

**Bibliometric analysis of highly-cited publications
in bone disease in the UK, 1997 – 2003**

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1 Summary

- ..e This report provides bibliometric profiling of bone disease research in the UK. Bibliometrics is the analysis of research publications in terms of their numbers and the number of times they are cited by subsequent publications, where more frequent citation is a measure of significance.
- ..e The analyses cover research publications produced by all sectors of the research community including higher education institutions, companies, public sector organisations and charities over the seven-year period between 1997 and 2003. The publications were selected using specific word searches to identify research pertaining to bone disease but excluding osteoarthritis and rheumatoid arthritis. The bibliography was further subdivided to elicit analyses on bone cancer and osteoporosis research separately.
- ..e In total, the UK output of bone disease research articles and reviews during the period was just over of 3000 publications. Of this, the University of Sheffield published 229 papers (around 7.4%).
- ..e The University of Sheffield was the top producer of research publications in bone disease (and both subdivisions of osteoporosis and bone cancer) in the UK producing the same number of papers as University College London.
- ..e The University of Sheffield published more papers in the world's top 20% as a proportion of their total output than any other individual institution.
- ..e The Impact Profiles™ further illustrate the strength of bone disease overall, osteoporosis and bone cancer research at University of Sheffield compared to similar publications from the rest of the UK.

2 Introduction to bibliometric profiling to identify excellent research in bone disease in the UK

2.1 Background

This report has been commissioned by the Section of Musculoskeletal Science at the University of Sheffield Medical School to support and inform management about the status of bone disease research at the University of Sheffield.

These analyses were undertaken following a report to the Department of Health [1] to support decision making around selection of NIHR Biomedical Research Units in six research areas, one of which being Musculoskeletal Disease.

The research output of the UK in bone disease has been indexed by the volume of the papers published by its researchers. The impact of this research output can be indexed by the frequency with which subsequent research makes reference (or citations) to those papers. Citation impact is regarded as a proxy measure for the quality of research output or 'excellence'. Analysis of published paper and citation counts is termed 'bibliometrics'.

The report has focussed on research in bone disease selected using customised searching for words found in the titles,

keywords and abstracts of UK-based publications. This has been necessary because this research area is not covered effectively by journal categories, assigned by Thomson Scientific to bibliometric data, which are normally used for bibliometric analyses. This bibliography has covered all sectors of the research community including higher education institutions (HEIs), hospitals and NHS trusts, companies, public sector research organisations and charities.

'Excellent' papers (those belonging to the world's top 20% of cited papers with regard to the year of publication and field) were mapped to leading institutions. These analyses are comparable to those provided by Rand/CWTS [1]. The term 'excellent' has been defined so as to be comparable to that of 'HCP' (highly cited papers) [1].

In addition to the above comparison using relative percentages of 'excellent' papers, *Evidence* Ltd has used a bibliometric methodology (Impact Profiles™, [2]) which can identify the institutions where bone disease research is better than the average for the UK.

2.2 Data sources

Evidence Ltd holds or has access to publication data derived from the databases of Thomson Scientific® Inc (formerly ISI) in Philadelphia, USA. Thomson maintain the most complete international data on research journal publications and their citations. More highly-cited work is recognised as having a greater impact and high citation rates are correlated with other measures of research excellence.

The core data used by *Evidence* are the expanded Citation Indexes from which Thomson's Web of Science® is derived. The Web of Science® currently covers publications from approximately 8,700 of the most prestigious, high-impact research journals in the world.

These data refer only to journal articles and not to conference proceedings or to books and chapters in books.

The article records for this report have been taken from Thomson's UK National Citation Report (NCR) (2006). World average impact data has been sourced from the Thomson Scientific National Science Indicators 2006.

The NCR data have been processed to collate publications and citations and to reconcile address variants. Address reconciliation is necessary because authors tend to use many address variants for their employing institution. As a consequence, 'raw' Thomson data can often produce extremely misleading results for institutions

because the indicator addresses are collated electronically. For example, *Evidence* has increased the publication tally for the University of Oxford by over 40% compared to prior Thomson aggregations. This has been due to better analysis of college addresses and the identification of research groups that had not included the University name in their address information.

Bone disease bibliography

Research publications pertaining to bone disease, for the purposes of this report, have been identified using variants of the following terms:

- 'osteoporosis; Paget's disease; bone disease; bone cancer or oncology or myeloma; osteoclast; osteoprotegerin; osteogenesis

in the title, author-defined keywords or abstract of the publication.

The purpose of this *a priori* selection of publications was not to provide a definitive bibliography of bone disease publications but an improved one not reliant on Thomson assignment of journals to one or more categories. Thus, in these analyses papers from the general medical journals have not been excluded.

To avoid double-counting when processing bibliometric data at institutional level, each publication is assigned to each

institution/cluster only once, regardless of the number of authors at that institution.

The bibliometric analyses were also performed on two subsets of the bone disease bibliography:

- osteoporosis and;
- bone cancer or oncology or myeloma

Excellent research publications

For the purpose of this report, 'excellent' papers have been defined as those articles and reviews which belong to the world's top 20% of most cited papers.

This corresponds to the percentile in which the paper ranks in its field and year, based on total citations (to end-2006) to the paper. The papers with the most citations will have the smallest percentile number. The minimum value is 100, indicating no cites received. Only publication types articles, notes, and reviews are used to determine the percentile distribution.

Impact Profiles™

Impact Profile™ methodology [2] has been used to calculate the number of highly-cited papers ($RBI \geq 4.0$, that is publications that were cited four or more times than the world average for the subject and year) for the University of Sheffield in bone disease research and this was compared to the UK (excluding Sheffield) bone disease Impact Profile™.

3 Bibliometric analyses

3.1 Publication output

The **total number** of articles and reviews for the period was collated as a count of unique publications for individual organisations (including HEIs, hospitals, charities and industry).

Publication output by institution in all bone disease

UK publication output in all bone disease (as defined by the terms above) from January 1997 through December 2003 was around 3100 substantive journal articles and reviews.

The three main institutions for research in bone disease are the University of

Sheffield, University College London and Imperial College London, which together publish just over 20% of research in this area.

All institutions publishing more than 100 papers in bone disease research were HEIs except for Guys Hospital whose research is often associated with Kings College London. Institutions publishing between 50 and 100 papers were evenly split between hospitals and HEIs. This group includes the Northern General Hospital whose research may be in collaboration with the University of Sheffield.

Institutions with ≥ 100 papers	Publication output	Institutions with ≥ 50 papers	Publication output
University of Sheffield	229	University of Bristol	82
University College London	229	St Georges, University of London	81
Imperial College London	194	Addenbrookes Hospital	77
University of Manchester	172	Royal Marsden Hospital	76
University of Cambridge	156	Nottingham City Hospital	74
University of Aberdeen	154	St Thomas' Hospital	70
Kings College London	148	Nuffield Orthopaedic Centre	62
University of Oxford	140	Newcastle University	59
Guys Hospital	105	Queen Mary, University of London	58
		Christie Hospital	56
		University of Birmingham	52
		University of Liverpool	52
		Northern General Hospital	51

Publication output by institution in osteoporosis

UK publication output in osteoporosis research (as defined above) from January 1997 through December 2003 was around 1400 substantive journal articles and reviews.

The University of Sheffield publishes significantly more papers in osteoporosis

research than any other institution in England.

Most institutions publishing in this area are either HEIs or hospitals but amongst the organisations who have published more than 20 articles/reviews are one company and a Research Council-funded institute.

Institutions with ≥ 50 papers	Publication output	Institutions with ≥ 20 papers	Publication output
University of Sheffield	150	Northern General Hospital	48
University of Manchester	98	Addenbrookes Hospital	40
University of Cambridge	96	Hull Royal Infirmary	32
University of Aberdeen	93	University of Oxford	32
Kings College London	70	University of York	32
Guys Hospital	66	Southampton General Hospital	29
Imperial College London	58	University of Bristol	28
University College London	58	Procter & Gamble	27
Nottingham City Hospital	54	Queens Medical Centre	26
St Thomas' Hospital	52	University of Birmingham	26
University of Southampton	52	Freeman Road Hospital	24
		St Georges, University of London	23
		MRC Dunn Human Nutrition Unit	21
		Newcastle University	21

Publication output by institution in bone cancer

UK publication output in bone cancer research (as defined above) from January 1997 through December 2003 was around 700 substantive journal articles and reviews.

The University of Sheffield has published more papers in bone cancer research than Imperial College London or than the two specialist cancer hospitals in England – the Royal Marsden and the Christie.

Institutions with ≥ 25 papers	Publication output	Institutions with ≥ 12 papers	Publication output
University of Sheffield	50	University of Aberdeen	24
Royal Marsden Hospital	45	University of Manchester	24
Imperial College London	42	University of Oxford	23
Christie Hospital	41	St Georges, University of London	21
University College London	37	Withington Hospital	20
Weston Park Hospital	36	Guys Hospital	20
University of Cambridge	30	Addenbrookes Hospital	19
Kings College London	27	Institute of Cancer Research	19
University of Bristol	25	University of Leeds	17
		Queen Mary, University of London	16
		University of Glasgow	15

3.2 Publication impact

Impact is calculated for any given dataset or bibliography by dividing observed citations by the sum of papers in the dataset. This can be done for papers within a specific research area such as bone disease or for a specific institution.

Citation impact is inevitably lower in the more recent years of any time period as papers have less time to accumulate citations. It also varies by field. We therefore need to take account of both the age of a paper and the field in which it is published to establish whether it is of high quality relative to comparable material. We do this by rebasing (or normalising) a specific citation count against the relevant world average.

Rebased impact (RBI) is impact normalised to the world average. For example, rebased impact of a publication in a given research field is the citation impact of that publication divided by the average impact for world publications in that research field. Citations from journal articles, notes and reviews but not meeting abstracts, are used to calculate rebased impact figures.

Figure 1

Excellent research, for the purposes of this report, refers to papers that fall among the world's 20% most cited papers in that year and field. The index in Figure 1 is the number of such papers published by a specific institution (denoted as I-20%) compared to the total number of such papers published anywhere in the UK. The index is calculated as $[I-20\%/UK-20\%*100]$. The data analysed here describe publications in bone disease as defined in section 2.2.

In Figure 1 the HEIs are represented by red bars, hospitals and NHS trusts by green bars, industry by pale blue bars, public

sector bodies by dark blue bars and medical charity by orange bars (only individual institutions with more than 1% of UK 'excellent' papers are shown).

- (a) **All bone disease**: The University of Sheffield has published more than 10% of the UK's 'excellent' research in bone disease. This is almost half of Sheffield's total output in this area. University College London, with the same total output in bone disease, had a much lower percentage of 'excellent' papers.
- (b) **Osteoporosis**: More than 15% of the UK's 'excellent' publications in osteoporosis have been published by the University of Sheffield.
- (c) **Bone cancer**: Again, the University of Sheffield has published more than 10% of the UK's 'excellent' research with Weston Park Hospital also recognised in this subject. Around one third of Sheffield's total output was 'excellent'.

Figure 2

Impact Profile™ methodology [2] has been used to compare the research output in bone disease for the University of Sheffield with that of the UK (excluding the Sheffield).

In Figure 2 the data for the cited categories in the Impact Profiles™ have been smoothed to highlight the differences between the citedness, or impact, of research from the University of Sheffield cluster and that from the rest of the UK.

The profiles show that research in bone disease from the University of Sheffield has been cited relatively more frequently, and thus has a greater impact on average, than similar publications from the rest of the UK.

Figure 1a: Excellent research in all bone disease in the UK

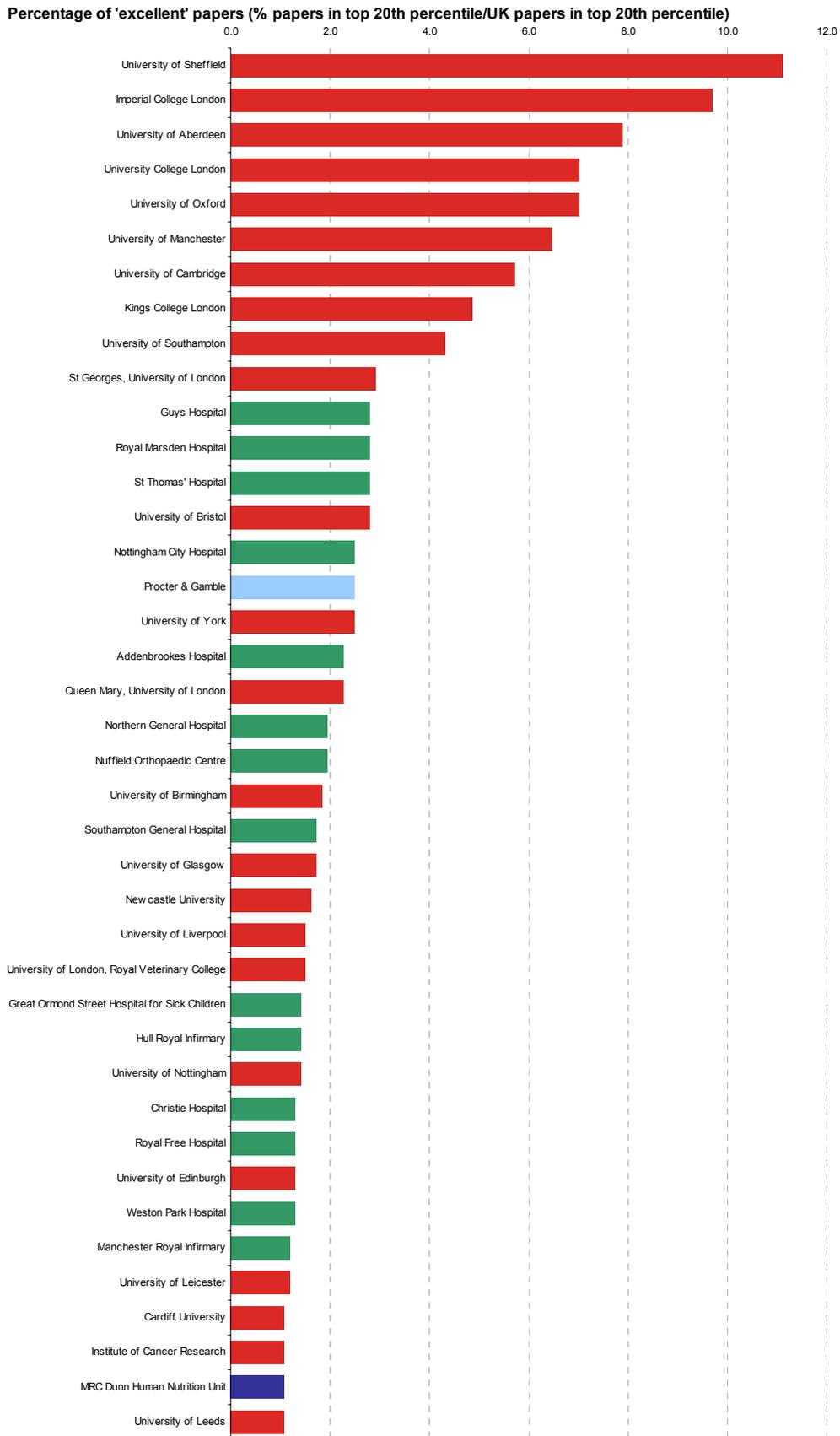


Figure 1b: Excellent research in osteoporosis in the UK

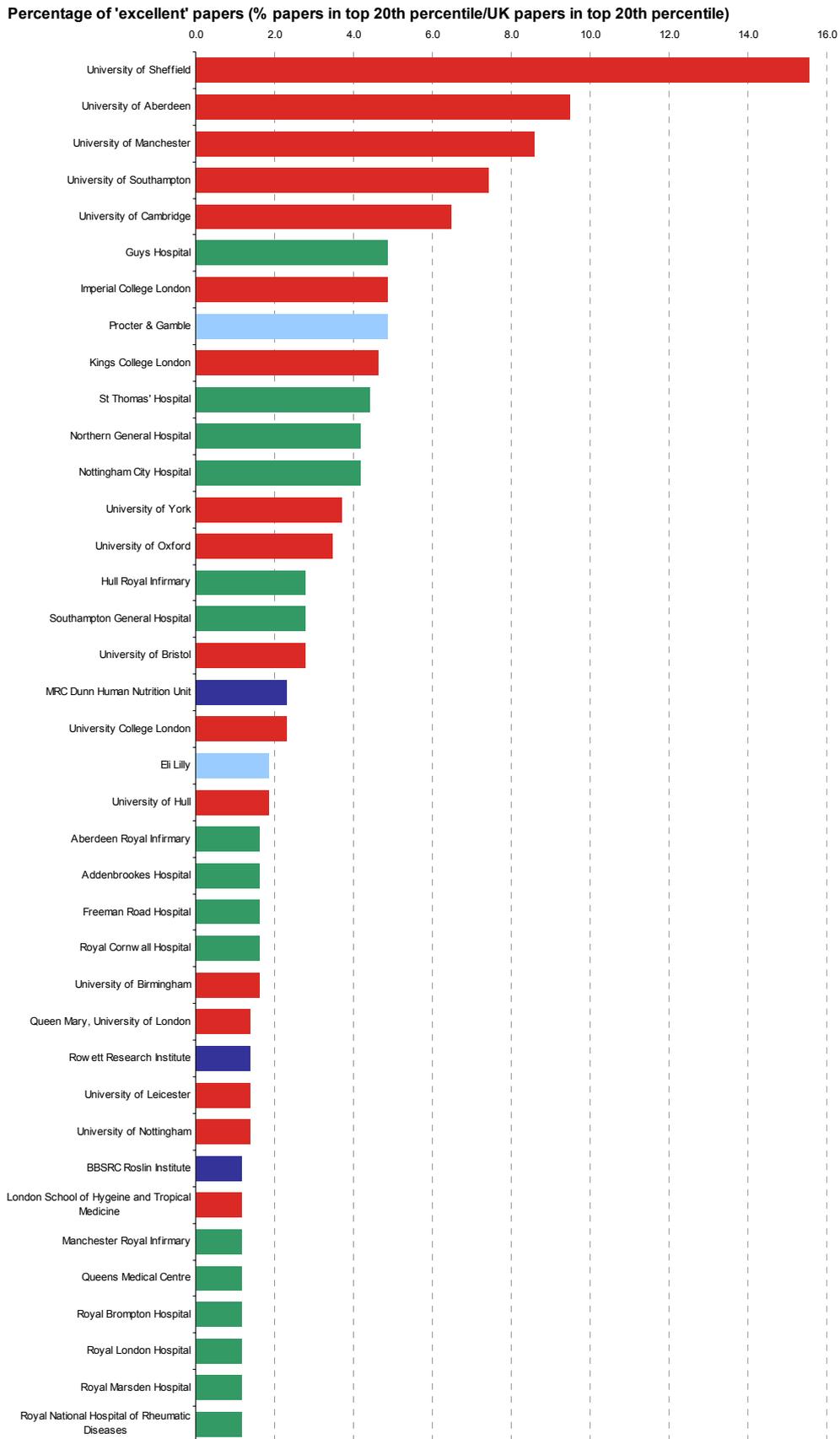
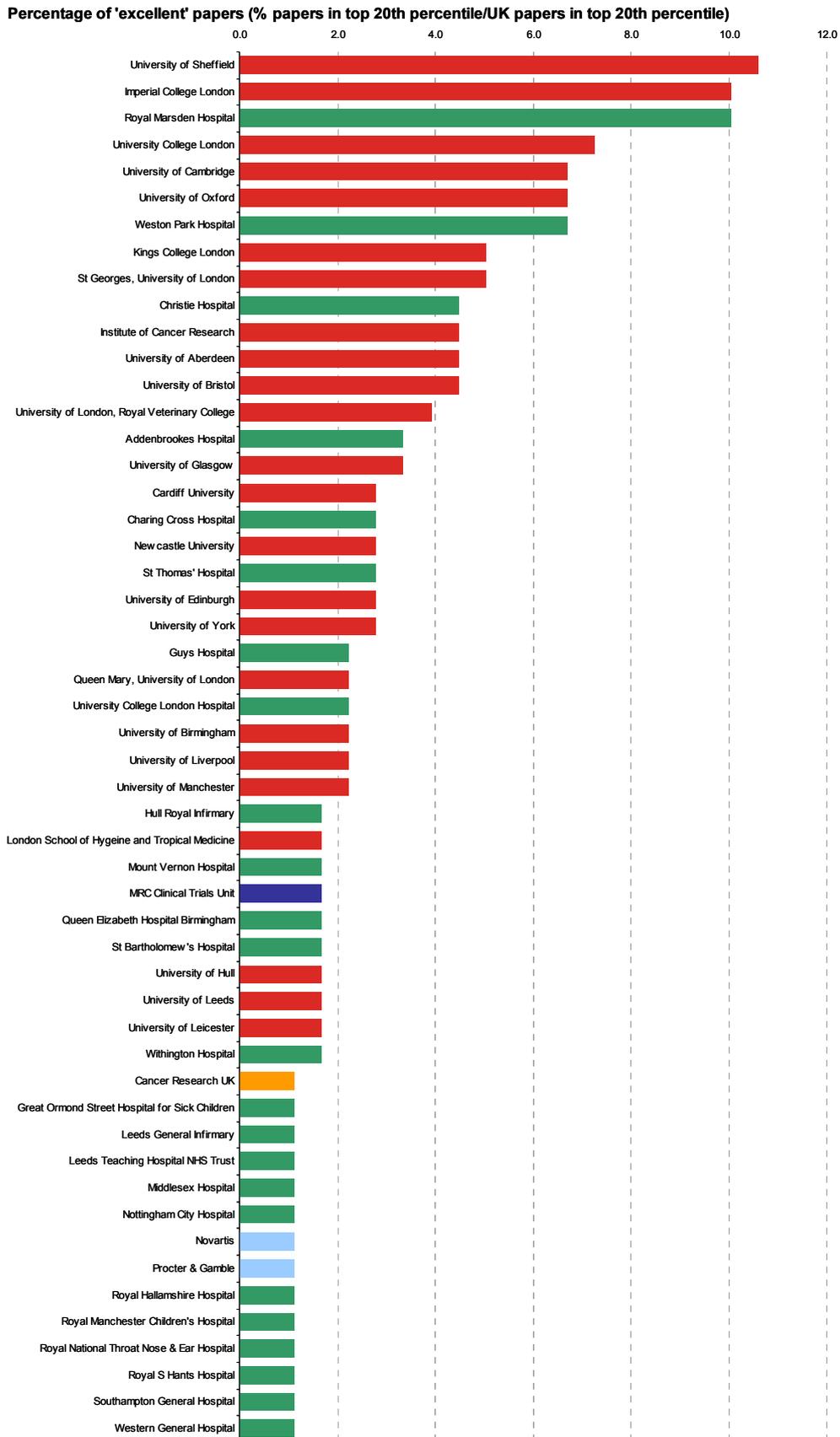


Figure 1c: Excellent research in bone cancer in the UK



3.3 **Impact Profiles™ of bone disease research**

Impact Profiles™ enable an examination and analysis of the balance of published outputs relative to world average and relative to a reference profile. This provides much more information about the basis and structure of research performance than conventionally reported averages in citation indices.

The Impact Profile™ shows what proportion of papers are uncited and what proportion are in each of eight categories of relative citation rates, normalised (rebased) to world average (which becomes 1.0 in this graph). Rebased citation rates above 1.0 indicate papers cited more often than world average for the field in which that journal is categorised and in their year of publication.

Attention should be paid to:

- The proportion of uncited papers on the left of the chart
- The proportion of cited papers either side of world average (1.0)
- The location of the most common (modal) group near the centre
- The proportion of papers in the most highly-cited categories to the right.

What are uncited papers?

It may be a surprise that some journal articles are never subsequently cited after publication, even by their authors. This accounts for about half the total global output and almost one quarter of UK output. We cannot tell why papers are not cited. It is likely that a significant proportion of papers remain uncited because they are reporting negative results which are an essential matter of record in their field but make the content less likely to be referenced in other papers. Inevitably, other papers are uncited because their content is trivial or marginal to the mainstream or plain wrong. It should not be

assumed that this is the case for all such papers.

There is variation in non-citation between countries and between fields. On the whole, engineering papers tend to remain uncited more often than papers in other sciences, indicative of a disciplinary factor as well as a quality/significance factor. There is also an obvious increase in the likelihood of citation over time but most papers that are going to be cited will be cited within a few years of publication.

We work on the assumption that relative non-citation rates within a field are one of the indicators of the extent to which a body of work is regarded by others in the same field to be of greater or lesser significance to their subsequent work.

What is the threshold for 'highly cited'?

Thomson Scientific has traditionally used the term 'Highly Cited Paper' to refer to the world's 1% of most frequently cited papers, taking into account year of publication and field. In rough terms, UK papers cited more than 8 times as often as relevant world average would fall into the Thomson Highly Cited category. About 1-2% of papers (all papers, cited or uncited) typically pass this hurdle. Such a threshold certainly delimits exceptional papers for international comparisons but, in practice, is an onerous marker for more general management purposes.

After reviewing the outcomes of a number of analyses, we have chosen a more relaxed definition for our descriptive and analytical work. We deem papers that are cited more often than 4 times the relevant world average to be relatively highly-cited for national comparisons. This covers the two most highly-cited categories in our graphical analyses. About 5% of total UK papers typically pass this hurdle.

Figure 2a: Impact Profile™ of all bone disease research in the UK

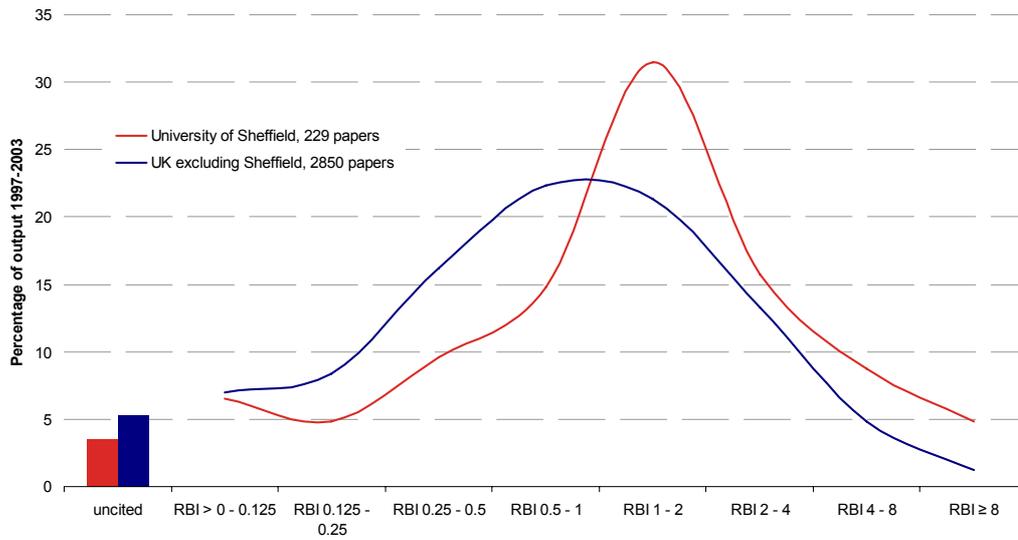


Figure 2b: Impact Profile™ of osteoporosis research in the UK

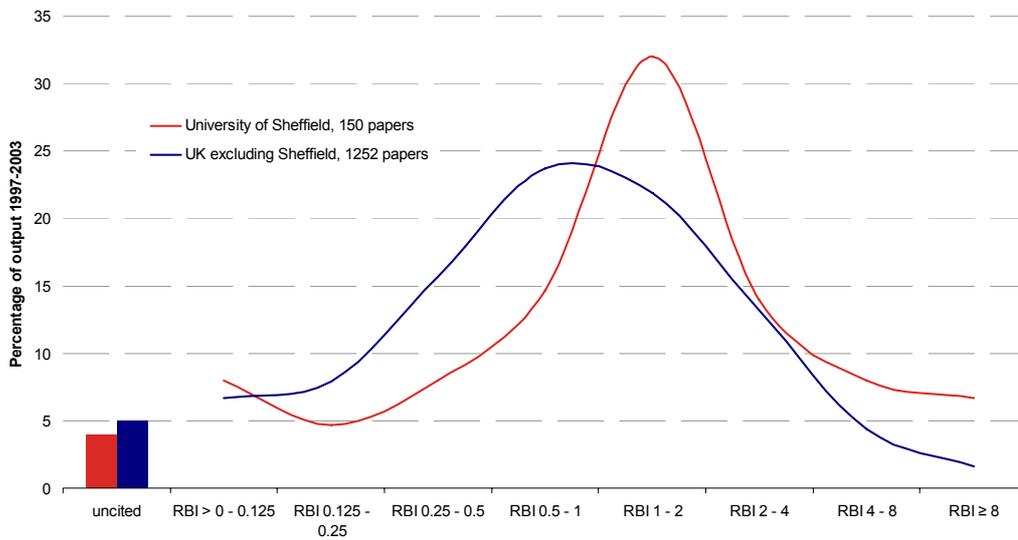
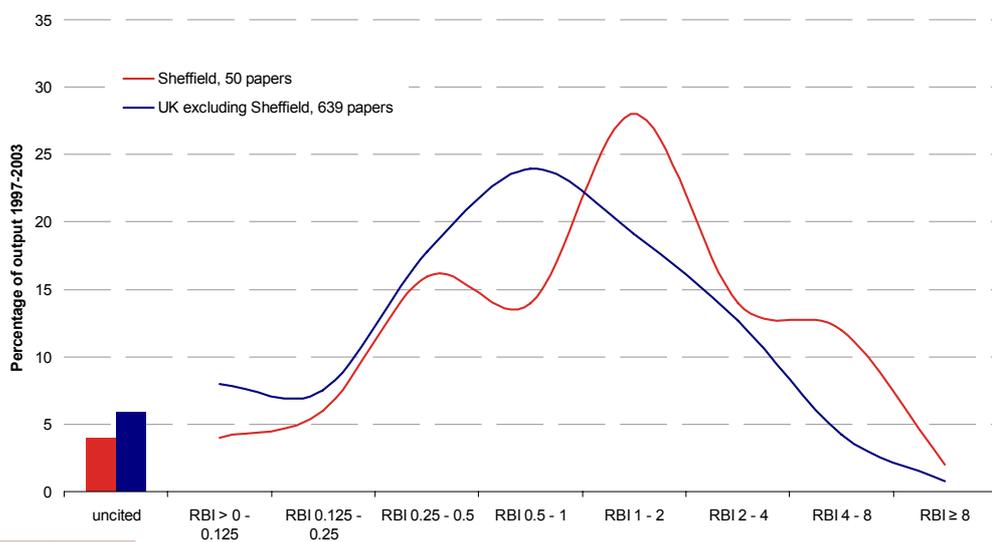


Figure 2c: Impact Profile™ of bone cancer research in the UK



- Research in bone disease by the University of Sheffield is excellent compared to the rest of the UK. Some 13.5% papers are highly-cited and there is a much greater relative percentage of extremely highly-cited papers (RBI \geq 8).
- The modal group for cited papers is above world average (1.0) at RBI 1–2. The proportion of cited papers above the world average (1.0) is 60.7% (UK = 40.7%).
- The University of Sheffield has relatively more papers cited above world average and relatively fewer papers cited below world average than the rest of the UK.
- In all impact categories above world average (to the right of the figure), publications from the University of Sheffield perform better than the rest of the UK, indicating that bone disease research from Sheffield is more frequently cited than publications from the rest of the UK.
- In all impact categories below world average (to the left of the figure) the University of Sheffield has a lower percentage of papers than the rest of the UK. Authors associated with the University of Sheffield have a slightly lower percentage of uncited papers as other UK research in this area (3.5% compared with 5.3%).
- These bibliometric indicators are consistent for both subsets of bone disease research – osteoporosis and bone cancer.

References

- [1] Rand working paper (July 2007) Bibliometric analysis of highly cited publications of health research in England, 1997 – 2003
- [2] Adams J, Gurney K & Marshall S (2007) Profiling citation impact: A new methodology *Scientometrics* **72**: 325-344