International variation in hip replacement rates

H Merx, K Dreinhöfer, P Schräder, T Stürmer, W Puhl, K-P Günther, H Brenner

EXTENDED REPORT

Objective: To summarise epidemiological data on the frequency of hip replacements in the countries of the developed world, especially in countries of the Organisation for Economic Cooperation and Development (OECD), and to investigate whether missing consensus criteria for the indication for total hip replacement (THR) result in different replacement rates.

Methods: Country-specific hip replacement rates were collected using the available literature, different data sources of national authorities, and estimates of leading hip replacement manufacturers.

Results: According to administrative and literature data sources the reported crude primary THR rate varied between 50 and 300 procedures/100 000 inhabitants in OECD countries in the 1990s. The crude overall hip implantation rate, summarising THR, partial hip replacement, and hip revision procedures, was reported to range from 60 to 200 procedures/100 000 inhabitants in the late 1990s. Moreover, large national differences were seen in the relationship between total and partial hip replacement procedures.

Conclusion: The reported differences in hip replacement rates in OECD countries are substantial. They may be due to various causes, including different coding systems, country-specific differences in the health care system, in total expenditure on health per capita, in the population age structure, and in different indication criteria for THR.

The review includes only population based studies with a specified data source of performed THR. In most cases the data source was either a national register or the hospital records/operating theatre registers of an entire country, county, or smaller area. Publications with district data were only included in the study when national data were not available. Moreover, national or district THR rates were only considered if the reference population was the total population. If there were several publications pertaining to the same data source—for example, a national register, only the most recent one was taken into consideration.

Whenever possible the THR rates as provided in the publications were used. In some cases, only numbers of THR units were given in the publications. In these cases the OECD Health Data File 1999 was the data source for the population used to calculate THR rates. With few exceptions, only crude rather than age specific or age standardised THR rates are presented because only a few THR figures by age groups were recorded.

Information from national authorities

To get information on national data of THR rates we performed a survey among national authorities. We asked in a standardised questionnaire for annual rates, or, alternatively, absolute numbers of primary THR and overall hip replacements (sum of primary THR, partial hip replacement, and hip revision procedures) for the years 1985, 1990, 1995, and the most recent year with available data. As OA is the main diagnosis requiring THR, we also asked for hospitalisation rates due to OA (ICD-9: 715). Additionally, we requested further information on the data source (that is, the coding system, National Register, percentage of the national hospitals) and, if available, more detailed data such as age- or sex-specific hospitalisation rates.

This questionnaire was sent to national authorities of all OECD countries except Korea and Mexico, because no

Abbreviations: OA, osteoarthritis; OECD, Organisation for Economic Cooperation and Development; THR, total hip replacement
pertinent address could be identified in these countries. Additionally, we got in touch with organisations in Singapore as a developed Asian country. We also contacted all organisations mentioned above; overall, more than 90 institutions in 30 countries. Non-responders were sent a maximum of two reminders. In addition, data of National Statistical Offices, National Health Ministries and other relevant national organisations were used. To demonstrate as much relevant information as possible, we present two endpoint criteria: national THR rates and overall national implantation rates. The latter combines national data of THR performed per 10^5 inhabitants: scientific literature data

table 1 Annual primary THR rates/10^5 inhabitants: scientific literature data

<table>
<thead>
<tr>
<th>Country</th>
<th>Period</th>
<th>Annual primary THR rate (per 10^5)</th>
<th>Done for OA</th>
<th>Data source</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norway</td>
<td>1995–98</td>
<td>110–120</td>
<td>68% a)</td>
<td>National register</td>
<td>Havellin, 199914</td>
</tr>
<tr>
<td>Iceland</td>
<td>1992–96</td>
<td>114*</td>
<td>68%</td>
<td>Records of all orthopaedic clinics</td>
<td>Ingvarsson et al, 199915</td>
</tr>
<tr>
<td>England</td>
<td>1995–96</td>
<td>78 n)</td>
<td>49% – 84%</td>
<td>Hospital Episode System (NHS hospitals)</td>
<td>Birrell et al, 199916</td>
</tr>
<tr>
<td>Australia</td>
<td>1997–98</td>
<td>72</td>
<td>&gt;90% c)</td>
<td>National Registry</td>
<td>Williamson, 1999</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>1994</td>
<td>105</td>
<td></td>
<td>SIG Zorginformatie (total population)</td>
<td>Oktuijse, 199817</td>
</tr>
<tr>
<td>Sweden</td>
<td>1991–95</td>
<td>108–125</td>
<td>76% 1)</td>
<td>National register</td>
<td>Herberts and Malchau, 199718</td>
</tr>
<tr>
<td>Scotland (western part)</td>
<td>Sep 1991 – 28 Feb 1993</td>
<td>67 d) (urban) 86 e) (rural)</td>
<td>86% (urban) 89% (rural)</td>
<td>Hospital records of all 16 hospitals in the western part of Scotland</td>
<td>Donsmuir et al, 199619</td>
</tr>
<tr>
<td>Canada</td>
<td>1 Apr 1988 – 31 Mar 1990</td>
<td>50* n)</td>
<td></td>
<td>Canadian Hospital morbidity file</td>
<td>Gentlemen et al, 199620</td>
</tr>
<tr>
<td>USA (San Francisco)</td>
<td>1984–88</td>
<td>White: 76% i) Black: 35% i) Hispanics: 13% i) Asian: &lt;17% i)</td>
<td>White: 66% Black: 55% Hispanics: 54% Asians: &lt;29%</td>
<td>Hospital records of the 17 hospitals within or near San Francisco</td>
<td>Hoaglund et al, 199521</td>
</tr>
<tr>
<td>USA (Olomsted County, Minnesota)</td>
<td>1987–90</td>
<td>60 j)</td>
<td>ca 75%</td>
<td>Registry of the Mayo Clinic, data of the Rochester Epidemiology Project</td>
<td>Madhok et al, 1993</td>
</tr>
<tr>
<td>Denmark (South Jutland)</td>
<td>1988–90</td>
<td>82</td>
<td>86% (1981–1990)</td>
<td>Hospital records of the two orthopaedic hospitals in South Jutland</td>
<td>Overgaard et al, 1992</td>
</tr>
<tr>
<td>Finland</td>
<td>1988</td>
<td>58</td>
<td>71% 1)</td>
<td>National register</td>
<td>Paaolainen et al, 199122</td>
</tr>
<tr>
<td>USA (Maryland)</td>
<td>1985–87</td>
<td>59*</td>
<td></td>
<td>Hospital discharges in Maryland</td>
<td>Gittelsohn et al, 199123</td>
</tr>
</tbody>
</table>

a) Data source: Havellin et al, 199326
b) Data source: Hospital Episode System (all patients admitted to hospitals of the National Health Service (NHS), including private patients treated in NHS hospitals).
c) Data for 1989.14
d) 84% of all elective THRs done for OA in six districts of the Oxford region.31
e) Data from a registry pilot study of 260 patients undergoing a primary THR or a primary total knee replacement.
f) Data source: Herberts and Malchau 2000.32
g) Age and sex standardised rates to the Scottish population, primary elective THR.
h) CCP code 93.5
i) Age-standardised rates to the 1980-specific racial population.
k) Reference to all (hip, knee, other) arthroplasties.
l) Reference to all hip implant procedures.

Most data pertained to “hip implant units” without further specification as primary THR, partial hip replacement, or revision procedures. Numbers of hip implants were again combined with population figures from the OECD Health Data File 1999 to estimate crude implantation rates.

These manufacturers’ data were only included in this survey if they referred to the period 1997–99 and if at least data from two companies for one country were available.

National authorities in different countries and international orthopaedic companies do not always record the same data type. To demonstrate as much relevant information as possible, we present two end-point criteria: national THR rates and overall national hip implantation rates. The latter summarise THR, partial hip replacement, and hip revision procedures.

RESULTS

Country-specific primary THR rates

Review of the literature

Published crude annual primary THR rates for white people vary between 50/10^5 and 125/10^5 inhabitants (table 1). For the period since 1990 the annual THR rates were reported to be between 100 and 125 in Norway,14 Iceland,15 Sweden,24 and in the Netherlands,17 whereas for England,18 Australia,13 and the western part of Scotland14 the corresponding rate varied between 65 and 90. For some countries only earlier data were available. In the period 1988–90, the crude annual THR rate in Denmark was 82/10^5,26 in Finland 58/10^5,19 in Canada 50/10^5,25 and in Olmsted County (USA) 60/10^5.18 A study of ethnic groups within the cosmopolitan population of San Francisco (USA) showed large ethnic differences in the incidence of THR.27 THR rates for white subjects were two to 10 times higher than that of any other ethnic group (black, Hispanics, Asians). For the residents of Maryland (USA) the annual THR
Canada.

data in western/northern European countries and in

tions from England and the United States are consistent with

black to white ratio of 0.73.

and declines thereafter (web extra fig W2).

of white people increases steadily up to the age of 75–79 years

rates than the other ethnic groups. The age-specific THR rate

of all THR were performed because of OA.

Japanese men and women living in Hawaii, only 30% and 36%

portion was found for white people (66%), followed by black

cation for THR varies between ethnic groups. The highest pro-

groups of San Francisco the proportion of OA among the indi-

inhabitants were reported for Singapore. The reported THR

inhabitants. Markedly lower rates were registered in Ireland

1998 varied between 8 and 135/10

15 18 23 29

country the crude national (primary) THR rate in

30

country the annual THR rates are observable. Whereas in Norway

and Sweden, countries with a high THR rate in 1990, the annual

THR rate increased only slightly between 1990 and

Over the past decade differences in the development of the

next later year

Table 2 Annual primary THR rates/105 inhabitants: national health authorities data

<table>
<thead>
<tr>
<th>Country</th>
<th>1985 or the next later year</th>
<th>1990 or the next later year</th>
<th>1995 or the next later year</th>
<th>1998</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>61</td>
<td>74</td>
<td>88</td>
<td>90</td>
</tr>
<tr>
<td>Denmark</td>
<td>70</td>
<td>74</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>England</td>
<td>55</td>
<td>68</td>
<td>71</td>
<td>71</td>
</tr>
<tr>
<td>Finland</td>
<td>44</td>
<td>66</td>
<td>88</td>
<td>93</td>
</tr>
<tr>
<td>France</td>
<td>51</td>
<td>70</td>
<td>79</td>
<td>90</td>
</tr>
<tr>
<td>Hungary</td>
<td>51</td>
<td>70</td>
<td>79</td>
<td>90</td>
</tr>
<tr>
<td>Iceland</td>
<td>51</td>
<td>70</td>
<td>79</td>
<td>90</td>
</tr>
<tr>
<td>Ireland</td>
<td>95</td>
<td>114</td>
<td>117</td>
<td>121</td>
</tr>
<tr>
<td>Norway</td>
<td>47</td>
<td>74</td>
<td>81</td>
<td>81</td>
</tr>
<tr>
<td>Scotland</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Singapore</td>
<td>106</td>
<td>102</td>
<td>108</td>
<td>118</td>
</tr>
<tr>
<td>Sweden</td>
<td>51</td>
<td>53</td>
<td>53†</td>
<td>53†</td>
</tr>
<tr>
<td>United States</td>
<td>78</td>
<td>69</td>
<td>69</td>
<td>69</td>
</tr>
<tr>
<td>Wales</td>
<td>51</td>
<td>53</td>
<td>53†</td>
<td>53†</td>
</tr>
</tbody>
</table>

*1999; †1997.

a) The classification of surgical procedures has changed in 1988 and 1996.

b) OPCS4: W371, W381, W391

c) All patients admitted to NHS hospitals, including private patients treated in NHS hospitals.


f) ICD-9-CM: 81.51 (total hip replacement).

g) Coded as total hip replacement.

h) ICD-9: 8410+8414, ICD-10; NFB2+NFB3+NFB4.


j) Coded as total hip replacement.

k) ICD-9: 8410+8414, ICD-10; NF82+nFB3+nFB4.

Country-specific overall hip implantation rates

National health authorities data

For overall hip implantation, defined as THR, partial hip replacement, and hip revision procedures combined, the national authorities reported for 1998 crude rates between 27 and 192 operations per 105 inhabitants (web extra table W1). In accordance with the primary THR data the French rate was the highest with 192 hip implants/105 inhabitants, whereas in most other western and northern European countries 100–150 hip implant procedures/105 inhabitants were performed. Lower national hip replacement rates were reported from eastern European countries and from Portugal. With fewer than 30 hip implantations/105 subjects the inhabitants of Singapore and the pacific people of New Zealand had the lowest hip implantation rates. The large national differences in the ratio of total to partial hip replacement procedures are remarkable. In Hungary, for example, this ratio is reported to be 10:1, in Australia nearly 3:1, in England 2:1, in the United States of America slightly over 1:1, and in Singapore 1:2.5 (data not shown).

As the Norwegian data do not include the hemiprostheses and the Polish and the Portuguese data do not include the hip revision procedures, the reported implant numbers of these countries are likely to underestimate the hip replacement procedures actually performed.

National health authorities data

According to information obtained from the contacted national authorities the crude national (primary) THR rate in 1998 varied between 8 and 135/105 inhabitants (table 2). France and the Scandinavian countries reported a high rate of primary THR with more than 90 procedures per 105 inhabitants. Markedly lower rates were registered in Ireland with 51 primary THR/105 inhabitants and in the United States with 53 primary THR/105 inhabitants. Only eight THR/105 inhabitants were reported for Singapore. The reported THR rates from Hungary and Singapore do not permit a further differentiation between primary and revision arthroplasty procedures. Therefore, primary THR rates are likely to be slightly lower for these countries.

Over the past decade differences in the development of the national annual THR rates are observable. Whereas in Norway and Sweden, countries with a high THR rate in 1990, the annual primary THR rate increased only slightly between 1990 and 1998, the Scottish and Finnish rates which were low in 1990 increased by 70% and 40% during this period, respectively.

Table 3 Hip implantation rates according to information from hip implant manufacturers

<table>
<thead>
<tr>
<th>Country</th>
<th>Hip implants/105 inhabitants*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>164–172</td>
</tr>
<tr>
<td>Belgium</td>
<td>158–160</td>
</tr>
<tr>
<td>France</td>
<td>162–201</td>
</tr>
<tr>
<td>Germany</td>
<td>145–183</td>
</tr>
<tr>
<td>Italy</td>
<td>66–90</td>
</tr>
<tr>
<td>Japan</td>
<td>45–74</td>
</tr>
<tr>
<td>Netherlands</td>
<td>115–119</td>
</tr>
<tr>
<td>Norway</td>
<td>All 145–146</td>
</tr>
<tr>
<td>Spain</td>
<td>62–102</td>
</tr>
<tr>
<td>Sweden</td>
<td>113–145</td>
</tr>
<tr>
<td>Switzerland</td>
<td>200–206</td>
</tr>
<tr>
<td>UK</td>
<td>101–132</td>
</tr>
<tr>
<td>United States</td>
<td>75–109</td>
</tr>
</tbody>
</table>

*Range of estimates from four companies.
DISCUSSION

THR is a common orthopaedic procedure in the elderly. However, detailed epidemiological data on the frequency of hip replacement are rare. We therefore collected all available country-specific hip replacement data for the OECD countries using different data sources.

Rates of THR varied considerably between the contacted OECD countries with a predominantly white population. The crude national annual primary THR rates as reported by national authorities varied between 50 and 140 procedures/100,000 inhabitants. These data are consistent with publications based on hospital records or on administrative data sources. As most data come from Scandinavian or English-speaking countries, the variation of crude THR rates may even be greater between all of the OECD countries. The reported low hip implantation rates for Poland and Portugal, the very low Spanish and Portuguese hospital discharge rates with the diagnosis of OA, and the low numbers shown by manufacturer data for hip implantation procedures in Italy and Spain may be indications of relatively low THR rates in some eastern and southern European countries. High levels of hip implants indicated by several companies for Switzerland and Germany in combination with the high total expenditure on health per capita in these countries may indicate high primary THR rates.

White men and women have substantially higher THR rates than all other ethnic groups. The low THR rates of Asian people living in San Francisco and Hawaii are consistent with the reported low national THR rates of residents of Singapore and the low hip implantation rate of the pacific people of New Zealand, indicating different prevalence of OA in different ethnic groups. However, other factors such as different access to health care by ethnicity may also play a part.

Although we attempted to acquire comparable data from each country, this was not always possible, because of different types of documentation systems in national authorities, orthopaedic societies, and implant manufacturers. Other restrictions and uncertainties were the different national coding systems, the scarcity of information about procedures performed in the private healthcare sector, uncertainty about the quality of the data—namely, its completeness, comparability over time, etc. So even when comparing one single procedure—for example, primary THR, the compilation of comparative data within different countries is difficult.

Most national primary THR rates are based on different coding systems. The three digit ICD-9-CM code, which is used for example in the United States and in Ireland, allows differentiation of THR, partial hip replacement, and hip revision. The specification of the French coding system that is derived from the American DRG, or of the OPS4 code used in England, Scotland, and Wales is more detailed. Furthermore, no detailed information on hip revisions is available for Singapore and Hungary, so that the reported THR data of these countries probably include the revision procedures.

Additionally, the variety of information about procedures performed in the private healthcare sector influences national THR rates as well. Singapore with a central claims processing system, the Scandinavian countries with National Hip Arthroplasty Registries, and France with the recently installed Medical Information System include public as well as private hospitals in their statistics. However, for many other countries the completeness of the data has to be questioned. In England the Hospital Episode Statistics, which is the data source of the reported THR rates, covers all patients treated in hospitals of the National Health Service (NHS) and includes private insurance payment. However, in addition to the reported 32,800 primary THR performed in NHS hospitals about 11,000 THR procedures are carried out in the private sector. Similarly, the reported hip implantation data of Portugal and of New Zealand refer only to the National Service Hospitals without further information on the THR procedures performed in private institutions. Consequently, the true incidence of THR or of hip implantations is underestimated in these countries.

As the age-specific THR incidence steadily increases in white people with age from 50 up to 75–79 years and declines thereafter, age standardised incidence rates are needed for a direct comparison between populations in order to eliminate differences in country-specific age structures. OECD countries with a relatively young population—defined as <12% of the total population older than 65 years in 1997—are Iceland, Ireland, Poland, New Zealand, and Australia. OECD countries with a relatively “old” population—defined as >15% of the total population older than 65 years—are, for example, Sweden, the United Kingdom, France, and Norway. Ingvarsson et al demonstrated the implications of different population age structures by comparing Swedish and Icelandic THR rates.
the basis of crude incidence rates there seemed to be no difference between the two countries, but after age standardisation THR incidence was at least 50% higher in Iceland than in Sweden. In the present paper we were unfortunately unable to perform age standardisation, because the few age-specific THR data obtainable were based on different age strata. Comparisons between countries with different age structure should therefore be interpreted with caution.

Besides limitations in the completeness and the comparability of the data, differences in the economic structure may influence national hip replacement rates as well. In 1997 great differences in total expenditure on health per capita ($ purchasing power parity) were reported in OECD countries. Countries with low expenditure on health typically have low national hip implantation rates, whereas high expenditure on health does not always correlate with high hip implantation rates. Despite comparable high expenditure on health per capita and a similar population age structure in France and the Scandinavian countries, major differences in hip implantation rates per 100,000 inhabitants were seen between these countries. In comparison, despite the highest expenditure on health per capita in the USA, national hip implantation rates are surprisingly low, even considering the young age structure and the limitation of the data to the public sector.

Our results indicate major variation in hip replacement rates between developed countries which are unlikely to be explained solely by differences in OA rates, age structure, or health expenditure per capita, underlining the need for commonly agreed indication criteria.

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Additional figures and table can be seen on the web at www.annrheumdis.com

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