



EUROPE

Bibliometric Analysis of Mental Health Research

1980–2008

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Preface

This report presents the findings of a bibliometric study of mental health research papers published from 1980 to 2008. This work has been funded as part of The Science of Science for Mental Health Research Network (SOS for Mental Health), an initiative founded by the Graham Boeckh Foundation in collaboration with RAND Europe.

The aim of this study was to map mental health research in the G20 and other leading countries in order to analyse i) the research productivity of nations; ii) the relative intensity of research; iii) the level of research (clinical or basic); iv) levels of scientific impact; and v) levels of collaboration. The work presented in this paper is the result of a collaboration between Observatoire des sciences et des technologies in Montreal and RAND Europe.

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Summary

This paper describes a bibliometric analysis of mental health research publications between 1980 and 2008. Over 350,000 papers on mental health research from 20 countries, accounting for over 95% of research output, were identified in the Thomson Reuters Web of Science. The bibliometric characteristics of these papers were analysed, which led to a set of ten key observations:

1. The volume of mental health research publication output is growing faster than that in biomedicine or science as a whole.
2. There is a convergence in the volume of mental health research publication output between the US and Europe, with the recent emergence of mental health research publication output in the BRIC countries.
3. Smaller countries such as Sweden, Israel, The Netherlands and Finland are the most productive in terms of number of publications per capita.
4. Countries with greater specialisation in mental health research, such as the US, the UK, Canada and The Netherlands, generally have higher scientific impact.
5. Spain, France, South Korea, Japan and Turkey obtain fewer citations than the world average for mental health publications and publish fewer mental health publications than one would expect, given the volume of their overall publication output.
6. Over the last 25 years, we observe a tendency towards publishing more basic research outputs in mental health. The only exception to this is The Netherlands.
7. Mental health research publications are increasingly the result of international collaboration. While 3% of all mental health papers published in 1980 was the result of an international collaboration, that percentage was 20% in 2008.
8. Countries/regions with a relatively large volume of research output – such as the US, the EU and Japan – tend to obtain relatively low international collaboration rates. This is not surprising as it is more difficult for researchers from a bigger country to find collaborators outside their borders.
9. The strongest bilateral relationship in mental health research is between Canada and the US, followed by the UK and the US, Germany and the US, and Italy and the US.
10. We observe a strong growth of research on autism, anxiety, bipolar disorders, hyperactivity, memory, schizophrenia, sleep and stress since the early 1980s.

The analysis provides trend and benchmark data on mental health research that will be updated on a regular basis. By their very nature these conclusions are descriptive, and do not (and cannot) explain why trends have occurred. That said, we may infer a number of emergent policy observations that warrant further and subsequent investigation. These include the following:

1. The performance of national mental health research systems varies. There is an apparent correlation with the size of the country; it seems that countries that are small, specialised or both have a relatively high citation impact. Large countries that do not specialise have a lower impact.
2. The rise of mental health research seems to be due to funding. There is a disproportionate increase in mental health research publications compared to all biomedical science. Though it is notoriously difficult to estimate the amount of funding going into different fields of biomedical science, research productivity (e.g. cost per paper) has not radically changed in either the US or the UK over the periods assessed, suggesting that funding is the major driver of publication increase.

3. Is mental health research lost in translation?

One of the frequent observations made about mental health research is that it has failed to be effectively translated from bench to bedside. Over the period analysed the output of basic

research increased at a faster rate than that of clinical research. The question that remains unanswered is whether the mental health translation gap is due to funding policies or lack of scientific tractability.

List of acronyms

ARC	average of relative citations
BRIC	Brazil, Russia, India and China
INMHA	Institute of Neurosciences, Mental Health and Addiction
MeSH	US National Library of Medicine Medical Subject Headings
NIMH	National Institute of Mental Health
NSF	National Science Foundation
OST	Observatoire des sciences et des technologies
RCT	randomised controlled trials
RII	Relative Intensity Index
RRL	relative research level
SCI Expanded	Science Citation Index Expanded
SOS for Mental Health	The Science of Science for Mental Health Research Network
WoS	Thomson Reuters' Web of Science

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The authors would like to thank The Science of Science for Mental Health Research Network (SOS for Mental Health) and the Graham Boeckh Foundation for supporting this project. The authors also thank the Institute of Neurosciences, Mental Health and Addiction (INMHA) of the Canadian Institutes of Health Research and the Graham Boeckh Foundation for their financial contributions to this research.

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Introduction

This paper describes a bibliometric analysis of mental health research publications between 1980 and 2008. Bibliometrics is the quantitative analysis of scientific publications and their citation, typically focusing on journal papers in the peer review literature. It is one of a set of evaluation methodologies – including case study analyses, peer review, economic rate-of-return analyses, surveys and consultations – that may be used to help assess the impact of research (Ismail *et al.*, 2009). This analysis was commissioned by SOS for Mental Health.

SOS for Mental Health is a network that has been established by the Graham Boeckh Foundation and RAND Europe to convene funders of mental health research in Canada, the UK, the US and elsewhere, along with mental health scientists and practitioners, and policy researchers interested in the science of science. The founding rationale for the network is the observation that a major and recurring challenge facing those involved in science and science policy is how best to spend research funding. This issue is especially challenging in fields with great diversity of science and opinion, such as mental health.

The network will identify and support a portfolio of policy research that aims to lead to improvements in the effectiveness and efficiency of research funding. The analysis described in this paper is one of the first outputs of the network. The aim of this study is to provide trend and benchmark data on mental health research activity and impact for the top 20 countries worldwide between 1980 and 2008. These 20 countries account for over 95% of all papers published.

This paper is divided into three sections. In Section 1, we describe how we identified mental health research papers and the key bibliometric indicators we used. In Section 2 we present the key results from our analysis before, in Section 3, drawing out our main observations and conclusions. In the appendices we provide details of our search strategy and the raw data for some of our analyses.

It should be noted that we envisage updating this paper on a regular (quinquennial) basis, and therefore we would be very interested in ideas or comments for subsequent analysis.

Chapter 1 Methods

Database

The bibliometric data presented here are drawn from the Thomson Reuters' Web of Science (WoS) built by the Observatoire des sciences et des technologies (OST).¹ The WoS includes three databases – the Science Citation Index Expanded™ (SCI Expanded), the Social Sciences Citation Index™ and the Arts & Humanities Citation Index™ – covering, in 2008, more than 10,500 journals in all disciplines of knowledge. These databases do not include all documents likely to have been published by researchers in any research area since some works (e.g. highly specialised journals, national journals, research reports and conference proceedings not published in journals) are disseminated through other scientific media not indexed by the WoS. What these statistics do measure, however, is the share of researchers' scientific output that is most visible for worldwide scientific communities and therefore that which is most likely to be cited. Although the WoS database includes several types of documents, only articles, research notes and review papers are typically selected in producing bibliometric studies since these are generally accepted as the main instruments for communicating original research (Carpenter and Narin, 1980; Moed, 1996).

Retrieval of papers

One of the key challenges in any bibliometric analysis is defining and identifying the field for investigation – in this case, mental health research. This may be done in three different ways: i) grouping relevant journals (such as *Schizophrenia Bulletin*, *Neuroscience*) and examining all papers in those

journals; ii) relying on keywords in the title and/or abstract of the paper; and/or iii) through other keyword classification systems. Given the broad nature of mental health research – stretching from neurogenetics through to the effectiveness of social interventions such as supported employment – we combined three strategies:

- **Key journals:** OST's database uses two distinct disciplinary classifications. The first is the journal subject categories developed by Thomson Reuters and used in the WoS. The second is the field and subfields classification developed by the firm CHI Research (Hamilton, 2003) and used by the National Science Foundation (NSF) in the US.² We selected all papers published in the 105 journals to which either CHI Research or Thomson Reuters assigned the 'Psychiatry' classification (as listed in Appendices A–C).
- **Keywords:** The US National Library of Medicine Medical Subject Headings (MeSH) uses a controlled vocabulary to assign a medical domain to each paper indexed in the PubMed database.³ Three MeSH headings that best describe mental health research were chosen by representatives from INMHA, part of the Canadian Institutes of Health Research: *Mental Disorders* (excluding Substance-related Disorders), *Mental Health Services* and *Mental Health*. By using MeSH headings we also pick up papers published in multidisciplinary journals. These three MeSH headings retrieved in PubMed, as of March 2010, 473,454 papers published between 1980 and 2008. Of these papers, 352,093 were recalled in the WoS

¹ <http://www.ost.uqam.ca/>

² <http://www.nsf.gov/statistics/seind06/>

³ <http://www.ncbi.nlm.nih.gov/pubmed>

using their author name(s), volume number, issue number and pages. Unmatched papers were mostly published in journals that are not indexed by Thomson Reuters and were excluded from our analysis.

- **Additional core journals:** Given that the match between the WoS papers and PubMed papers was not perfect, and mental health related papers may not always have a proper MeSH attributed, it was decided to complement papers to which MeSH headings were assigned with papers published in core mental health journals that were not indexed by CHI or Thomson Reuters but where 75% of the papers had a mental health MeSH term. This resulted in the identification of an additional 18 journals (listed in Appendix D).

In total, 366,322 mental health papers were retrieved between 1980 and 2008, of which 307,451 had been retrieved using MeSH headings and 165,220 using the lists of journals. The overlap between the two methods contained 106,349 papers, which means that an important proportion of papers (55%, $N=201,102$) consist of MeSH-retrieved papers published outside core psychiatry journals, as illustrated in Figure 1.1 below.

Similarly, a large proportion of papers published in core journals (36%) did not have any of the three MeSH headings assigned. This clearly shows the importance of using both core journals and MeSH headings to retrieve papers in the area. Finally, using PubMed's document types, we also retrieved meta-analysis, clinical guidelines and

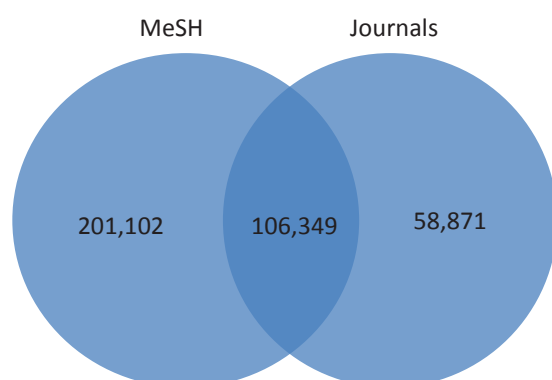
randomised controlled trials (RCTs) indexed in the WoS between 1989 and 2008. These types of documents allow us to assess the contribution of countries in terms of more 'clinical' types of documents related to mental health, as well as to measure whether countries' mental health papers are cited in these specific document types.

Indicators

We used the following bibliometric indicators in our analysis:

- **Number of papers:** This is the number of scientific papers with authors from a given country, as found in authors' addresses appearing on scientific papers. Papers are attributed using the 'full' counting method, which means that each country appearing on a paper gets one 'contribution'. In other words, if there are three authors from the US and one author from the UK, both the US and UK get a publication count of one.
- **Average of relative citations (ARC):** This indicator is based on the number of citations received by papers during a four-year citation window (including the publication year). Hence, for papers published in 2000 citations are counted until the end of 2003. Papers published in 2006, 2007 and 2008 thus have an incomplete citation window. The number of citations received by each paper is normalised by the average number of citations received by all mental health papers of the same publication year and subfield, hence taking into account the fact that citation practices are different for each specialty. When the ARC is greater than 1, it means that a paper or a group of papers scores better than the world average for its research area; when it is below 1, those publications are not cited as often as the world average for the research area.
- **Relative Intensity Index (RII):** This is an indicator of the relative intensity of publication of a given country by mental health research area or document type (e.g. meta-analysis) relative to the intensity of the world in the same domain or document type. An RII value above 1 means that a given group of researchers publishes more in the domain (or is more active in publishing a certain document type) compared

Figure 1.1
Conceptual illustration of search strategy results



to the world average, while an index value below 1 means the opposite.

- **Percentage of international collaboration:** This is an indicator of the relative intensity of scientific collaboration between countries. The rate is calculated by dividing the number of papers with at least one author with a foreign country address by the country's total number of papers.
- **Research level:** Assigned to each journal by CHI Research (Hamilton, 2003), based on the type of medical research it publishes. It has four levels: i) clinical observation (e.g. *Schizophrenia Bulletin*); ii) clinical mix (e.g. *Journal of Psychiatric Research*); iii) clinical investigation (e.g. *Neuropsychopharmacology*, *Journal of Clinical Investigation*); and iv) basic biomedical research (e.g. *Neuroscience*).

Chapter 2 Results

Number of papers

Figure 2.1A presents the evolution of mental health papers published worldwide since 1980, as well as the percentage that these papers account for among medical papers as well as among papers published for all disciplines combined. It shows that, in absolute numbers, the volume of mental health publication output grew four-fold over the period studied; from 5,810 in 1980 to 23,539 in 2007.⁴ Given that the number of papers published in other science and biomedical research areas also increased, the relative increase in mental health papers is lower. The share of mental health publications in the total medical publication output increased by 87% (from 2.9% in 1980 to 5.3% in 2008), while its share among papers published for all (science) disciplines combined increased by 78% (from 1.3% in 1980 to 2.3% in 2008). On the whole, this shows that mental health research is growing faster than the medical disciplines altogether and science as a whole.

Countries' proportion of the mental health output has also changed considerably over the period studied (Figure 2.1B; Figure 2.2). The US's proportion of the world output dropped from about 60% in 1980 to 45% in 2008, while the EU increased its share from 27% to 40% in 2007–2008. Taken together, Brazil, Russia, India and China (the BRIC countries) also increased their proportion of world mental health papers – from 0.7% in 1980 to 7.1% in 2008 – thanks mainly to significant increases by Brazil and China. In other words, there is a convergence of mental health research output between the US and Europe, and the emergence of the BRIC countries.

Although the UK's scientific output increased from 10% in 1980 to 12% in the mid-1990s, it has remained stable at this percentage since then. Germany's share increased from 6% in the early 1980s to about 8% at the end of the period, while the output of Canadian researchers is roughly at the same level today as it was in the early 1980s – mainly because of an important drop in research output in the mid-1990s.⁵ On the other hand, Australia, The Netherlands and Italy significantly increased their participation in the worldwide mental health research effort, while France's research output remained relatively stable. After increasing from 1980 to the early 2000s, Japan's output decreased steadily thereafter.

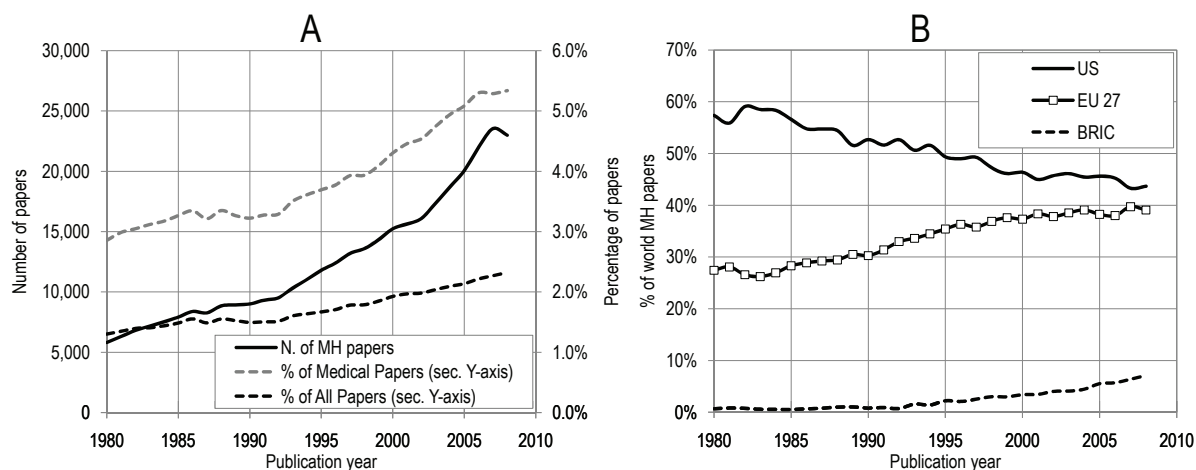
When the output of countries is weighted by their population, a distinct pattern is observed. Smaller countries such as Sweden, Israel, The Netherlands, Switzerland and Finland are the most productive, with more than 30 mental health papers per 100,000 inhabitants, as illustrated in Figure 2.3. This is a finding that was also observed in other areas of medical research (see, among others, Academy of Finland and Swedish Research Council, 2009; Kondilis *et al.*, 2008; Swaminathan *et al.*, 2007). Australia, Canada and the UK produce between 25 and 30 mental health papers per 100,000 inhabitants, while US researchers contributed to 15–20 mental health papers per 100,000 inhabitants. Germany is the only country with a mental health research output between 10 and 15 papers per 100,000 inhabitants, while the EU as a whole, Italy, Spain and France's outputs are between 5 and 10 papers per 100,000

⁴ Data for 2008 are preliminary – about 10% of the dataset is missing – which is why we observe a decrease in number of papers.

⁵ This drop is also observed for all disciplines combined (see Figure 2.1).
http://www.ost.uqam.ca/LinkClick.aspx?link=docs%2fnote%2fOST_Note20_ang.pdf

Figure 2.1

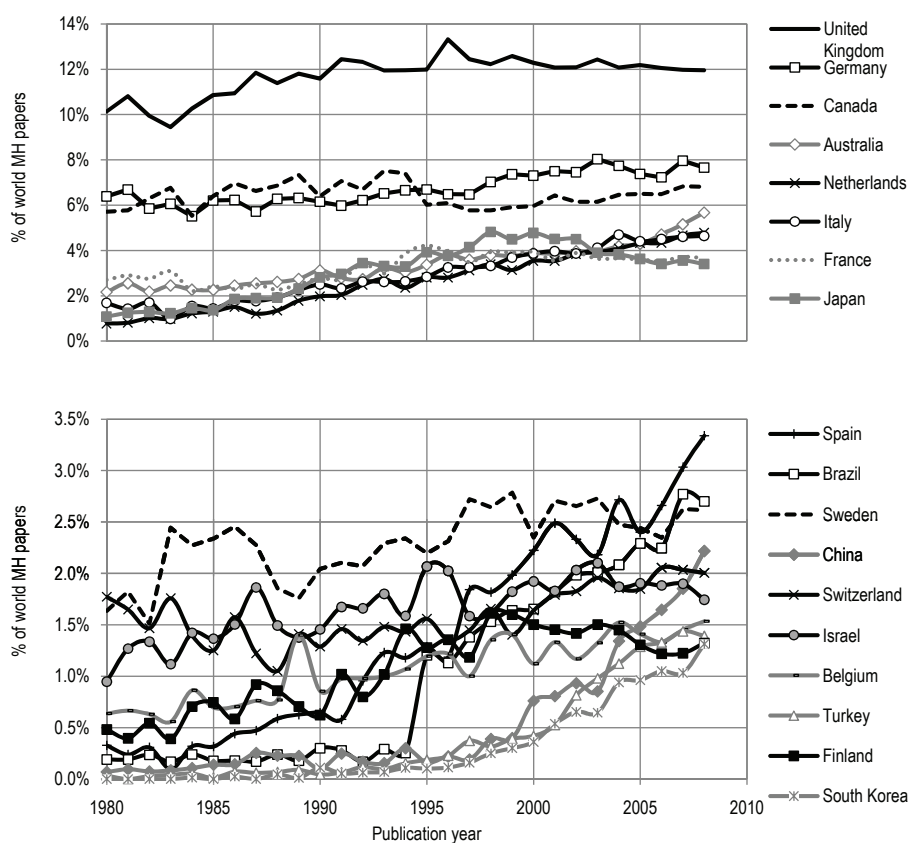
A) Number of mental health papers, 1980–2008, and mental health papers as a percentage of all papers and of all medical papers; B) Percentage of world mental health papers for the US, EU 27 and BRIC countries



SOURCE: Observatoire des sciences et des technologies (OST) Web of Science (WoS) database

Figure 2.2

Percentage of world's mental health papers, by country, 1980–2008



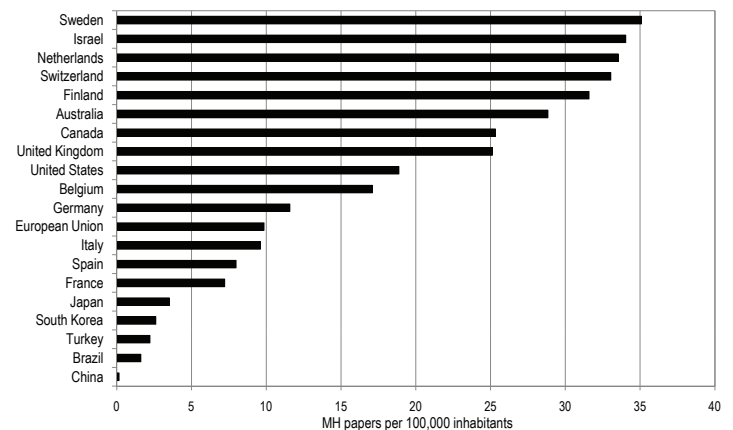
SOURCE: Observatoire des sciences et des technologies (OST) Web of Science (WoS) database

inhabitants. Finally, Japan, South Korea, Turkey, Brazil and China publish fewer than 5 papers per 100,000 inhabitants.

Research impact and intensity

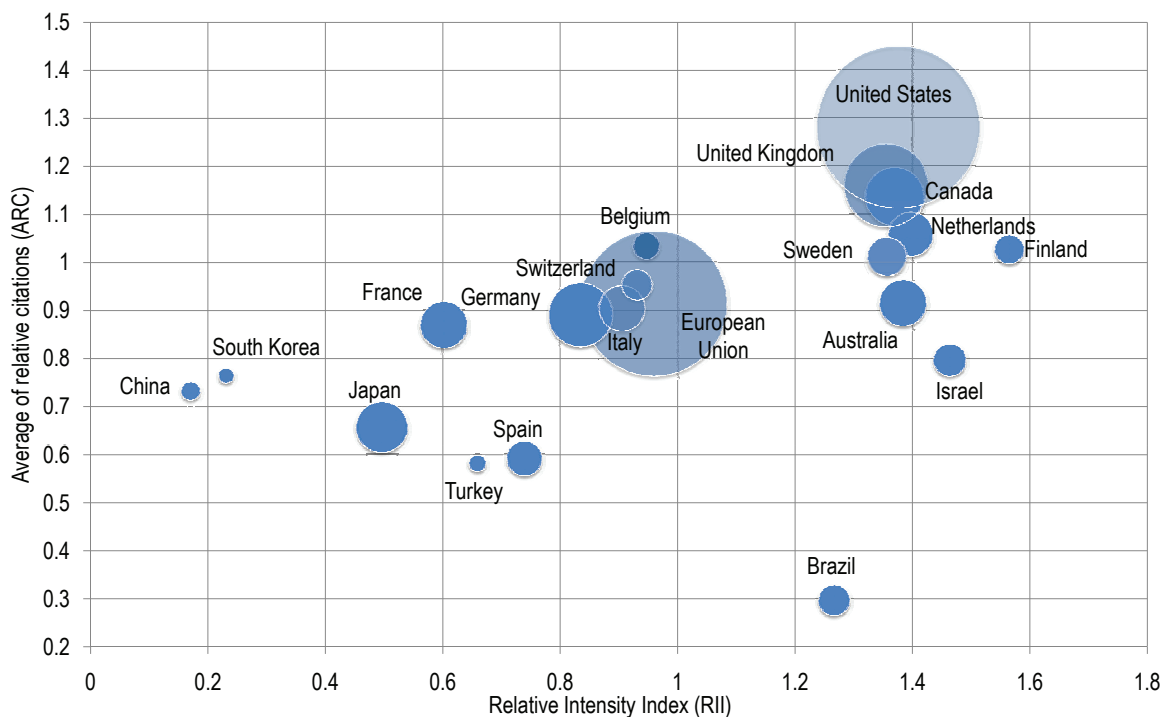
Figures 2.4 and 2.5 present the relative research intensity index (RII) and the average of relative citations (ARC) crossed in a scatter plot of the top 20 countries for the periods 1997–2002 (Figure 2.4) and 2003–2008 (Figure 2.5). These figures are divided into four quadrants. Countries in the upper right-hand quadrant ($ARC > 1$ and $RII > 1$) have a scientific impact above average and are specialised in the domain compared to the world average. Those in the lower right-hand quadrant ($ARC < 1$ and $RII > 1$) are specialised but have a scientific impact lower than the world average, while countries in the higher left quadrant ($ARC > 1$ and $RII < 1$) have a scientific impact above world average but a specialisation that is lower. Countries

Figure 2.3
Number of mental health papers per 100,000 inhabitants, for the 20 most active countries, 1980–2008



SOURCES: EUROSTAT⁶ for population sizes of European countries; United Nations Statistics Division⁷ for other countries.

Figure 2.4
Scientific impact and relative research intensity in mental health for top 20 countries, 1997–2002



SOURCE: Observatoire des sciences et des technologies (OST) Web of Science (WoS) database

⁶ <http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/>

⁷ http://unstats.un.org/unsd/demographic/products/dyb/2000_round.htm

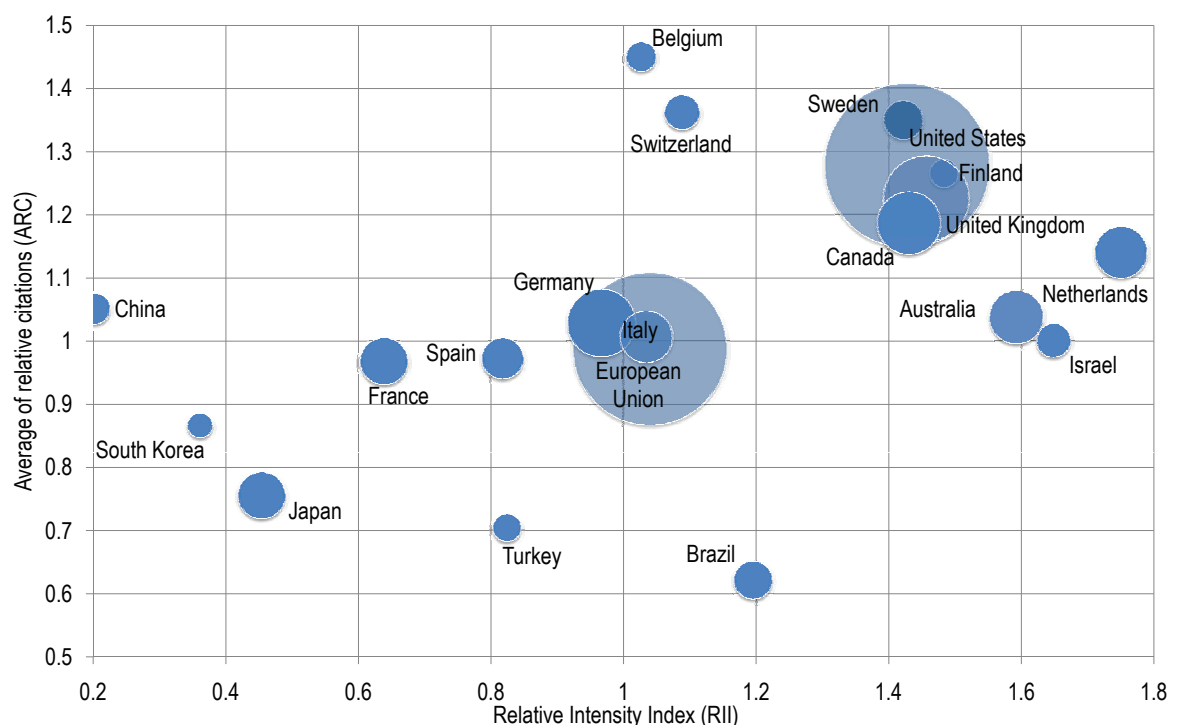
in the lower left quadrant ($ARC < 1$ and $RII < 1$) are below world average in terms of impact and specialisation. Finally, the size of the dots is proportional to the number of papers published by a given country in this area.

As one can readily see from the figures, countries with greater research intensity in mental health are also generally those with a high scientific impact (upper right-hand quadrant). The US, UK, Canada and The Netherlands are in this category for both time periods. They are joined by Belgium, Finland, Australia, Switzerland and Sweden for the 2003–2008 period, thanks to a strong increase in both scientific impact and research intensity for the first two countries, and in scientific impact for the remaining three. Israel and Brazil's scientific impact also increased, although neither of them is above the world level for 2003–2008.

China's scientific impact increased between the two periods and is slightly greater than the world average for 2003–2008, although it still publishes far fewer mental health papers than one would expect given the overall research output. The EU

altogether, Germany and Italy have increased both impact and intensity, and are on a par with the world average both in terms of RII and ARC for 2003–2008. Finally, for both time periods, Spain, France, South Korea, Japan and Turkey obtain fewer citations than the world average of mental health papers and publish fewer mental health papers than one would expect, given their overall number of papers. However, one should bear in mind that there is potential for countries whose researchers publish their work in languages other than English to be placed at a disadvantage. The comparative advantage that the English language confers on the research base in the UK, the US and other English-speaking countries may diminish in the future as English is also used for teaching in countries where English is not the first language, particularly in programmes designed to attract foreign students. Historically, this was often the case in countries with historical or colonial ties to the UK or elsewhere, but the practice is spreading. In addition, while national and institutional capacity in English, especially in the sci-

Figure 2.5
Scientific impact and relative research intensity in mental health for top 20 countries, 2003–2008



SOURCE: Observatoire des sciences et des technologies (OST) Web of Science (WoS) database

ences, may provide a comparative advantage in the current state of the world, this many change going forwards as other languages gain in importance.

Research level and types of documents published

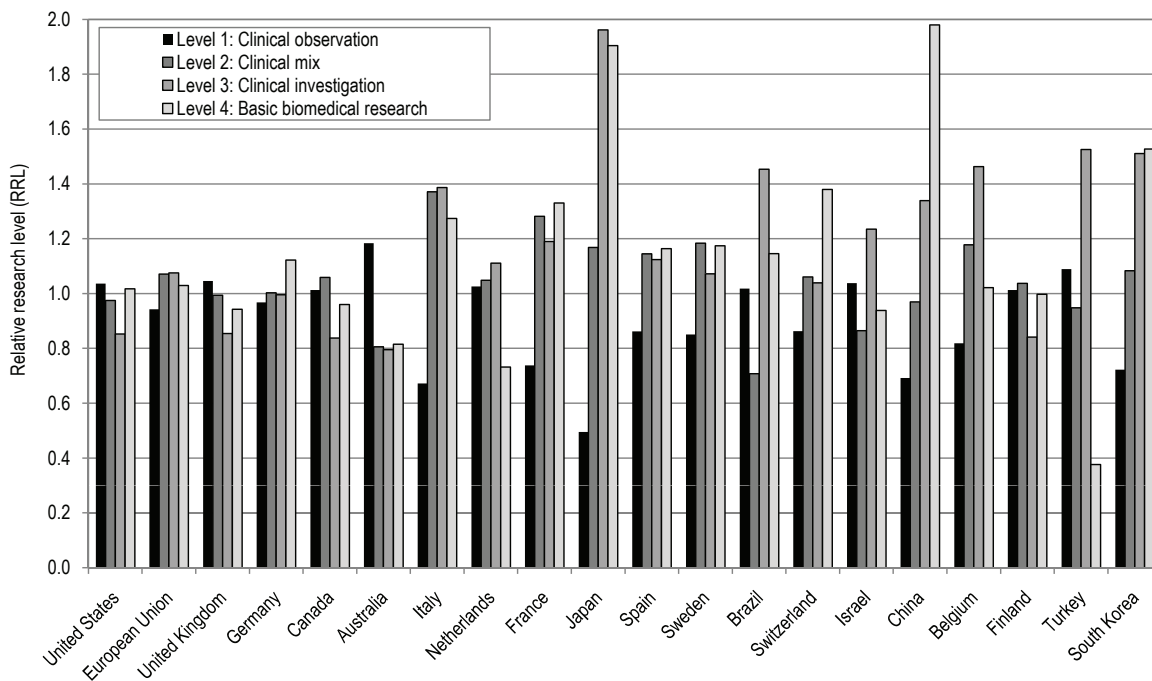
Figure 2.6 presents the distribution of countries' papers by the relative research level (RRL) of journals in which they are published. It shows that Australia, Turkey, Israel, UK, The Netherlands, the US, Finland, Brazil and Canada are more active than the world average in publishing in clinical observation (level 1) journals. Italy, France, Sweden, Belgium, Spain and Japan, in contrast, publish relatively more papers in clinical mix (level 2) journals. Finally, Asian countries such as Japan, China and South Korea are much more active in more clinical investigation (level 3) and basic biomedical research (levels 3 and 4) journals. The same may also be said of France, Italy, Brazil and, to a lesser extent, Switzerland and Germany. As shown in Figure 2.7,

there has been, over the last 25 years, a tendency towards more basic research in mental health. (The only exception to this is The Netherlands, for which we observe a clear increase in clinical research.)

An indication of the 'clinical' research effort of countries is the publication of RCTs, meta-analyses and practical guidelines. As Figure 2.8 shows, these types of documents account for a small – although increasingly important – proportion all of mental health papers. RCTs, for instance, increased from 3.3% of all mental health papers in 1989 to 6.3% in 2004. The figure has remained stable at approximately 6% since then. Meta-analyses have also risen, from 0.2% in 1990 to 1.1% in 2008, while practical guidelines have increased from 0.02% in 1990 to a percentage between 0.1% and 0.2% since 2000.

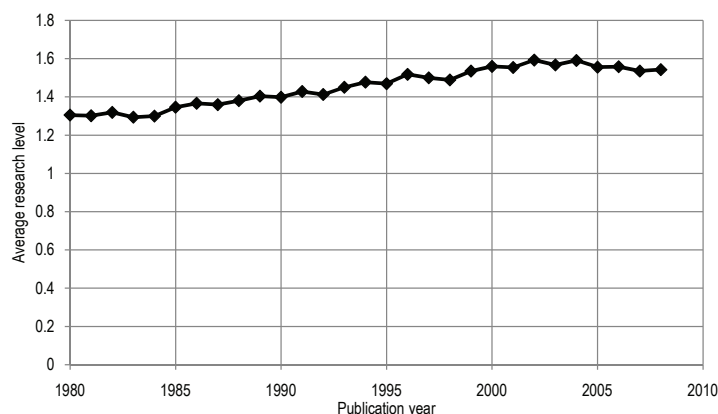
Figure 2.9 presents the relative intensity index of countries in their contributions to each of these three types of documents. When this index is greater than 1, it means that the country is more active than expected in publishing a given type

Figure 2.6
Distribution of the relative research level of journals in which mental health papers of the top 20 most productive countries are published, 2003–2008



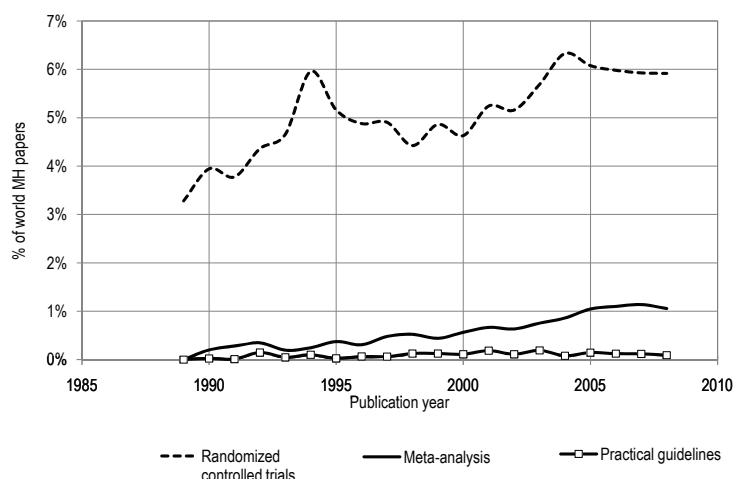
SOURCE: Observatoire des sciences et des technologies (OST) Web of Science (WoS) database

Figure 2.7
Average research level of mental health papers,
1980–2008



SOURCE: Observatoire des sciences et des technologies (OST) Web of Science (WoS) database

Figure 2.8
Percentage of meta-analyses, practical guidelines
and randomised controlled trials among all
mental health papers, 1989–2008



SOURCE: Observatoire des sciences et des technologies (OST) Web of Science (WoS) database

of document, while a index smaller than 1 means the opposite. The figure shows that The Netherlands, the US, Canada, Finland, Belgium and, to a lesser extent, the UK, South Korea and Australia contribute to more mental health RCTs than expected. China, Canada, the EU (driven mainly by The Netherlands, the UK and Germany), the US and Switzerland are more active in the publication of meta-analyses. Given the smaller number of practical guidelines retrieved in this study, countries' relative intensity may be the result of a few papers only. A few countries combine a suf-

ficient number of papers ($N > 20$) and a RII greater than 1: the US, the EU, the UK and Germany.

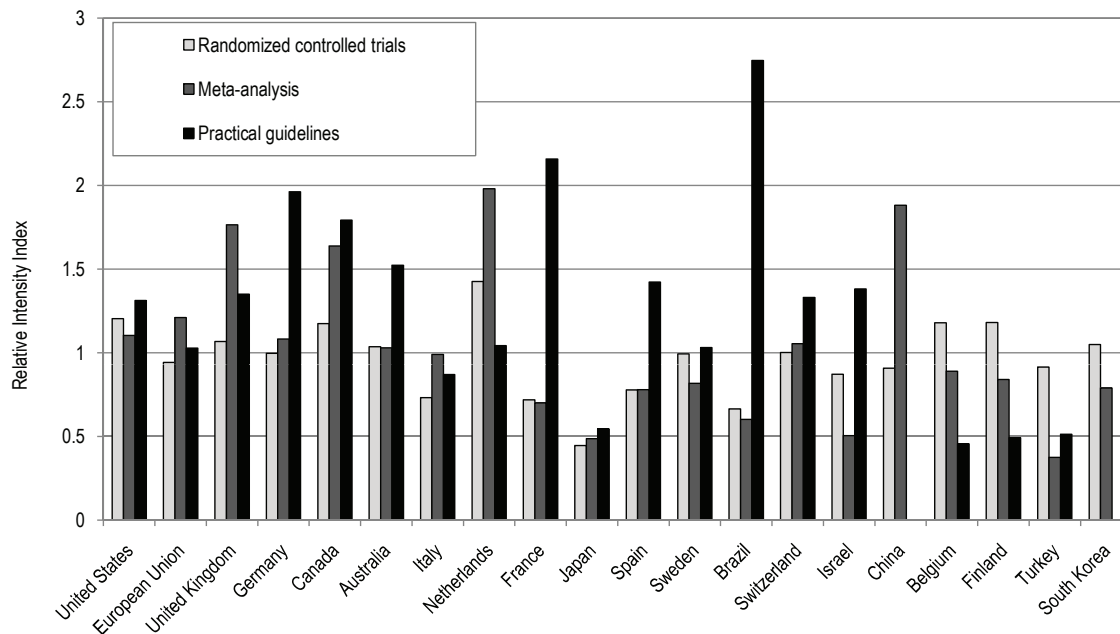
Figure 2.10 presents the average of relative citations received by countries' mental health RCTs published between 2003 and 2008. Belgium and France's mental health RCTs obtain the highest citation rates, followed by Sweden, Spain, Switzerland and the US. Australia, Canada and Finland's ARC values are between 1.7 and 1.8, while the UK, Germany and Italy are only slightly above the world average which, in this case, is at 1.54. All other countries' RCTs obtain lower citation rates than average.

Collaboration network

Science is increasingly being performed in international and bigger teams (Larivière *et al.*, 2006; Wuchty *et al.*, 2007). A similar pattern is observed in mental health research; as seen in the inset of Figure 2.11, mental health research papers are increasingly the result of international collaboration. More specifically, while 3% of all mental health papers published in 1980 were the result of an international collaboration, this percentage rises to 20% for 2008. The 2008 percentage is very similar to the percentage of international collaboration observed in all medical research combined (19%). We note, however, that some countries' mental health publications are much more international than their other health papers (China, Japan, South Korea, Turkey and the US), while for some others (Finland, The Netherlands, Switzerland, Sweden and the UK) it is the opposite.

Figure 2.11 shows that big countries/regions in terms of research output – such as the US, EU and Japan – obtain low international collaboration rates. This trend is not surprising; it is more difficult, from the probability point of view, for researchers from a bigger country to find collaborators outside their borders, as they encompass an important proportion of the overall scientific world. On the other hand, researchers from small countries – such as Switzerland and Belgium – have a greater probability of finding colleagues to co-author with outside their country as there are more mental health researchers outside their borders than within. Nevertheless, size is not the only determinant of countries' international collaboration. Language, geography and history also play a role (Larivière *et al.*, 2006). Canada, for instance,

Figure 2.9
Relative intensity index in mental health meta-analyses, practical guidelines and randomised controlled trials of top 20 most productive countries, 2003–2008



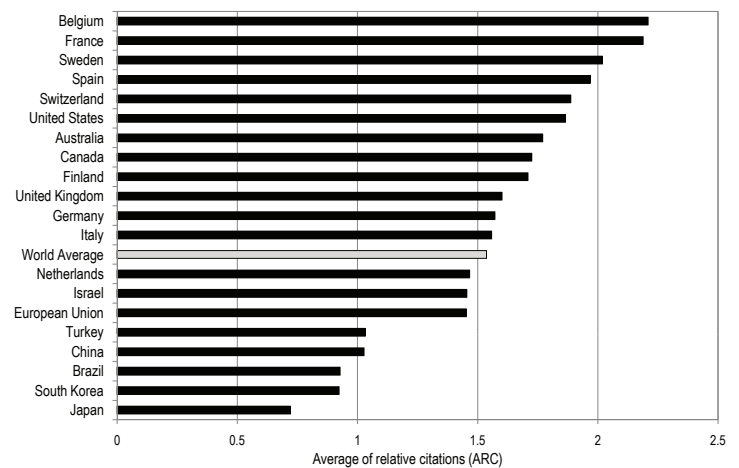
SOURCE: Observatoire des sciences et des technologies (OST) Web of Science (WoS) database

has five times the number of mental health papers of Finland, but the two countries have a similar international collaboration rate, mainly due to the important ties between Canada and the US. On the other hand, countries like Israel, Brazil and Turkey have lower international collaboration than one would expect, given their smaller research output. This may be due to their relative isolation – they are the only countries active in mental health in their respective parts of the world.

Finally, one might note that the world's international collaboration rate is lower than all countries' international rates. This is a result of the fact that the international collaborations are not only bilateral collaborations, but multilateral collaborations. A publication that is the result of international collaboration is counted for each participating country, but accounts for only one paper in the international collaboration rate compiled at the world level.

Figure 2.12 was drawn using the NetDraw software (Borgatti, 2002) and presents the international collaboration network of countries. The size of the lines between countries reflects the number of joint papers. Unsurprisingly, the US

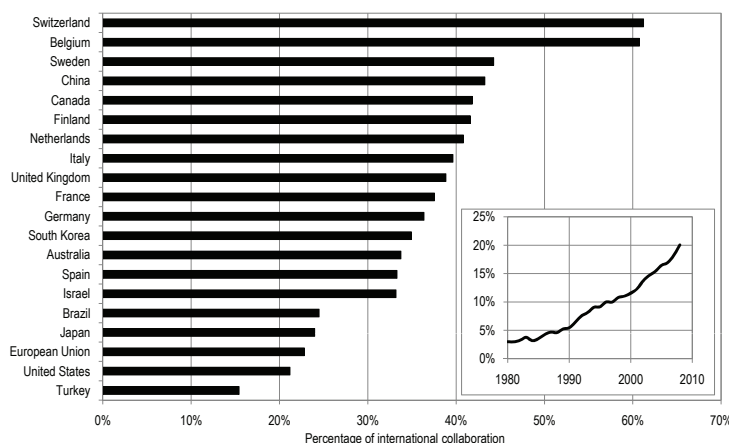
Figure 2.10
Average of relative citations of mental health randomised controlled trials (RCTs) for top 20 most productive countries, 2003–2008



SOURCE: Observatoire des sciences et des technologies (OST) Web of Science (WoS) database

is the main collaborator with most countries and, hence, the most central node of the network, as calculated by Freeman's degree of centrality (Freeman, 1979). It is followed by the UK, France, Ger-

Figure 2.11
International collaboration of mental health papers of top 20 most productive countries, 2003–2008. Inset: percentage of world papers with at least two countries, 1980–2008



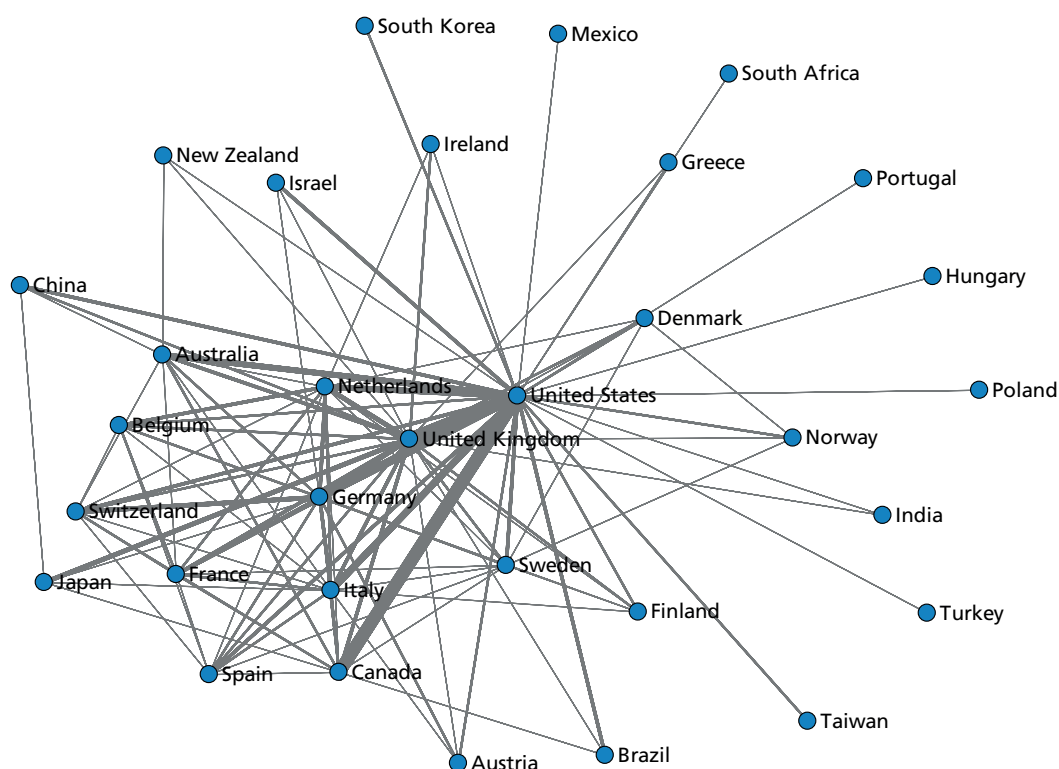
SOURCE: Observatoire des sciences et des technologies (OST) Web of Science (WoS) database

many, Canada, Australia and Italy. The strongest bilateral relationship is between Canada and the US (2,130 papers), followed by the UK and the US (2,081 papers), Germany and the US (1,371 papers), and Italy and the US (1,134 papers). It is also worth noting the strong collaborative ties between the Scandinavian countries, as well as between European countries.

Evolution of research topics

The topics of mental health research papers have evolved considerably since the early 1980s. Figure 2.13 presents, in alphabetical order, the relative evolution of 24 words found in the titles⁸ of papers – presented as a percentage of papers with the word in the title. Globally, we see an increase in research on groups of patients such as adolescents, adults, children and women, while research on family, elderly people – not shown – and

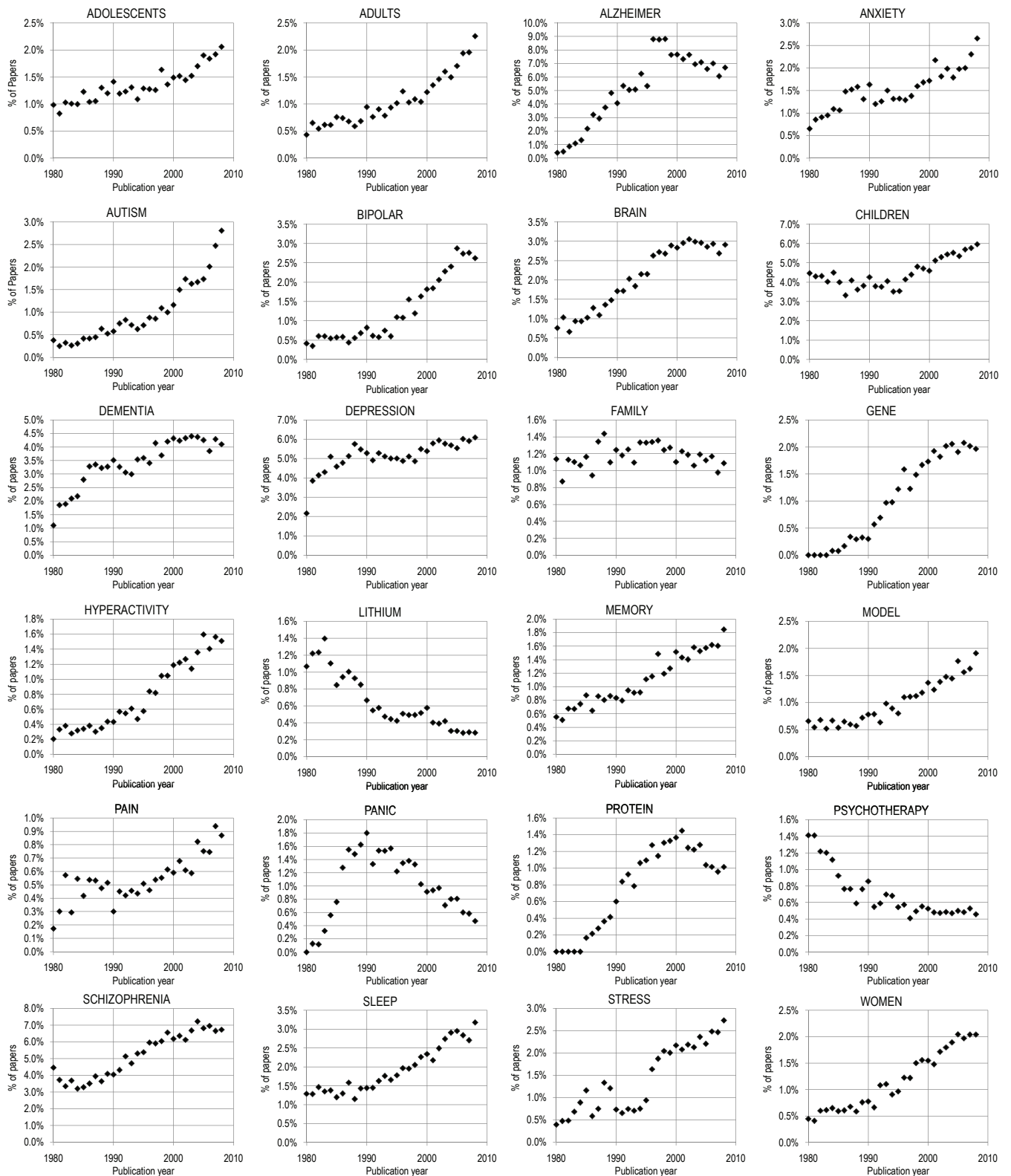
Figure 2.12
Network of international collaboration in mental health research, 2003–2008 (75 joint papers or more)



SOURCE: Observatoire des sciences et des technologies (OST) Web of Science (WoS) database

⁸ Another method would have been to use keywords – which use a more standardised vocabulary than titles – but unfortunately they were not indexed in the WoS prior to 1996.

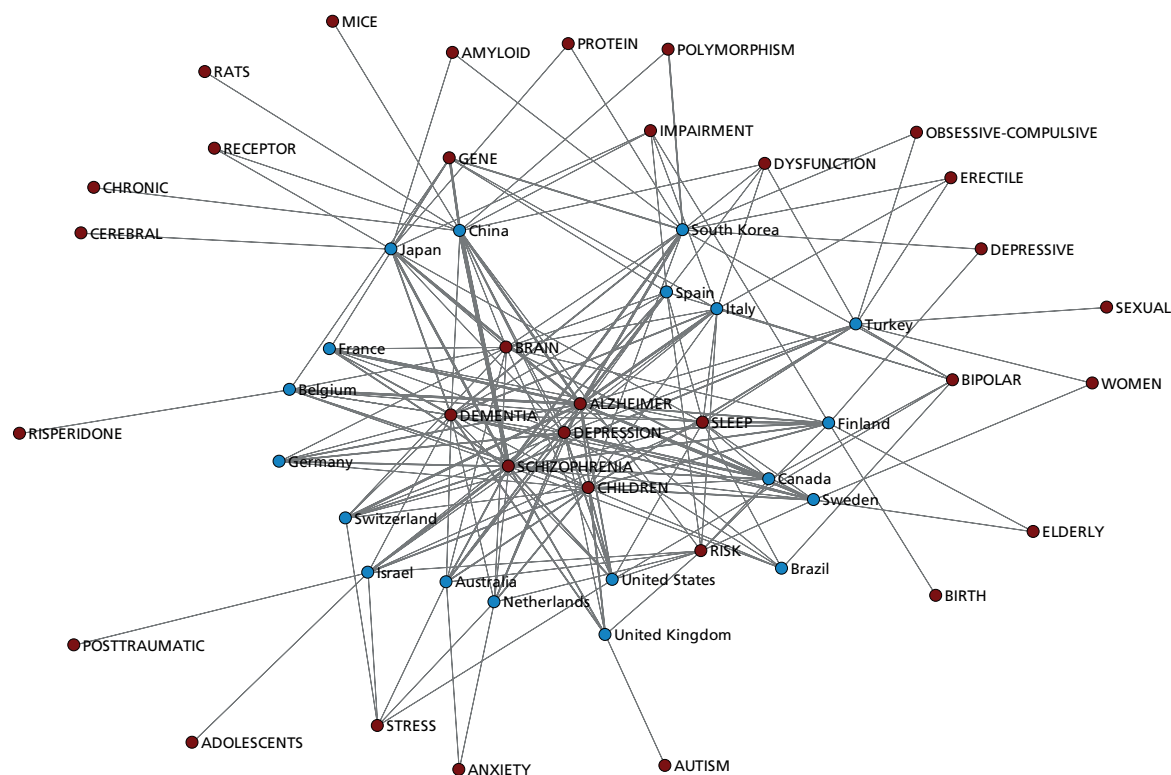
Figure 2.13
Evolution of a selection of words in titles, 1980–2008



SOURCE: Observatoire des sciences et des technologies (OST) Web of Science (WoS) database

Figure 2.14

Network analysis of a selection of research topics and top 20 most productive countries.



NOTE: Links shown represent keywords that appear in more than 2% of papers from a country.

SOURCE: Observatoire des sciences et des technologies (OST) Web of Science (WoS) database

Alzheimer has decreased relatively since the end of the 1990s. Research on genes, proteins, dementia and depression has increased relatively up to the early 2000s, while psychotherapy, research on lithium and research on panic disorders are decreasing. Finally, we observe a strong growth of research on autism, anxiety, bipolar disorders, hyperactivity, memory, schizophrenia, sleep and stress since the early 1980s.

The importance of these research topics varies greatly by country. Figure 2.14 shows the use of specific words in the title of countries' papers – presented as a NetDraw network (Borgatti, 2002). While Alzheimer, brain, children, dementia, depression, sleep and schizophrenia constitute the core of almost all top 20 countries' mental health

research, some countries are more active in specific areas. For instance Asian countries are more active in basic mental health research (gene, proteins, amyloid, polymorphism) – which is consistent with what was shown previously in the report – while Australia, The Netherlands and, to a lesser extent, Israel and Switzerland are more active in stress and anxiety research. Israel is also more active in post-traumatic and adolescent research. Research on bipolarity is relatively more frequent in Turkey, South Korea, Spain, Italy, Canada, the US and Brazil, while obsessive-compulsive disorders are a recurrent topic of Turkish and South Korean papers. Finally, Canada and Sweden are publishing more papers than expected on elderly people.

Chapter 3 Concluding remarks

The purpose of this paper was to map global mental health research activity since the 1980s. It thus provides an analytical basis for benchmarking mental health research trends in the past and for future assessment. It follows two previous bibliometric studies by Pincus *et al.* (1993) and Theander and Wetterberg (2009). Pincus *et al.* (1993) examine the characteristics and trends of papers published in the *American Journal of Psychiatry* and the *Archives of General Psychiatry* between 1969 and 1990. They conclude that such analysis 'can be useful ... [in] ... assessing the growth and utilization of knowledge in the field, to planning how to most effectively use limited resources, and to increasing public support for research'. Over 25 years later, Theander and Wetterberg (2009) go on to illustrate the utility of bibliometrics in an analysis of schizophrenia research in Medline between 1950 and 2006. Theander and Wetterberg focus on research output (i.e. the number of publications). The current paper adds to this body of knowledge by: i) taking a broader scope – that is, looking at mental health research as a whole as opposed to just schizophrenia research; ii) using a broader dataset: with the WoS as its basis, but including Medline indexed papers using MeSH; and iii) examining research impact, geography and collaborations, as well as productivity.

While we are aware of the limitations and caveats of using bibliometrics to measure research volume and impact, there are a number of broad conclusions we can make as well as some tentative policy observations. Based on our analysis of over 350,000 research papers published between 1980 and 2008, we come to the following conclusions:

1. The volume of mental health research publication output is growing faster than that for biomedicine or science as a whole.
2. There is a convergence in the volume of mental health research publication output between the US and Europe, with the recent emergence of mental health research publication output in the BRIC countries.
3. Smaller countries such as Sweden, Israel, The Netherlands and Finland are the most productive in terms of number of publications per capita.
4. Countries with greater specialisation in mental health research, such as the US, the UK, Canada and The Netherlands, generally have higher scientific impact.
5. Spain, France, South Korea, Japan and Turkey obtain fewer citations than the world average of mental health publications and publish fewer mental health publications than one would expect, given the volume of their overall publication output.
6. Over the last 25 years, we observe a tendency towards publishing more basic research outputs in mental health. The only exception to this is The Netherlands.
7. Mental health research publications are increasingly the result of international collaboration. While 3% of all mental health papers published in 1980 were the result of an international collaboration, this percentage was 20% in 2008.
8. Countries/regions with a relatively large volume of research output – such as the US, the EU and Japan – tend to obtain relatively low international collaboration rates. This is not surprising as it is more difficult for researchers from a bigger country to find collaborators outside their borders.
9. The strongest bilateral relationship in mental health research is between Canada and the US, followed by the UK and the US, Germany and the US, and Italy and the US.
10. We observe a strong growth of research on autism, anxiety, bipolar disorders, hyperactivity,

memory, schizophrenia, sleep and stress since the early 1980s.

By their very nature these conclusions are descriptive – that is, they capture what has happened in mental health research between 1980 and 2008 but do not (and cannot) explain why those trends have occurred. That said, we may infer a number of emergent policy observations that would warrant further and subsequent investigation. These include the following.

The performance of national mental health research systems vary

In Figures 2.4 and 2.5 countries in the top right-hand quadrant may be considered ‘high performers’. In addition to the US, UK and Canada, these include a range of smaller countries such as Belgium, Switzerland, Sweden, Finland and The Netherlands. What may be learned from these top performers? To address that question satisfactorily it would be necessary to undertake a detailed comparative analysis of the mental health research system in each (or in a sample of) high and low performer. But one apparent correlation is with the size of the country: it seems that countries that are small (in terms of population size), specialised (as measured by the relative intensity index) or both have a relatively high citation impact. Large countries that do not specialise have a lower impact.

From a strategic viewpoint this would suggest that relatively large countries that are

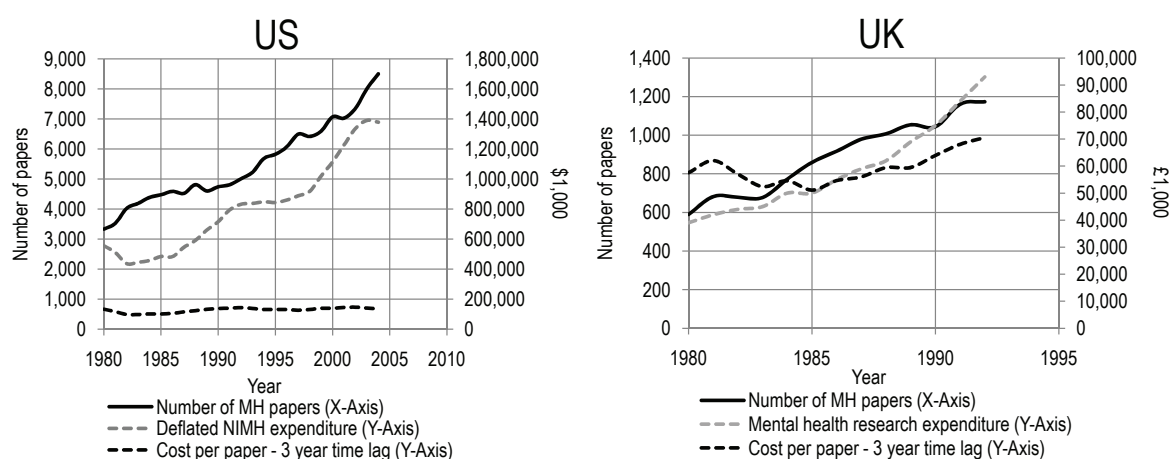
underperforming in terms of citation – such as Japan, France, Spain, and to a lesser extent Germany and Italy – need to specialise more if they wish to increase their global impact. Clearly they may have decided that mental health research is not a strategic priority and have focused resources on other fields.

The rise of mental health research seems to be due to funding

One of the most striking observations to make from this analysis is the disproportionate increase in mental health research publications compared to all biomedical science. As illustrated in Figure 2.1A, the number of mental health research publications has grown faster than that of biomedicine or science as a whole. What has driven this?

One explanation may be an increase in research funding. However, it is notoriously difficult to estimate the amount of funding going into different fields of biomedical science, owing to the plurality and different structures of funding in different countries (Chevreul *et al.*, 2011). Nevertheless, for the US we can look at National Institute of Mental Health (NIMH) expenditure over the period and for the UK use a previous estimate of mental health research expenditure between 1980 and 1992 (Buxton *et al.*, 2008). We have built in a three-year time lag for publication, and for the US it is worth noting that non-NIMH expenditure is excluded (Grant and Lewison,

Figure 3.1
Research productivity, measured by cost per paper, in the US and UK, over time



SOURCE: Observatoire des sciences et des technologies (OST) Web of Science (WoS) database

1997). As illustrated in Figure 3.1 below, research productivity (e.g. cost per paper) has not radically changed in either the US or UK over the periods assessed, suggesting that funding is the major driver of publication increase.

Is mental health research lost in translation?

One of the frequent observations made about mental health research is that it has failed to be effectively translated from bench to bedside (Insel, 2009). This may be a reflection of the (lack of) basic scientific understanding of mental health research, but it is interesting to note that over the period analysed the output of basic research increased at a faster rate than that of clinical research (compound annual growth rate of 9% for basic research versus 3% for clinical observation research) and the growth and volume of RCTs, clinical guidelines and meta-analyses remained low (Figure 2.8). Clearly more work needs to be undertaken to understand the relationship between basic and clinical research in the context of mental health (and indeed this is currently being undertaken as part of SOS for Mental Health (see Grant and

Wooding, 2010)), but it is interesting to note that a recent study on cardiovascular research concluded that, over a 15–20-year timeframe, basic research had a greater academic impact and clinical research a wider impact on policy, health and the economy (Wooding *et al.*, 2011). The question that remains unanswered at the current time is whether the mental health translation gap is due to funding policies or lack of scientific tractability.

As researchers, including those in mental health, seek to justify and secure more resources to fund an existing and increasing array of scientific opportunities, they and others need to undertake a parallel exercise to understand the impact of that research funding (Grant and Wooding, 2010). Doing so will make it possible to develop an evidence base that will inform future funding strategy, policy and processes. In this respect, bibliometric analysis may be instrumental in characterising the nature and measuring the volume and impact of mental health research. The aim of SOS for Mental Health is to contribute to the evidence base, and the bibliometrics analysis in this report is a small but important step in that direction.

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Appendix A: Journals categorised in psychiatry by both CHI Research and Thomson Reuters

<i>Acta Psychiatrica Scandinavica</i>	<i>Journal of Personality Disorders</i>
<i>American Journal of Psychiatry</i>	<i>Journal of Psychiatric Practice</i>
<i>Archives of General Psychiatry</i>	<i>Journal of Psychiatric Research</i>
<i>Archives of Women's Mental Health</i>	<i>Journal of Psychiatry & Neuroscience</i>
<i>Australian and New Zealand Journal of Psychiatry</i>	<i>Journal of Psychosomatic Research</i>
<i>British Journal of Psychiatry</i>	<i>Nordic Journal of Psychiatry</i>
<i>Bulletin of the Menninger Clinic</i>	<i>Psychiatric Annals</i>
<i>Canadian Journal of Psychiatry / Revue Canadienne de Psychiatrie</i>	<i>Psychiatric Clinics of North America</i>
<i>Child and Adolescent Psychiatric Clinics of North America</i>	<i>Psychiatric Quarterly</i>
<i>Comprehensive Psychiatry</i>	<i>Psychiatrische Praxis</i>
<i>Convulsive Therapy</i>	<i>Psychiatry Research</i>
<i>Current Opinion in Psychiatry</i>	<i>Psychiatry: Interpersonal and Biological Processes</i>
<i>Depression and Anxiety</i>	<i>Psychology and Psychotherapy: Theory, Research and Practice</i>
<i>European Child & Adolescent Psychiatry</i>	<i>Psychopathology</i>
<i>European Psychiatry</i>	<i>Psychosomatic Medicine</i>
<i>General Hospital Psychiatry</i>	<i>Psychosomatics</i>
<i>Harvard Review of Psychiatry</i>	<i>Psychotherapy and Psychosomatics</i>
<i>International Journal of Geriatric Psychiatry</i>	<i>Revista Brasileira de Psiquiatria</i>
<i>International Journal of Psychiatry in Medicine</i>	<i>Schizophrenia Bulletin</i>
<i>International Journal of Social Psychiatry</i>	<i>Schizophrenia Research</i>
<i>International Review of Psychiatry</i>	<i>Social Psychiatry and Psychiatric Epidemiology</i>
<i>Israel Journal of Psychiatry and Related Sciences</i>	<i>Stress Medicine</i>
<i>Journal of Affective Disorders</i>	<i>Suicide and Life-Threatening Behavior</i>
<i>Journal of Clinical Psychiatry</i>	<i>World Journal of Biological Psychiatry</i>

Appendix B: Journals categorised in psychiatry by CHI Research, but not by Thomson Reuters

Actas Espanolas de Psiquiatria
Actas Luso-Espanolas de Neurologia Psiquiatria y
Ciencias Afines
Advances in Psychosomatic Medicine
American Journal of Geriatric Psychiatry
American Journal of Psychotherapy
Archivos de Neuro-Psiquiatria
Australasian Psychiatry
Biological Psychiatry
Bipolar Disorders
CNS Spectrums
Cortex
Developmental Disabilities Research Reviews
Eating and Weight Disorders Studies on Anorexia,
Bulimia and Obesity
Encephale: Revue de Psychiatrie Clinique
Biologique et Therapeutique
Epilepsy & Behavior
International Journal of Eating Disorders
International Journal of Mental Health
International Journal of Methods in Psychiatric
Research
International Journal of Psychoanalysis
Irish Journal of Psychological Medicine

Journal of Child and Adolescent
Psychopharmacology
Journal of ECT
Journal of Nervous and Mental Disease
Journal of Neuropsychiatry and Clinical
Neurosciences
Journal of Psychosomatic Obstetrics and Gynecology
Molecular Psychiatry
Mood Disorders
Neuropsychiatry
Neuropsychiatry, Neuropsychology, and Behavioral
Neurology
Neuropsychobiology
Pharmacopsychiatry
Psychiatria Danubina
Psychiatria Polska
Psychiatry and Clinical Neurosciences
Psychiatry Research: Neuroimaging
Psychological Medicine
Psychologie & Neuropsychiatrie du Vieillissement
Transcultural Psychiatry
Türk Psikiyatri Dergisi
Zhurnal Nevrologii i Psikhiatrii Imeni S S
Korsakova

Appendix C: Journals categorised in psychiatry by Thomson Reuters, but not by CHI Research

American Journal of Orthopsychiatry
Anxiety, Stress and Coping
Archives of Psychiatric Nursing
Behavioral Medicine
British Journal of Medical Psychology
Community Mental Health Journal
Epidemiologia e Psichiatria Sociale: An
International Journal for Epidemiology and
Psychiatric Sciences
International Journal of Clinical and Experimental
Hypnosis
Journal of Anxiety Disorders

Journal of Behavior Therapy and Experimental
Psychiatry
Journal of the American Academy of Child and
Adolescent Psychiatry
Journal of the American Psychoanalytic Association
Praxis der Kinderpsychologie und Kinderpsychiatrie
Psychiatric Services
Psychopharmacology Bulletin
Zeitschrift für Kinder-und Jugendpsychiatrie und
Psychotherapie
Zeitschrift für Psychosomatische Medizin und
Psychoanalyse

Appendix D: Journals in which 75% of the papers have a mental health MeSH term, but to which neither CHI Research nor Thomson Reuters assign psychiatry as the discipline

Alzheimer Disease & Associated Disorders
American Journal of Alzheimers Disease and Other Dementias
American Journal of Mental Retardation
Autism
Dementia and Geriatric Cognitive Disorders
Dyslexia
Intellectual and Developmental Disabilities
International Clinical Psychopharmacology
International Psychogeriatrics

Journal of Alzheimers Disease
Journal of Autism and Developmental Disorders
Journal of Geriatric Psychiatry and Neurology
Journal of Intellectual Disability Research
Journal of Learning Disabilities
Journal of Mental Health Policy and Economics
Journal of Traumatic Stress
Mental Retardation
Research in Developmental Disabilities

Appendix E: Number of papers of countries in mental health, 1980–2008

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Australia	126	161	149	176	171	179	206	211	231	245	281	260	260	334	335	398	471	474	515	538	592	602	638	686	784	861	1,034	1,213	1,303
Belgium	37	42	43	40	65	55	59	63	68	125	77	91	93	103	118	141	151	132	184	201	171	208	188	230	285	283	293	342	353
Brazil	11	12	16	12	18	14	15	14	21	16	27	26	16	30	28	142	140	182	208	235	252	284	319	349	390	460	494	652	621
Canada	332	364	429	485	416	506	584	548	607	655	575	658	636	776	817	711	755	761	784	846	909	1,005	989	1,069	1,208	1,303	1,427	1,606	1,568
China	4	6	5	6	8	11	12	21	20	20	9	23	16	16	33	19	27	25	53	57	116	126	150	148	251	298	362	436	510
Finland	28	25	37	28	53	59	49	76	76	63	56	95	76	105	161	151	168	156	219	229	229	227	228	261	271	262	268	288	304
France	157	183	188	221	168	191	193	207	201	224	250	254	326	308	427	497	489	460	534	558	600	555	626	631	684	723	777	875	842
Germany	371	422	399	434	415	491	522	473	555	564	554	557	592	673	734	790	804	854	955	1,054	1,114	1,172	1,199	1,395	1,448	1,481	1,590	1,874	1,761
Israel	55	80	91	80	107	108	126	154	132	123	131	156	158	186	175	244	251	209	220	261	293	286	327	365	350	382	414	447	401
Italy	98	90	116	70	117	114	149	146	170	201	225	217	250	270	291	335	403	430	451	528	590	620	622	715	879	884	991	1,084	1,067
Japan	63	79	88	88	110	108	156	157	170	207	253	276	328	342	363	463	467	547	655	644	728	705	724	678	717	729	750	838	783
Netherlands	45	51	69	70	92	103	126	100	119	159	178	190	236	283	259	331	348	412	461	449	540	553	618	683	765	867	954	1,099	1,101
South Korea				1		2		4	1	10	5	6	7	12	12	14	21	34	43	55	84	105	112	176	193	231	243	302	
Spain	19	15	21	7	24	25	37	39	52	56	58	54	91	127	130	152	147	243	247	284	339	389	375	379	508	482	585	714	768
Sweden	95	115	103	175	171	185	206	188	164	157	184	196	197	237	258	259	287	359	359	399	358	423	427	474	463	490	516	618	601
Switzerland	103	104	100	126	105	99	132	101	93	126	116	136	128	153	158	184	168	191	225	201	250	280	294	340	347	371	452	479	461
Turkey	2			2	3	4	1	6	5	6	8	4	6	11	10	17	22	28	49	43	56	64	82	131	170	210	258	292	338
United Kingdom	589	682	678	677	772	859	917	979	1,007	1,054	1,043	1,160	1,173	1,234	1,318	1,414	1,652	1,641	1,661	1,801	1,873	1,887	1,944	2,160	2,259	2,445	2,652	2,818	2,748
United States	3,333	3,526	4,027	4,191	4,391	4,478	4,592	4,524	4,813	4,605	4,744	4,812	5,012	5,228	5,689	5,824	6,076	6,497	6,419	6,598	7,072	7,029	7,356	8,010	8,504	9,151	9,950	10,186	10,044
BRIC	39	51	51	41	41	42	55	64	88	91	72	84	68	163	154	263	259	334	409	428	518	539	649	711	835	1,112	1,257	1,504	1,638
EU 27	1,594	1,771	1,811	1,878	2,027	2,239	2,420	2,416	2,603	2,723	2,725	2,923	3,138	3,470	3,801	4,178	4,504	4,720	5,012	5,384	5,688	5,990	6,084	6,692	7,314	7,674	8,357	9,350	8,986
World	5,810	6,309	6,816	7,164	7,525	7,912	8,383	8,265	8,843	8,930	9,003	9,319	9,516	10,327	11,028	11,802	12,400	13,191	13,587	14,317	15,246	15,627	16,090	17,370	18,713	20,067	21,992	23,539	22,994