<ul style="list-style-type: none"> OA patients were separated into non arthroplasty and arthroplasty groups. Costs, mortality, and new disease diagnoses were adjusted for age, sex, race, buy-in status, region, and Charlson score. 	Descriptive Statistics Relative Risk Ratios Logistic Regression	<ul style="list-style-type: none"> The 7-year cumulative average Medicare payments for all treatments were \$63,940 for the non-TKA group and \$83,783 for the TKA group. The risk adjusted mortality hazard ratio (HR) of the TKA group ranged from 0.48 to 0.54 through seven years (all Pb0.001). The risk of heart failure in the TKA group was 40.9% at 7years (HR=0.93, Pb0.001). Results demonstrate the patients in the TKA cohort as having a lower probability of heart failure and mortality, at a total incremental cost of \$19,843. 	<ul style="list-style-type: none"> Limitations in line with retrospective database reviews Lack of clinical information in the Database Non-specificity of the coding system

24 Neuburger, J et al. 2012 2009-2010 England	Cross-sectional 117 736 patients n.a.	Hip Knee PROMs Programme	<ul style="list-style-type: none"> Differences in the use of hip and knee replacement by sex, age, ethnicity or socioeconomic status may lead to differences in disease severity between those who have surgery. 	<ul style="list-style-type: none"> Adjusted differences were estimated in the Oxford Hip Score (OHS) or the Oxford Knee Score (OKS), both expressed on a scale from 0 to 48, and the proportion with longstanding problems expressed as odds ratios (ORs). 	Multivariable Logistic Regression Wald test	<ul style="list-style-type: none"> Women had more severe pain and disability than men on average (difference OHS 2.3 and OKS 3.3), but less often longstanding problems. Compared with white patients, average severity was higher in South Asian patients (difference OHS 2.7 and OKS 3.0) and in black patients (difference OHS 0.9 and OKS 1.6), who also more often had longstanding problems (OR 1.40 for hip and 1.54 for knee). Patients from deprived areas had more severe disease (difference OHS 3.6 and OKS 3.3 between least and most deprived quintile). There is evidence that non-white and deprived patients tend to have hip and knee replacement surgery at a later stage in the course of their disease. 	<ul style="list-style-type: none"> Sample representative of around 60% of all procedures performed by the NHS in that period Lack of information on behavioral risk factors
78 Davis, ET et al. 2008 1997-1999 US, UK Australia Canada	Prospective observational n.a. 974 TKR	Knee Observed Data	<ul style="list-style-type: none"> Whether patients in lower SES groups had worse pain and functional levels prior to total knee arthroplasty Whether these patients had poorer post-operative outcomes 	<ul style="list-style-type: none"> Pre-operative data was collected and patients were followed for 2 years post-operatively The WOMAC scores were obtained preoperatively and during follow-up. Pre-operative details of the patients' demographics; SES; height; weight and co-morbid conditions were obtained. 	Multivariate Linear Regression	<ul style="list-style-type: none"> Patients with a lower income had a significantly worse pre-operative WOMAC Pain (P ¼ 0.021) and function score (P ¼ 0.039) than those with higher incomes. Income did not have a significant impact on outcome at final follow-up after adjusting for other significant covariates. Level of education did not correlate with pre-operative scores or with outcome at any time during follow-up. Across all four countries, patients with lower incomes appeared to have a greater need for total knee arthroplasty. However, level of income and educational status did not appear to affect the final outcome following total knee arthroplasty. 	<ul style="list-style-type: none"> Difficult process of standardisation between different countries Patients in different healthcare settings Not a population-based cohort Data was obtained originally for another study
47 Cai, X et al 2012 2002-2005 United States	Two retrospective cohorts 91,599 patients	Knee Medicare database	<ul style="list-style-type: none"> Profile hospital quality of care If African Americans were more likely to receive TKAs at low quality compared with Caucasian patients. 	<ul style="list-style-type: none"> A risk-adjusted, 90-day postoperative outcome measure to identify high-, intermediate-, and low-quality hospitals based on patient records A second cohort of African American and Caucasian patients receiving Medicare who underwent primary TKAs 	Bivariate and Multivariable Analysis X ² tests Wilcoxon Tests Multinomial Logistic Models	<ul style="list-style-type: none"> The risk-adjusted postoperative mortality/complication rate varied substantially across hospitals and hospitals can be meaningfully categorized into quality groups In the second cohort of admissions, 8% of African American patients (n = 4894) versus 9.2% of Caucasian patients (n = 86,705) were treated in high-quality hospitals whereas 14.7% of African American patients versus 12.7% of Caucasians patients were treated in low-quality hospitals. After controlling for patient demographic, socioeconomic, geographic, and diagnostic characteristics, the odds ratio for admission to low-quality hospitals was 1.28 for African American patients compared with Caucasian patients (95%CI, 1.18–1.41). Among elderly Medicare beneficiaries undergoing TKA, African American patients were more likely than Caucasian patients to be admitted to hospitals with higher risk-adjusted postoperative rates of complications or mortality. 	<ul style="list-style-type: none"> Analysis limited to elderly Medicare patients The model might not capture all important clinical risk factors Socioeconomic measure based on geographic location
8 Jenkins, P et al. 2009 1998-2005 Scotland	Prospective n.a. 1865 THR	Hip Primary Database	<ul style="list-style-type: none"> Association of deprivation and function before operation and at 18 months If deprivation was associated with comorbidity or adverse outcomes. 	<ul style="list-style-type: none"> Deprivation was categorized using the Scottish Index of Multiple Deprivation (SIMD) government rating 	Anova Analysis of Variance Multivariate Linear Regression Model X ² Test	<ul style="list-style-type: none"> The most deprived quintiles had lower absolute functional scores at time of operation. At 18 months the least deprived quintile had a greater SF36 physical function score and relative improvement. Deprivation was not linked with length of stay or BMI. There was a higher proportion of ASA (American Society of Anesthesiologists) category 1 patients in the least deprived group signifying less comorbidity. Smoking was more prevalent in patients from areas of greater deprivation. There was no observed difference in mortality, infection, dislocation or thromboembolism. This study demonstrates a socioeconomic gradient in the function of patients undergoing total hip arthroplasty. 	<ul style="list-style-type: none"> No data from the independent sector (private) Small sample, difficult to generalise results

IV. Inequality in preoperative conditions before undergoing TKR and THR

Ref. ID Author(s) (Date of Publication) Years Covered Country	Study Design	Proc. Specific	Population (denominat.)	Data Source (Private or Public)	Aim	Methods	Analysis	Findings	Limitations
26 Neuburger, J et al 2012 2009-2011 England	Cross Sectional	Hip Knee	n.a. 59,680 THR 62,303 TKR	National Patient- Reported Outcomes (PROMS)	<ul style="list-style-type: none"> Investigate socioeconomic differences in patient-reported outcomes after a hip or knee replacement 	<ul style="list-style-type: none"> Socioeconomic status was measured by the English Index of Multiple Deprivation. Outcomes at 6 months Oxford hip or knee score and the percentage reporting no improvement Adjustment for age, sex, ethnicity, comorbidity, general health, revision surgery, primary diagnosis, preoperative OHS or OKS and having longstanding problems 	Multivariable Linear Regression	<ul style="list-style-type: none"> Comparing the most- with the least-deprived group, the mean OHS was 5.0 points lower and the OKS 5.4 lower. Adjusted differences, reflecting the differences in improvement in the condition, were 2.8 [95% confidence interval (CI): 2.5–3.0] on OHS and 2.4 (95% CI: 2.2–2.7) on OKS. Adjusted odds ratios for reporting no improvement were 1.4 (1.2–1.6) for the hip and 1.4 (1.3–1.5) for the knee. On average, patients living in socioeconomically deprived areas had worse outcomes after surgery, partly related to preoperative differences in health and disease severity and partly to less postoperative improvement. 	<ul style="list-style-type: none"> Self-reported nature of the data used Lack of information on risk factors Some data could not be linked because of no response to the questionnaires
22 Martin, CT et al. 2012 n.a. Canada	Prospective Observational	Hip Knee	1312 patients n.a.	Preoperative Short Form 36	<ul style="list-style-type: none"> To describe the disparity between insurance payer types in total joint arthroplasty 	<ul style="list-style-type: none"> Patients who underwent elective primary total hip or knee arthroplasty were stratified into groups based on insurance type Compare demographics, access to care, and functional data 	Multiple Pairwise of the least mean squares Turkey-Kramer Adjustment	<ul style="list-style-type: none"> Few differences existed between patients with Iowa Care and Medicaid, but both groups had significantly lower Short Form 36 and Western Ontario and McMaster University Osteoarthritis Index scores across every category compared with patients with Medicare or private insurance (<i>P</i>,.05 for each comparison) Patients with Iowa Care and Medicaid had a higher incidence of current smoking and higher mean body mass index and traveled an average of 29 to 30 miles farther for access to care (<i>P</i>,.05 for each comparison) Payer type was an independent predictor of preoperative Short Form 36 and Western Ontario and McMaster University Osteoarthritis Index functional scores in the multivariate analysis (<i>P</i>,.02) 	<ul style="list-style-type: none"> Single institution database No follow-up after the procedure Lack of clinical information on national database
44 Slover, JD et al. 2010 n.a. United States	Prospective Observational	Hip Knee	3542 patients 1596 THR 1946 TKR	Primary Data	<ul style="list-style-type: none"> Relationship between sex, race, and preoperative function in a population undergoing hip and knee arthroplasty 	<ul style="list-style-type: none"> Harris Hip and Knee Society Scores were used to quantify preoperative function. Bivariate association between ethnic groups and knee/hip function 	One Way Analysis of Variance Bonferroni Adjustment	<ul style="list-style-type: none"> The results demonstrate lower function, with average Harris Hip Scores that were 4.9 (<i>P</i> b .0001) and 8.77 (<i>P</i> b .001) and average Knee Society Scores that were 6.03 (<i>P</i> b .06) and 12.8 (<i>P</i> b.001) points lower in African American and Hispanic patients than white patients for the population, respectively Hispanic and African American patients have worse preoperative hip and knee function before arthroplasty than white patients 	<ul style="list-style-type: none"> Lack of preoperative general health scores as well as follow-up functional outcome scores Data from a single institution

V. Inequity in Access of THR and TKR

Ref. ID Author(s) (Date of Publication) Years Covered Country	Study Design	Proc. Specific Data Source (Private or Public)	Aim	Methods	Analysis	Findings	Limitations
5 Cooper, ZN et al 2009 1997-2007 England	Cross Sectional n.a. 427,277 TKR 406,253 THR	Hip Knee and other elective procedures Hospital Episode Statistics	<ul style="list-style-type: none"> Whether changes in waiting times to elective procedures in the English National Health Service occurred Analyse distribution of those changes as an indicator of equity. 	<ul style="list-style-type: none"> statistical relation between waiting times and patients' socioeconomic status Main outcome measures were Days waited from referral for surgery to surgery itself; socioeconomic status based on Carstairs index of deprivation. 	Ordinary least squares regression Wilcoxon Test	<ul style="list-style-type: none"> Mean and median waiting times rose initially and then fell steadily over time. By 2007 variation in waiting times across the population tended to be lower. In 1997 waiting times and deprivation tended to be positively related. By 2007 the relation between deprivation and waiting time was less pronounced, and, in some cases, patients from the most deprived fifth were waiting less time than patients from the most advantaged fifth. Between 1997 and 2007 waiting times for patients having elective hip replacement, knee replacement, and cataract repair in England went down and the variation in waiting times for those procedures across socioeconomic groups was reduced. 	<ul style="list-style-type: none"> Socioeconomic data based on geographical location Descriptive analysis Sample changes overtime Only three elective procedures
12 Judge, A et al 2010 2002 England	Ecological n.a. n.a.	Hip Knee Hospital Episode Statistics	<ul style="list-style-type: none"> Explore geographical and sociodemographic factors associated with variation in equity in access to total hip and knee replacement 	<ul style="list-style-type: none"> Combining small area estimates of need and provision to explore equity in access to care. Predicted rates of need and provision Equity rate ratios comparing rates of provision relative to need by sociodemographic, hospital, and distance variables. 	Multilevel Poisson Regression	<ul style="list-style-type: none"> Compared with people aged 50-59, those aged 60-84 got more provision relative to need, while those aged ≥ 85 received less total hip replacement (adjusted rate ratio 0.68, 95% confidence interval 0.65 to 0.72) and less total knee replacement (0.87, 0.82 to 0.93). Compared with women, men received more provision relative to need for total hip replacement (1.08, 1.05 to 1.10) and total knee replacement (1.31, 1.28 to 1.34). Compared with the least deprived, residents in the most deprived areas got less provision relative to need for total hip replacement (0.31, 0.30 to 0.33) and total knee replacement (0.33, 0.31 to 0.34). For total knee replacement, those in urban areas got higher provision relative to need, but for total hip replacement it was highest in villages/isolated areas. For total knee replacement, patients living in non-white areas received more provision relative to need (1.04, 1.00 to 1.07) than those in predominantly white areas, but for total hip replacement there was no effect. There is evidence of inequity in access to total hip and total knee replacement surgery by age, sex, deprivation, rurality, and ethnicity. Adjustment for hospital and distance did not attenuate these effects. 	<ul style="list-style-type: none"> Lack of individual data Completeness and accuracy of a large database Lack of data from the private sector
21 Lavernia, CJ et al 2012 n.a. United States	Prospective Observational 117 Offices	Hip Knee Primary Data	<ul style="list-style-type: none"> Compare the availability of THR and TKR to an adult insured by Medicaid and by private insurance 	<ul style="list-style-type: none"> All orthopedic surgeons' offices in a South Florida county were contacted by telephone and presented with a hypothetical patient that needed either a hip or a knee arthroplasty for end stage arthritis. Two scenarios were presented. The hypothetical patient was presented as either having private insurance or Medicaid. 	Fisher exact test Mann-Whitney U Test	<ul style="list-style-type: none"> 14.3% of all offices contacted offered an appointment to patients with Medicaid coverage for hip and knee arthroplasty, respectively. All offices offered an appointment to patients with private insurance. The mean time until appointment was longer for patients with Medicaid when compared with private insurance. Adults insured with Medicaid currently have limited access to total joint arthroplasty within the studied community. 	<ul style="list-style-type: none"> Data based on phone calls located only in a urban area Small sample size Other variables for refusing the offer of this procedure not accounted for

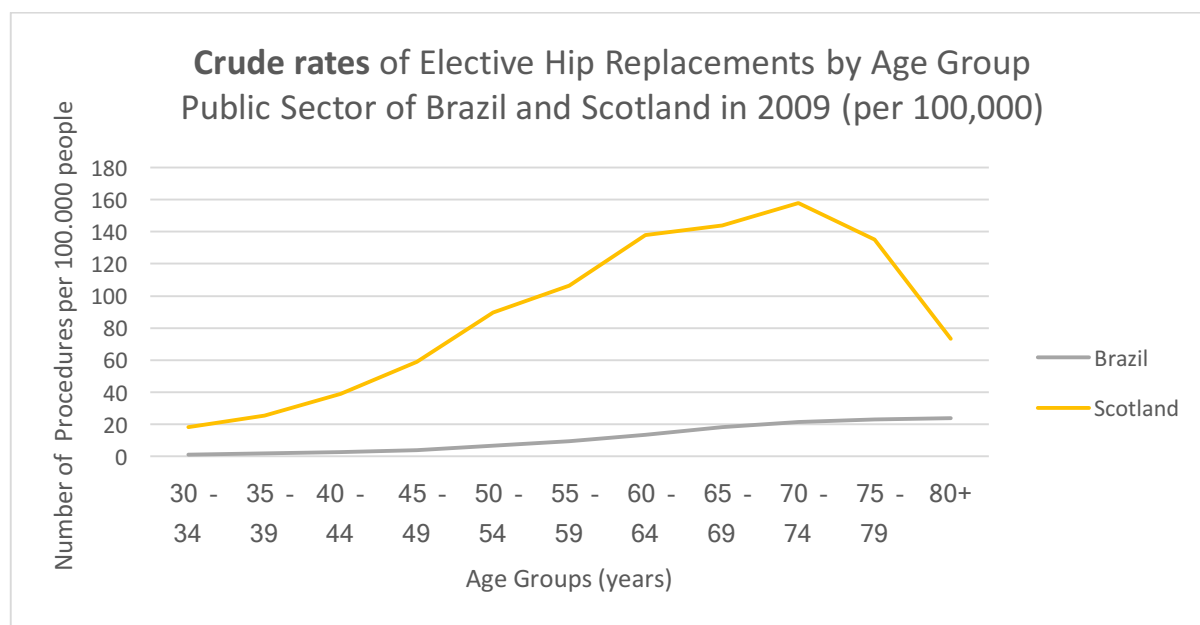
17 Hawkins, K et al. 2011 2006-2007 United States	Cross-sectional 2,200,000 35,527 THR or TKR	Hip Knee Medicare Data	<ul style="list-style-type: none"> If there are disparities in THR and TKR surgery among osteoarthritis patients with AARP-branded Medicare supplement plan coverage provided by United Healthcare 	<ul style="list-style-type: none"> Patients selected if they had 1 or more medical claims with a diagnosis of osteoarthritis Logistic regression analyses tested for age-, sex-, race-, or income-related differences in the likelihood of receiving a hip or knee replacement surgery Regression models controlled for socioeconomic, health status, type of supplement plan, and residential location 	<ul style="list-style-type: none"> Univariate Analysis X² Test Student <i>t</i> Test Logistic Regression Analysis 	<ul style="list-style-type: none"> Of the 2.2 million Medigap insureds eligible for this study, 529,652 (24%) had osteoarthritis. Of these, 32,527 (6.1%) received a hip or knee replacement. Males were 6% (P<0.001) more likely than females to have a replacement surgery. Patients living in minority or lower income neighborhoods were less likely to receive a hip or knee replacement. Supplement plan type was not a strong predictor of the likelihood of hip or knee replacement. Disparities were much greater by comorbid condition and residential location. Disparities in hip and knee replacement surgery existed by age, sex, race, and income levels. Larger disparities were found by residential location and comorbid condition. 	<ul style="list-style-type: none"> Data based on a single insurer Short period of one year Lack of accuracy of geographical data (socioeconomics bias)
4 Matlock, D et al 2008 2001-2002 United States	Cross-sectional n.a. 272,618 THR 507,095 TKR	Hip Knee National Inpatient Sample	<ul style="list-style-type: none"> Utilization of elective THR and TKR increases after 65? Difference between insured and general population decrease at age 65? Medicare is the primary payer of elective THR and TKR after age 65? 	<ul style="list-style-type: none"> Was used the National Inpatient Sample to identify patients and payers of elective hip and knee arthroplasties by age. Rates per 100,000 were calculated Risk Ratios were calculated and compared with observed ratios 	<ul style="list-style-type: none"> Logistic Regression Models Two-tailed <i>t</i> Test 	<ul style="list-style-type: none"> At age 65, there was an upward shift in the incidence of arthroplasties in the general and the insured populations and the difference between these two populations decreased. Medicare was the primary payer for the majority of arthroplasties after age 65. At age 65 the following occurs: (1) utilization of elective joint arthroplasty increases; (2) the difference between the insured population and the general population decreases; and (3) Medicare becomes the primary payer of arthroplasties. 	<ul style="list-style-type: none"> Main data comes from billing records, not clinical The sample does not represent the whole US The numbers of the insured population might be overestimated
29 Dunlop, DD et al 2008 1998-2004 United States	Cross-sectional 16,713 adults aged 51 and older	Hip Knee Health and Retirement Database	<ul style="list-style-type: none"> Age-specific racial/ethnic differences in arthritis-related knee and hip surgeries 	<ul style="list-style-type: none"> National probability sample of US community-dwelling adults. Outcome is self-reported 2-year use of arthritis related hip or knee surgery. Independent variables are demographic (race/ethnicity, age, gender), health needs (arthritis, chronic diseases, obesity, physical activity, and functional limitations), and medical access (income, wealth, education, and health insurance). 	<ul style="list-style-type: none"> X² Test <i>t</i> Test Survival Analysis Andersen's Model 	<ul style="list-style-type: none"> Black adults under the age of 65 years report similar age/gender adjusted rates of hip/knee arthritis surgeries _ hazard ratio (HR) 1.43, 95% confidence interval (CI) 0.87–2.38 Older blacks (age 65) have significantly lower rates (HR 0.38, CI 0.16 – 0.55) compared with whites. These relationships hold controlling for health and economic differences. Both under age 65 years (HR _ 0.64, CI _ 0.12–1.44) and older (age 65 _) Hispanic adults (HR _ 0.60, CI _ 0.32–1.10) report lower utilization rates, although not statistically different than whites. A large portion of the Hispanic disparity is explained by economic differences. 	<ul style="list-style-type: none"> Self-reported clinical information No information on health insurance plans No information if death occurred in the period Differences in need for the procedure
7 Francis, M et al 2009 2005 United States	Cross-sectional 5,647,423 Rural 37,956,429 Urban n.a.	Hip Knee Medicare Database	<ul style="list-style-type: none"> Whether Medicare beneficiaries in rural areas were less likely to have elective THR or TKR compared with their urban counterparts 	<ul style="list-style-type: none"> Beneficiaries were assigned to rural versus urban areas based on their zip code of residence and the 10-point Rural-Urban Commuting Area designation. Odds ratios (ORs) and 95% confidence intervals (95% CIs) were calculated. 	<ul style="list-style-type: none"> Logistic Regression Models Multivariable Analysis 	<ul style="list-style-type: none"> Compared with urban beneficiaries, rural beneficiaries were 27% more likely to have total knee or hip replacement surgeries (OR 1.27 [95% CI 1.26– 1.28]). After adjusting for age, sex, race/ethnicity, median household income, average house value, mean poverty ratio, and state of residence, rural beneficiaries were still 14% more likely to have total joint replacement surgeries (OR 1.14 [95% CI 1.13–1.16]). Differential use of surgery before and after receiving Medicare eligibility did not explain the findings. While significant sex, racial, and ethnic disparities were present in both rural and urban areas, for the most part these disparities were ameliorated rather than accentuated in rural areas. Medicare beneficiaries living in rural areas are more likely to undergo total knee or hip replacement surgeries. 	<ul style="list-style-type: none"> Inaccuracies of the database regarding race classifications Confounder clinical factors not considered by the database

77 Brennan, SL et al 2012 2006-2007 Australia	Cross-sectional n.a. 642 THR	Hip National Joint Replacement Registry	<ul style="list-style-type: none"> To examine primary THR across SES for both genders for the Barwon Statistical Division (BSD) of Victoria, Australia 	<ul style="list-style-type: none"> Index of Relative Socioeconomic Disadvantage was used to measure SES; Data were categorized into quintiles; quintile 1 indicating the most disadvantaged. Age- and sex-specific rates of primary THR per 1,000 person years by 10-year age bands 	Poisson Regression Models Residual Quantile Plot	<ul style="list-style-type: none"> Females accounted for 46.9% of the 642 primary THR performed during 2006–7. THR utilization per 1,000 person years was 1.9 for males and 1.5 for females. The highest utilization of primary THR was observed in those aged 70–79 years (males 6.1, and females 5.4 per 1,000 person years). Overall, the U-shaped pattern of THR across SES gave the appearance of bimodality for both males and females, whereby rates were greater for both the most disadvantaged and least disadvantaged groups. 	<ul style="list-style-type: none"> Private versus public provider is a confounder not accounted for Aggregated SES data and not individual Small sample
19 Rahman, MM et al 2011 1991-2004 Canada	Cohort 34,420 2,814 TJA	Hip Knee Primary Data	<ul style="list-style-type: none"> Quantify the effect of demographic variables and SES on surgical consultation and total joint arthroplasty (TJA) rates among patients with osteoarthritis 	<ul style="list-style-type: none"> From April 1996 to March 1998, we documented 34,420 new patients with OA and these patients were followed to March 2004 for their first surgical consultation and TJA. Effects of age, sex, and SES were evaluated by Cox proportional hazards models after adjusting for comorbidities and pain medication used. 	Charlson Comorbidity Score Cox proportional Hazards Models Kaplan-Meier Curves	<ul style="list-style-type: none"> During a mean 5.5-year follow-up period, 7475 patients with OA had their first surgical consultations and 2814 patients received TJA within a 6-year mean follow-up period. Crude hazards ratio (HR) for men compared to women was 1.25 (95% CI 1.20–1.31) for surgical consultation and was 1.14 (95% CI 1.06–1.23) for TJA. The interaction between sex and SES was significant. Stratified analysis showed among men an HR of 1.42 (95% CI 1.27–1.58) and 1.52 (95% CI 1.26–1.83) for surgical consultations and TJA, respectively, for the highest SES compared with the lowest SES quintiles. Similarly significant results were observed among women. Women with OA were less likely than men to see an orthopedic surgeon as well as to obtain TJA. Patients with higher SES consulted orthopedic surgeons more frequently and received more TJA than those with the lowest SES. 	<ul style="list-style-type: none"> Both false-negatives and false-positives might have occurred within the database
9 Manderbacka, K et al 2009 1992-2003 Finland	Ecological n.a. n.a.	Hip Knee Other elective procedures Administrative Registers	<ul style="list-style-type: none"> Examines the socioeconomic distribution of elective surgery from 1992 to 2003 in Finland 	<ul style="list-style-type: none"> Administrative registers were used to identify common elective procedures performed in all public and private hospitals in Finland in 1992–2003. Patients' individual SES data came from 1990–2003 census and employment statistics databases. Age-standardized procedure rates by income quintile were calculated for both genders Concentration indices were developed and applied to age-standardized procedure rates 	Annual age- standardised Rates Logistic Regression	<ul style="list-style-type: none"> Most procedure rates increased during the study period. Three trends emerged: declining inequality for coronary revascularisations, an increase and then a decline in cataract extractions and primary knee replacements among men, and positive relationships between income and treatment for hysterectomy and lumbar disc operations. Results suggest that structural features – uneven availability, co-payments and plurality of provision – sustain inequity in access Decreasing inequities reflect directed service expansion Increased attention to collective, prospective funding of primary and specialist ambulatory care is required to increase equity of access to elective surgery. 	<ul style="list-style-type: none"> Lack of clinical variables Potential uncompleted data Geographic based SES inherent limitations
6 Derrett, S et al 2009 2000-2005 New Zealand	Ecological n.a. 74,836 elective procedures	Hip Knee Other Elective Procedures National Health System Administrative Data	<ul style="list-style-type: none"> Evaluate equity of provision of surgery after introduction of a prioritization system to manage access 	<ul style="list-style-type: none"> Data for people receiving publicly funded elective joint replacement, cataract surgery as well as most recent data for people receiving privately funded surgery (2001 and 2002). NZDep2001, a small-area deprivation index, was used to identify people in poorest deciles. 	Standardised Rates Simple Correlation	<ul style="list-style-type: none"> Despite the introduction of a prioritization system aimed at increased equity and fairness, the provision of elective surgery remains inequitable geographically. High private provision was not associated with better access to publicly funded surgery. The argument that private provision for the well off reduces the burden on the public system allowing better access for the poor was not supported. 	<ul style="list-style-type: none"> Geographic based SES inherent limitations Different aspects of need not considered in the analysis

15 Dixon, T et al 2009	Cross-sectional	Hip Knee	<ul style="list-style-type: none"> Whether rates of hip and knee joint replacement vary according to socio-economic status, geographical locality, birthplace and indigenous status in Australia. 	<ul style="list-style-type: none"> All separations for primary hip or knee joint replacement with the principal diagnosis of arthritis were identified. Age-standardized procedure rates were compared based on socio-economic status, geographical locality, birthplace and indigenous status. 	Simple correlation Holm-Bonferroni Method	<ul style="list-style-type: none"> Compared with age- and gender-matched individuals, rates of joint replacement overall were significantly lower in people living in the most disadvantaged ($P < 0.05$) and remote areas ($P < 0.001$) people born outside Australia ($P < 0.05$) and indigenous people ($P < 0.001$) Knee replacement rates were higher in the most disadvantaged areas than in the least disadvantaged areas ($P < 0.01$), and both hip and knee replacement rates were higher in regional areas than in major cities ($P < 0.05$). Males and females born in New Zealand and females born in the United Kingdom, Ireland and parts of Europe had a greater rate of hip replacement, and females from North Africa and the Middle East had a greater rate of knee replacement, than Australia-born people ($P < 0.001$). There is significant variation in the rates of primary total hip and knee replacement in Australia. 	<ul style="list-style-type: none"> Issues related to multiple testing with different P values Rather than adjusting for potential confounders the variables were analyzed individually
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Appendix 2. Standardisation tables

Figure 1.



Brazil 2009

Crude Overall Rate 6.8/100.000	Age/Sex Standardised Rate 7.8/100.000	95% Confidence Interval 7.6 – 8 /100.000
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Scotland 2009

Crude Overall Rate 73.2/100.000	Age/Sex Standardised Rate 61.1/100.000	95% Confidence Interval 58.6 – 63.6 /100.000
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Figure 2.

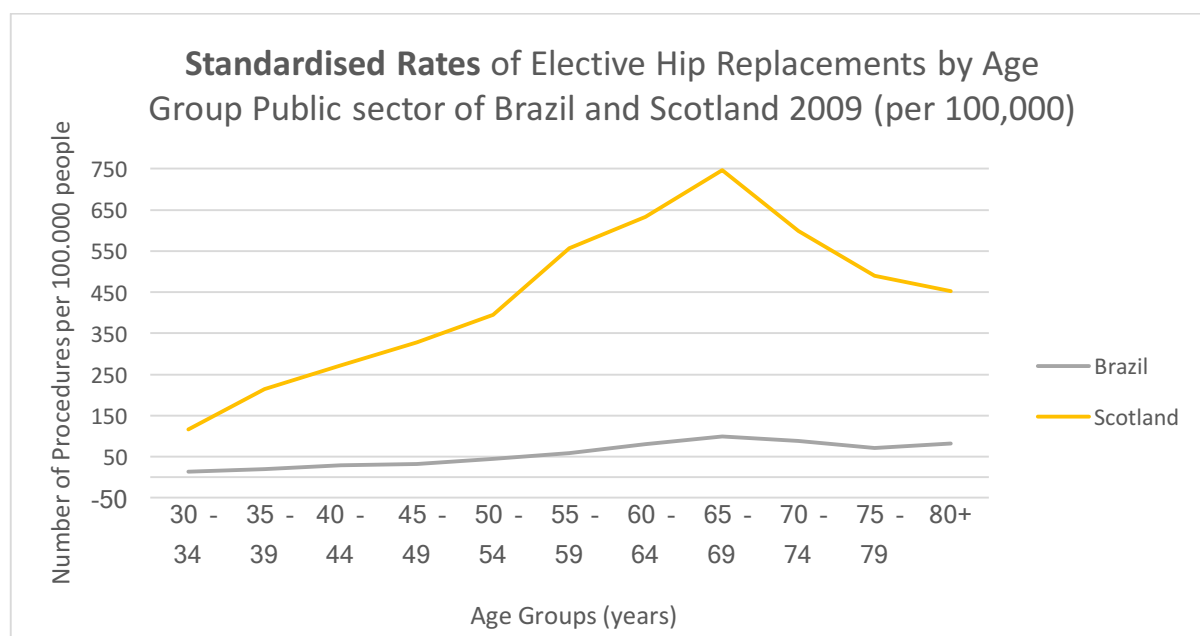


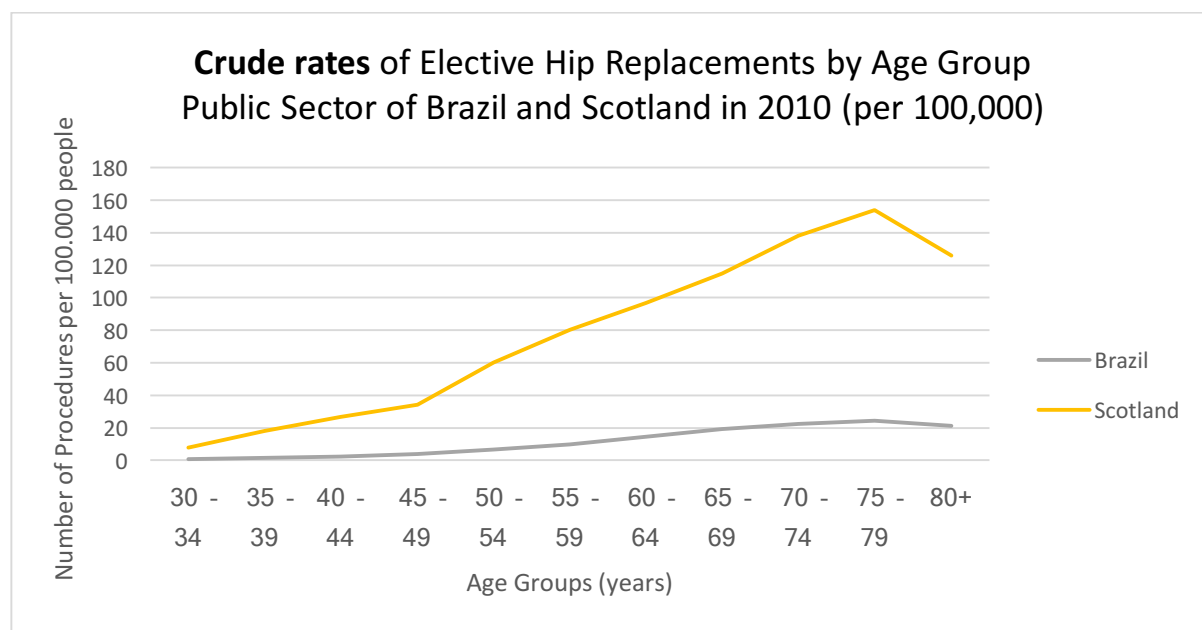
Table 1.
Elective Hip Replacements in the Brazilian Public Sector 2009 - Over 30s Population (Standardised to the 1991 Canadian Population)

Age Groups	MALES				Females				Crude Rate per Age Group
	Events	Standard	Study Population	Expected Events	Events	Standard	Study Population	Expected Events	
30 - 34	90	1,312,036	7,713,847	15.3	61	1,285,944	7,934,643	9.9	12.5
35 - 39	150	1,173,504	6,545,922	26.9	69	1,171,180	6,918,036	11.7	19.2
40 - 44	225	1,077,008	6,101,335	39.7	117	1,061,763	6,552,084	19.0	29.3
45 - 49	252	844,091	5,564,349	38.2	181	830,034	6,062,223	24.8	31.5
50 - 54	371	673,195	4,634,706	53.9	259	666,661	5,097,609	33.9	43.8
55 - 59	383	618,181	3,699,985	64.0	352	620,200	4,138,050	52.8	58.3
60 - 64	421	578,610	2,850,939	85.4	402	611,562	3,244,962	75.8	80.6
65 - 69	346	497,864	2,060,998	83.6	486	586,692	2,468,503	115.5	99.5
70 - 74	283	364,284	1,572,371	65.6	472	469,730	1,979,700	112.0	88.7
75 - 79	190	255,603	1,044,446	46.5	372	366,627	1,413,032	96.5	71.5
80+	190	229,917	1,129,793	38.7	472	440,273	1,663,342	124.9	81.8
All	2,901	7,624,293	42,918,691		3,243	8,110,666	47,472,184		

Table 2.
Elective Hip Replacements in the Scottish Public Sector 2009 - Over 30s Population (Standardised to the 1991 Canadian Population)

Age Groups	MALES				Females				Crude Rate per Age Group
	Events	Standard	Study Population	Expected Events	Events	Standard	Study Population	Expected Events	
30 - 34	13	1,312,036	150,237	113.53	14	1,285,944	152,297	118.21	115.9
35 - 39	28	1,173,504	167,415	196.27	36	1,171,180	180,864	233.12	214.7
40 - 44	52	1,077,008	190,907	293.36	49	1,061,763	206,824	251.55	272.5
45 - 49	81	844,091	191,390	357.24	74	830,034	206,174	297.92	327.6
50 - 54	106	673,195	174,089	409.90	105	666,661	184,353	379.70	394.8
55 - 59	147	618,181	158,114	574.73	143	620,200	165,060	537.31	556.0
60 - 64	167	578,610	155,859	619.97	174	611,562	164,333	647.54	633.8
65 - 69	177	497,864	118,616	742.92	171	586,692	133,497	751.51	747.2
70 - 74	154	364,284	98,803	567.79	160	469,730	119,075	631.17	599.5
75 - 79	131	255,603	73,474	455.73	144	366,627	100,775	523.88	489.8
80+	108	229,917	77,488	320.45	195	440,273	146,784	584.90	452.7
All	1164	7,624,293	1,556,392		1265	8,110,666	1,760,036		

Figure 5.



Brazil 2010

Crude Overall Rate	Age/Sex Standardised Rate	95% Confidence Interval
7.1/100.000	8/100.000	7.8 – 8.2 /100.000

Scotland 2010

Crude Overall Rate	Age/Sex Standardised Rate	95% Confidence Interval
68.3/100.000	56.7/100.000	54.3 – 59.1 /100.000

Figure 6.

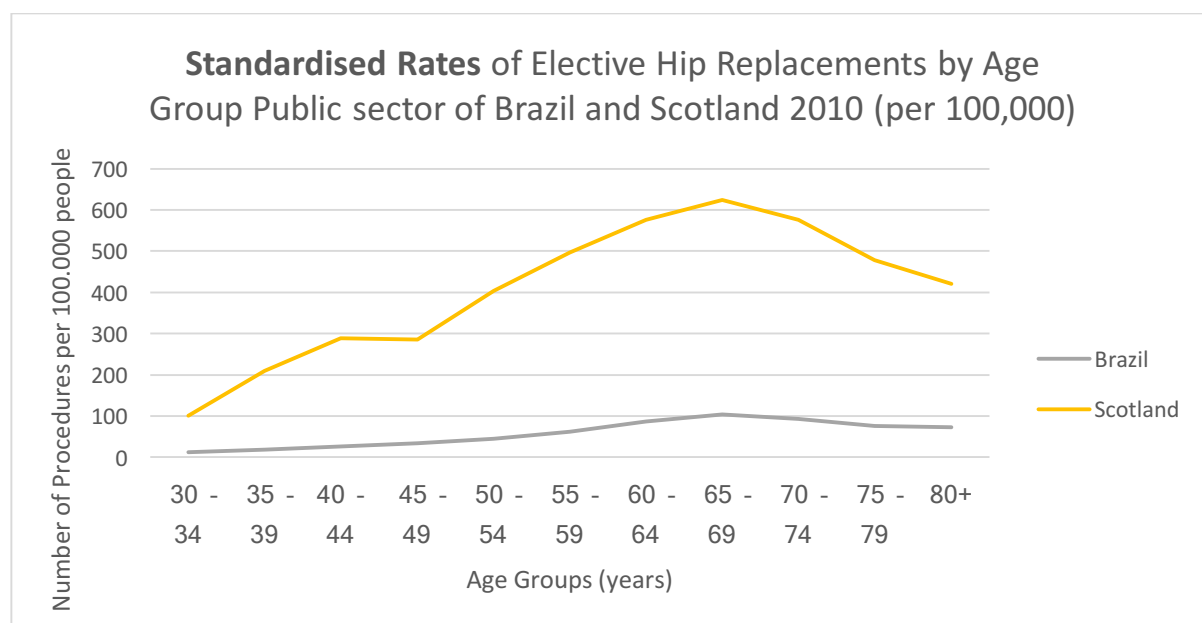


Table 5.

Elective Hip Replacements in the Brazilian Public Sector 2010 - Over 30s Population (Standardised to the 1991 Canadian Population)

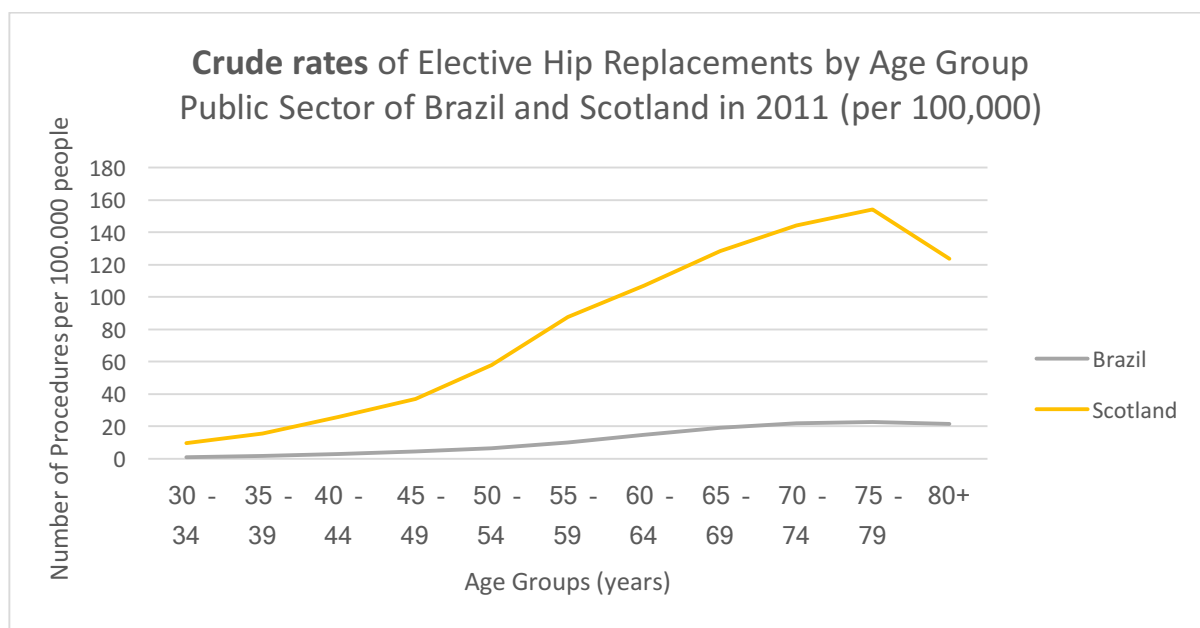
Age Groups	MALES				Females				Crude Rate per Age Group
	Events	Standard	Study Population	Expected Events	Events	Standard	Study Population	Expected Events	
30 - 34	98	1,312,036	7,717,657	16.7	56	1,285,944	8,026,855	9.0	12.8
35 - 39	138	1,173,504	6,766,665	23.9	86	1,171,180	7,121,916	14.1	19.0
40 - 44	207	1,077,008	6,320,570	35.3	110	1,061,763	6,688,797	17.5	26.3
45 - 49	287	844,091	5,692,013	42.6	178	830,034	6,141,338	24.1	33.3
50 - 54	407	673,195	4,834,995	56.7	270	666,661	5,305,407	33.9	45.2
55 - 59	419	618,181	3,902,344	66.4	409	620,200	4,373,875	58.0	62.1
60 - 64	462	578,610	3,041,034	87.9	488	611,562	3,468,085	86.1	86.9
65 - 69	407	497,864	2,224,065	91.1	519	586,692	2,616,745	116.4	103.7
70 - 74	325	364,284	1,667,373	71.0	507	469,730	2,074,264	114.8	92.9
75 - 79	227	255,603	1,090,518	53.2	400	366,627	1,472,930	99.6	76.3
80+	181	229,917	1,133,122	36.7	446	440,273	1,802,463	108.9	72.8
All	3,158	7,624,293	44,390,356		3,469	8,110,666	49,092,675		

Table 6.

Elective Hip Replacements in the Scottish Public Sector 2010 - Over 30s Population (Standardised to the 1991 Canadian Population)

Age Groups	MALES				Females				Crude Rate per Age Group
	Events	Standard	Study Population	Expected Events	Events	Standard	Study Population	Expected Events	
30 - 34	13	1,312,036	156,089	109.27	11	1,285,944	154,953	91.29	100.3
35 - 39	25	1,173,504	161,215	181.98	35	1,171,180	173,843	235.79	208.9
40 - 44	53	1,077,008	186,661	305.80	52	1,061,763	203,033	271.93	288.9
45 - 49	70	844,091	192,850	306.39	67	830,034	209,099	265.96	286.2
50 - 54	111	673,195	177,390	421.24	109	666,661	188,853	384.78	403.0
55 - 59	122	618,181	158,082	477.08	138	620,200	165,873	515.98	496.5
60 - 64	160	578,610	159,572	580.16	157	611,562	167,917	571.80	576.0
65 - 69	141	497,864	120,391	583.09	152	586,692	134,380	663.62	623.4
70 - 74	149	364,284	99,722	544.30	154	469,730	119,364	606.03	575.2
75 - 79	120	255,603	74,873	409.66	151	366,627	101,222	546.92	478.3
80+	118	229,917	80,186	338.34	171	440,273	149,354	504.08	421.2
All	1082	7,624,293	1,567,031		1197	8,110,666	1,767,891		

Figure 9.



Brazil 2011

Crude Overall Rate 7.1/100.000	Age/Sex Standardised Rate 8/100.000	95% Confidence Interval 7.8 – 8.2 /100.000
------------------------------------------	-----------------------------------------------	------------------------------------------------------

Scotland 2011

Crude Overall Rate 71.6/100.000	Age/Sex Standardised Rate 59.1/100.000	95% Confidence Interval 56.7 – 61.5 /100.000
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Figure 10.

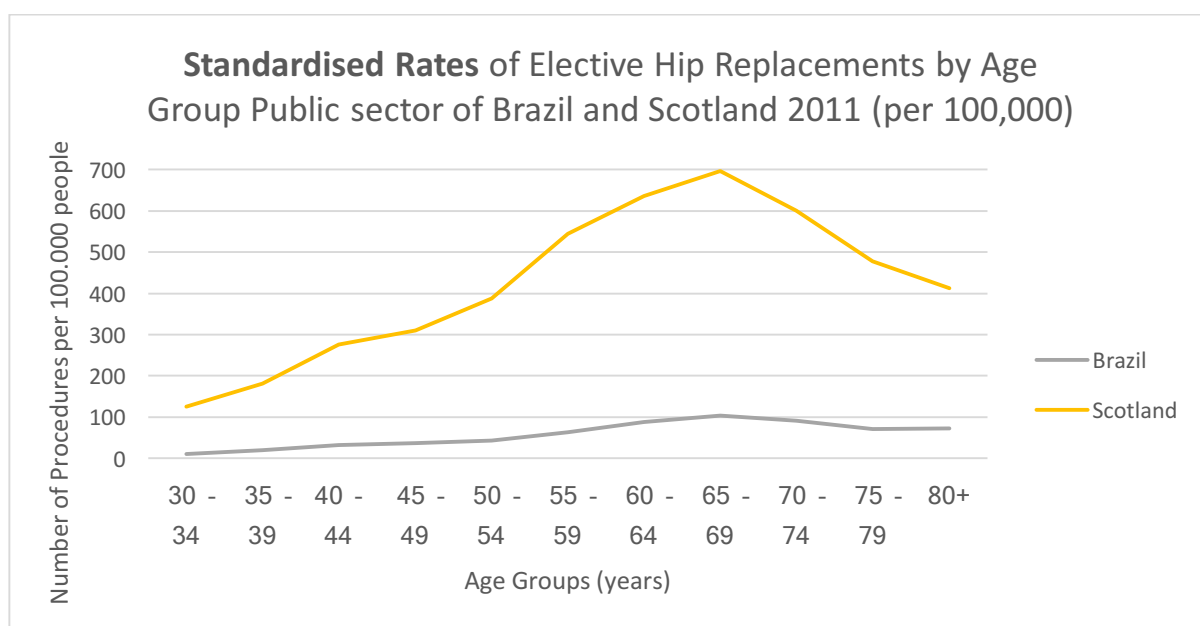


Table 9.

Elective Hip Replacements in the Brazilian Public Sector 2011 - Over 30s Population (Standardised to the 1991 Canadian Population)

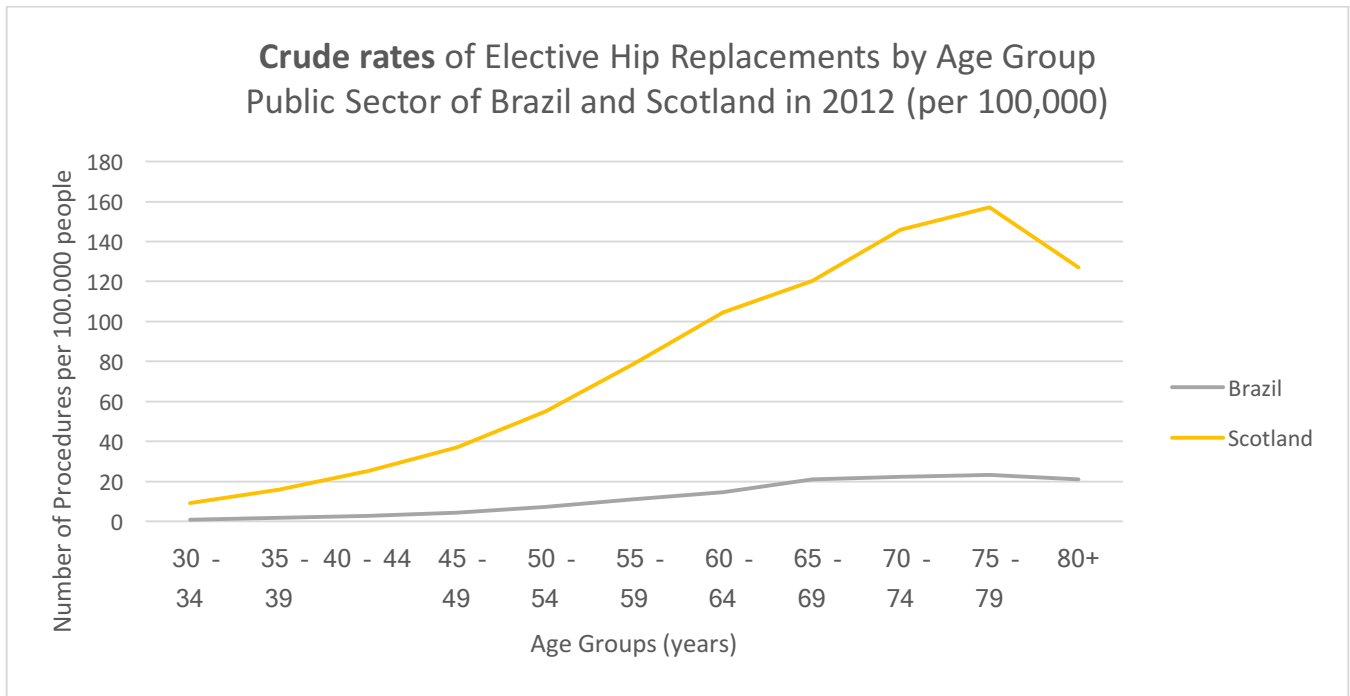
Age Groups	MALES				Females				Crude Rate per Age Group
	Events	Standard	Study Population	Expected Events	Events	Standard	Study Population	Expected Events	
30 - 34	77	1,312,036	7,786,064	13.0	51	1,285,944	8,097,404	8.1	10.5
35 - 39	155	1,173,504	6,825,567	26.7	75	1,171,180	7,183,236	12.2	19.4
40 - 44	238	1,077,008	6,374,156	40.2	143	1,061,763	6,745,032	22.5	31.4
45 - 49	333	844,091	5,738,966	49.0	180	830,034	6,191,677	24.1	36.6
50 - 54	387	673,195	4,874,186	53.5	269	666,661	5,347,927	33.5	43.5
55 - 59	456	618,181	3,933,219	71.7	388	620,200	4,408,020	54.6	63.1
60 - 64	464	578,610	3,064,436	87.6	509	611,562	3,494,415	89.1	88.3
65 - 69	424	497,864	2,240,683	94.2	511	586,692	2,636,099	113.7	104.0
70 - 74	347	364,284	1,679,474	75.3	474	469,730	2,089,278	106.6	90.9
75 - 79	208	255,603	1,098,258	48.4	375	366,627	1,483,407	92.7	70.5
80+	193	229,917	1,140,928	38.9	437	440,273	1,815,248	106.0	72.4
All	3,282	7,624,293	44,755,937		3,412	8,110,666	49,491,743		

Table 10.

Elective Hip Replacements in the Scottish Public Sector 2011 - Over 30s Population (Standardised to the 1991 Canadian Population)

Age Groups	MALES				Females				Crude Rate per Age Group
	Events	Standard	Study Population	Expected Events	Events	Standard	Study Population	Expected Events	
30 - 34	13	1,312,036	162,928	104.69	18	1,285,944	159,172	145.42	125.1
35 - 39	23	1,173,504	155,436	173.64	27	1,171,180	166,275	190.18	181.9
40 - 44	49	1,077,008	184,202	286.50	50	1,061,763	200,441	264.86	275.7
45 - 49	71	844,091	192,578	311.20	78	830,034	209,974	308.34	309.8
50 - 54	109	673,195	180,504	406.52	107	666,661	193,527	368.59	387.6
55 - 59	146	618,181	160,001	564.09	142	620,200	168,046	524.07	544.1
60 - 64	180	578,610	161,473	645.00	175	611,562	170,514	627.65	636.3
65 - 69	158	497,864	124,444	632.11	178	586,692	137,089	761.78	696.9
70 - 74	146	364,284	99,208	536.10	168	469,730	118,572	665.54	600.8
75 - 79	128	255,603	76,231	429.18	146	366,627	101,768	525.98	477.6
80+	127	229,917	88,113	331.39	170	440,273	151,962	492.53	412.0
All	1150	7,624,293	1,585,118		1259	8,110,666	1,777,340		

Figure 13.



Brazil 2012

Crude Overall Rate 7.4/100.000	Age/Sex Standardised Rate 8.3/100.000	95% Confidence Interval 8.1 – 8.5 /100.000
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Scotland 2012

Crude Overall Rate 70.1/100.000	Age/Sex Standardised Rate 57.7/100.000	95% Confidence Interval 55.3 – 60.1 /100.000
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Figure 14.

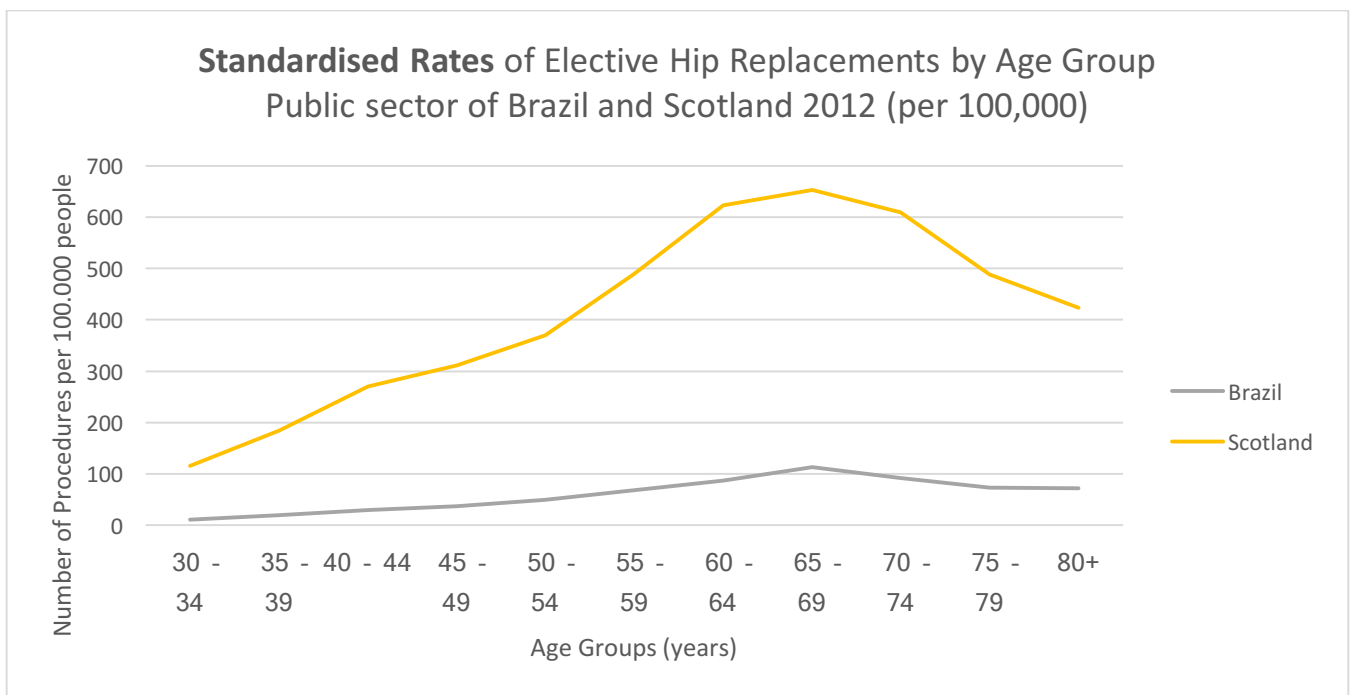


Table 13.

Elective Hip Replacements in the Brazilian Public Sector 2012 - Over 30s Population (Standardised to the 1991 Canadian Population)

Age Groups	MALES				Females				Crude Rate per Age Group
	Events	Standard	Study Population	Expected Events	Events	Standard	Study Population	Expected Events	
30 - 34	82	1,312,036	7,853,458	13.7	54	1,285,944	8,166,586	8.5	11.1
35 - 39	152	1,173,504	6,883,541	25.9	93	1,171,180	7,243,527	15.0	20.5
40 - 44	240	1,077,008	6,427,350	40.2	127	1,061,763	6,800,153	19.8	30.0
45 - 49	343	844,091	5,785,459	50.0	186	830,034	6,240,934	24.7	37.4
50 - 54	444	673,195	4,912,910	60.8	314	666,661	5,389,329	38.8	49.8
55 - 59	509	618,181	3,963,556	79.4	414	620,200	4,441,120	57.8	68.6
60 - 64	505	578,610	3,087,312	94.6	458	611,562	3,520,063	79.6	87.1
65 - 69	481	497,864	2,256,975	106.1	547	586,692	2,654,866	120.9	113.5
70 - 74	363	364,284	1,691,406	78.2	480	469,730	2,103,802	107.2	92.7
75 - 79	223	255,603	1,105,881	51.5	385	366,627	1,493,580	94.5	73.0
80+	170	229,917	1,148,647	34.0	457	440,273	1,827,317	110.1	72.1
All	3,512	7,624,293	45,116,495		3,515	8,110,666	49,881,277		

Table 14.

Elective Hip Replacements in the Scottish Public Sector 2012 - Over 30s Population (Standardised to the 1991 Canadian Population)

Age Groups	MALES				Females				Crude Rate per Age Group
	Events	Standard	Study Population	Expected Events	Events	Standard	Study Population	Expected Events	
30 - 34	12	1,312,036	163,281	96.43	18	1,285,944	169,681	136.41	116.4
35 - 39	18	1,173,504	158,158	133.56	33	1,171,180	163,850	235.88	184.7
40 - 44	50	1,077,008	186,186	289.23	47	1,061,763	199,274	250.42	269.8
45 - 49	81	844,091	199,540	342.64	71	830,034	210,765	279.61	311.1
50 - 54	106	673,195	188,241	379.08	106	666,661	196,466	359.69	369.4
55 - 59	129	618,181	166,198	479.82	139	620,200	173,090	498.05	488.9
60 - 64	170	578,610	157,797	623.36	168	611,562	164,841	623.28	623.3
65 - 69	169	497,864	137,334	612.66	175	586,692	148,398	691.86	652.3
70 - 74	144	364,284	101,619	516.21	179	469,730	119,914	701.18	608.7
75 - 79	126	255,603	78,407	410.75	158	366,627	102,204	566.78	488.8
80+	128	229,917	85,596	343.82	174	440,273	152,279	503.07	423.4
	1133	7,624,293	1,622,357		1268	8,110,666	1,800,762		

Appendix 3. General script for interviews

Appendix 3. General script for Interviews

1. Present myself and the informed consent, which will be read and signed for both researcher and interviewee before the audio recording starts;
2. A brief discussion around the background, aims and objectives, first results of the research will prompt the discussion.
3. According to expertise and work of the interviewee the discussion will lean towards his area of expertise.
4. Questions which will be asked to all interviewees:
 - a. Is there a difference in health technologies use by the public and private sector?
 - b. How established in evidences do you believe the clinical decision regarding use of which technology/care is by Brazilian practitioners? Is there a difference between public and private sectors?
 - c. To what factors do you attribute the findings of this research (national and regional rates), considering such an uneven distribution of the same healthcare technology?
 - d. About the the statistical model proposed by this study utilising income equity (Gini Index), Human Development (HDI) and rate of elective primary hip arthroplasties in Brazil, to which factors would you attribute such results?

Appendix 4. Approval from the Ethics Committee



Queen Mary, University of London
Room W117
Queen's Building
Mile End Road
London
E1 4NS

Queen Mary Research Ethics Committee
Hazel Covill
Research Ethics Committee Administrator
Tel: +44 (0) 20 7882 7915
Email: h.covill@gmul.ac.uk

c/o Professor Allyson Pollock
Room 2.19
Yvonne Carter Building
58 Turner Street
Whitechapel
London

23rd April 2014

To Whom It May Concern:

Re: QMREC1352d – Equity in universal Health Systems – hip replacements in Brazil and Scotland.

I can confirm that Mr Jonathan Filippou has completed a Research Ethics Questionnaire with regard to the above research.

The result of which was the conclusion that his proposed work does not present any ethical concerns; is extremely low risk; and thus does not require the scrutiny of the full Research Ethics Committee.

Yours faithfully

A handwritten signature in black ink, appearing to read "Hazel Covill".

Ms Hazel Covill
Research Ethics Committee Administrator

Patron: Her Majesty the Queen
Incorporated by Royal Charter as Queen Mary
and Westfield College, University of London

Appendix 5. Information sheet for interviews

Pro forma information sheet and consent form



Information sheet

Equity in universal health systems – Hip Replacements in Brazil and Scotland - information for participants

We would like to invite you to be part of this research project, if you would like to. You should only agree to take part if you want to, it is entirely up to you. If you choose not to take part there won't be any disadvantages for you and you will hear no more about it.

Please read the following information carefully before you decide to take part; this will tell you why the research is being done and what you will be asked to do if you take part. Please ask if there is anything that is not clear or if you would like more information.

If you decide to take part you will be asked to sign the attached form to say that you agree.

You are still free to withdraw at any time and without giving a reason.

It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form.

If you have any questions or concerns about the manner in which the study was conducted please, in the first instance, contact the researcher responsible for the study. If this is unsuccessful, or not appropriate, please contact the Secretary at the Queen Mary Ethics of Research Committee, Room W117, Queen's Building, Mile End Campus, Mile End Road, London or research-ethics@qmul.ac.uk.

Researcher:

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Contact - 44-07725808645

Centre for Primary Care and Public Health

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E1 2AB

Research Supervisor:

Professor Allyson M. Pollock – a.pollock@qmul.ac.uk

Appendix 6. Consent form for interviews



Consent form

Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research.

Title of Study: ***Equity in universal health systems – Hip Replacements in Brazil and Scotland***

Queen Mary Ethics of Research Committee Ref:

- Thank you for considering taking part in this research. The person organizing the research must explain the project to you before you agree to take part.

- If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

- *I understand that if I decide at any other time during the research that I no longer wish to participate in this project, I can notify the researchers involved and be withdrawn from it immediately.*

- *I consent to the processing of my personal information for the purposes of this research study. I understand that such information will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.*

Participant's Statement:

I _____ agree that the research project named above has been explained to me to my satisfaction and I agree to take part in the study. I have read both the notes written above and the Information Sheet about the project, and understand what the research study involves.

Signed:

Date:

Investigator's Statement:

I **Jonathan G. Filippin** confirm that I have carefully explained the nature, demands and any foreseeable risks (where applicable) of the proposed research to the volunteer