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Ireland's contribution to orthopaedic literature: A bibliometric analysis

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ABSTRACT

Background: Bibliometric analysis of scientific performance within a country or speciality, facilitate the recognition of factors that may further enhance research activity and performance. Our aim was to illicit the current state of Irelands orthopaedic research output in terms of quantity and quality.

Methods: We performed a retrospective bibliometric analysis of all Irish orthopaedic publications over the past 5 years, in the top 20 peer-reviewed orthopaedic journals. Utilising the MEDLINE database, each journal was evaluated for articles that were published over the study period. Reviews, editorials, reports and letters were excluded. Each article abstract was analysed for research content, and country of origin. A nation's mean IF was defined by multiplying each journal's IF by the number of articles. Publications per million (PmP) was calculated by dividing the total number of publications by the population of each country.

Results: We analysed a total of 25,595 article abstracts. Ireland contributed 109 articles in total (0.42% of all articles), however ranking according to population per million was 10th worldwide. Ireland ranked 18th worldwide in relation to mean impact factor, which was 2.91 over the study period. Ireland published in 16 of the top 20 journals, 9 of these were of European origin, and 1 of the top 5 was of American origin. In total, 61 Irish articles were assignable to clinical orthopaedic units. Clinical based studies (randomised controlled trials, observational, and epidemiology/bibliometric articles) and research based studies (In vivo, In vitro, and biomechanical) numbered 76 (69.7%) and 33 (30.2%) articles, respectively.

Conclusion: This study provides a novel overview of current Irish orthopaedic related research, and how our standards translate to the worldwide orthopaedic community. In order to maintain our publication productivity, academic research should continue to be encouraged at post graduate level.

Introduction

The academic careers of Irish orthopaedic trainees, is now commonly evaluated by examining the number of articles published in peer- reviewed scientific journals. Publication productivity is the most visible result of research, and is utilised as an objective parameter to allow candidates to gain entry into the higher surgical training (HST). Furthermore, Irish higher surgical trainees are currently encouraged to publish a minimum of one article in a peer-reviewed journal annually. Based on this strong ethos for basic science and clinical research, we aimed to evaluate Ireland's contribution

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Table 1 – Top 20 countries according to publications, publications per capita, mean impact factor, and research spending.

Rank	Country	Population	Total publications	Publications per 10^6	Mean impact factor	Research spending (% GDP)
1	Australia	21,515,754	1017	47.27	2.96(15)	2.35(9)
2	Holland	16,783,092	792	47.19	3.12(5)	1.84(14)
3	Canada	33,759,742	1524	45.14	3.02(10)	1.95(13)
4	Sweden	9,074,055	383	42.21	3.16(3)	3.62(3)
5	Norway	4,676,305	193	41.27	3.23(2)	1.8(16)
6	Denmark	5,515,575	215	38.98	3.14(4)	3.02(6)
7	USA	310,232,863	11352	36.59	3.04(9)	2.79(8)
8	Finland	5,255,068	181	34.44	3.36(1)	3.84(2)
9	UK	61,284,806	1756	28.65	2.84(20)	1.82(15)
10	**Ireland**	**4,250,163**	**109**	**25.65**	**2.91(18)**	**1.77(17)**
11	NZ	4,252,277	108	25.40	2.85(19)	1.17(20)
12	Belgium	10,423,493	262	25.14	3.1(6)	1.96(12)
13	Israel	7,353,985	168	22.84	2.96(16)	4.27(1)
14	S Korea	48,636,068	1033	21.24	3.08(7)	3.36(4)
15	Taiwan	23,024,956	479	20.80	2.99(11)	2.30(10)
16	Germany	82,282,988	1235	15.01	3.05(8)	2.82(7)
17	Japan	126,804,433	1621	12.78	2.96(14)	3.45(5)
18	Italy	58,090,681	665	11.45	2.92(17)	1.27(18)
19	France	64,057,792	626	9.77	2.97(13)	2.23(11)
20	Spain	40,548,753	228	5.62	2.99(12)	1.25(19)

Abbreviations: GDP, gross domestic product, %, percentage. Values in brackets are rankings.
The bold value signifies Ireland's ranking in the table. The main focus is Ireland's publication productivity.

to orthopaedic literature. Previous bibliometric studies have evaluated the productivity of individual countries in major orthopaedic journals.[1,2] Murphy CG et al. previously examined the academic output from Irish clinical orthopaedic units, however he did not examine the quality of publications originating from research and clinical affiliated institutions.[3]

Therefore, we performed a retrospective bibliometric analysis of all Irish orthopaedic publications over the past 5 years, in the top 20 peer- reviewed orthopaedic journals. Our aim to provide a comprehensive overview of the quality Irish orthopaedic research focussing on institution of origin, institution ranking, distribution of articles among journals, and article content.

Table 2 – Distribution of Irish articles among the top 20 orthopaedic journals based on impact factor (2006–2011).

Journal name	Impact factor	5 year impact factor	No. of Irish articles
Osteoarthritis and cartilage	3.953	4.495	3
American journal of sports medicine	3.821	4.801	3
Arthroscopy	3.317	3.127	3
Spine journal	3.024	3.024	0
Journal of orthopaedic research	2.976	3.379	15
Journal of bone and joint surgery (American volume)	2.967	3.762	1
Physical therapy	2.645	3.158	0
Journal of American academy of orthopaedic surgeons	2.547	2.897	0
Journal of orthopaedic sports physiotherapy	2.538	2.695	3
Spine	2.510	3.338	8
The journal of bone and joint surgery (British volume)	2.351	2.77	18
Journal of shoulder and elbow surgery	2.314	2.643	4
Gait and posture	2.313	2.936	10
Injury	2.269	2.435	18
The journal of arthroplasty	2.207	2.137	1
Clinical orthopaedics and related research	2.116	2.405	3
Clinical journal of sport medicine	2.110	2.393	3
Connective tissue research	2.093	2.005	0
Clinical biomechanics	2.036	2.519	5
European spine journal	1.994	2.493	11

Methods

The top 20 ranking orthopaedics journals based on their 5 year impact factor, were obtained from the ISI Journal Citation Report database.[4] Each of these journals was subsequently evaluated utilising the Medline/PubMed database, and articles that met the following criteria were included: publication year 2006–2011, publication type "Journal –Article", English language. Reviews, editorials, reports and letters were not considered. Each article abstract was analysed for the following: country of origin (based on the affiliated institution of primary author), and research theme. A nation's mean IF was defined by multiplying each journal's IF by the number of articles. Finally, the GeoHive Network was utilised to acquire population figures for each country.[5] Publications per million (PmP) was calculated by dividing the total number of publications by the population of each country. Research spending was based on the percentage of each countries GDP which contributed to research and development[6].

Results

We analysed a total of 25,595 article abstracts in the chosen journals over the study period. As expected the USA

Table 3 – Irish institution ranking according to publication productivity (2006–2011).

Rank	Centre/institution breakdown	No of publications
1	Mater Hospital-Spinal Unit/Dept Orthopaedics	15
2	Cappagh National Orthopaedic Hospital	14
3	Tallagh Hospital-Centre for Pelvic and Acetabular Surgery	9
4	Trinity College Dublin - Centre of Bioengineering	5
5	University College Dublin-Centre of Physiotherapy	5
6	Merlin Park University Hospital, Galway - Dept of Orthopaedics	5
7	Sports Surgery Clinic, Santry - Dept of Orthopaedics	4
8	University College Dublin- School of Engineering	4
9	St. Vincent's Hospital, Dublin - Dept of Orthopaedics	3
10	UCD - School of Medicine and Medical Sciences	3
11	Royal College of Surgeons-Dept of Anatomy	3
12	University of Limerick - Biomechanics Research Unit	3
13	Waterford Regional Hospital - Dept of Trauma and Orthopaedics	3
14	Cork University Hospital- Dept of Orthopaedics	2
15	Cork University Hospital- Dept of Surgical Research	2
16	NUIG - Regenerative Medicine Institute	2
17	Galway University Hospital - Dept of Orthopaedics	2
18	Beaumont Hospital - Dept of Physiotherapy	2
19	Beaumont Hospital - Dept of Neurosurgery	2
20	Central Remedial Clinic, Dublin	2
21	Our Lady of Lourdes Hospital, Drogheda	2
22	Trinity College Dublin - Dept of Physiotherapy	1
23	TCD - Centre for Research ón Adaptive Nanostructures	1
24	Royal College of Surgeons - Dept of Orthopaedics	1
25	Mater Private, Dublin	1
26	Cork University Hospital - Dept of Rheumatology	1
27	UCD - School of Public Health	1
28	UCD - School of Agriculture, Food Science and Veterinary Medicine	1
29	NUIG - Dept of Mechanical and Biomedical Engineering	1
30	St. Mary's Orthopaedic Hospital, Cork	1
31	NUIG Medical Engineering Dept	1
32	NUIG - Clinical Sciences Institute	1
33	University of Limerick - Dept of Electrical and Computer Engineering	1
34	Dublin City University - School of Health and Human Performance	1
35	Institute of Technology, Carlow - Dept of Science and Health	1
36	Connolly Memorial Hospital, Dublin - Dept of Orthopaedics	1
37	Mayo General Hospital - Dept of Orthopaedics	1
38	Mid-West Regional Hospital, Limerick-Dept of Orthopaedics	1
	Total	109

Abbreviations: NUIG, National University of Ireland, Galway; UCD, University College Dublin; TCD, Trinity College.

accounted for the largest number of publications by a country (11,352 [44.3% of all articles]), when adjusted for population it ranked 7th overall. Ireland contributed 109 articles in total (0.42% of all articles), however ranking according to population per million was 10th worldwide. Ireland's mean impact factor over the study period was 2.91 (18th worldwide ranking). Small highly industrialised nations [Holland, Sweden, Norway, Denmark and Finland] all ranked in the top in respect to both PmP and mean IF categories, and outperformed larger highly industrialised counterparts [UK, Germany, Japan, and France] [Table 1]. Based on research expenditure Ireland ranked 17th overall [Table 1].

The contribution from Ireland was highest in the British volume of Journal of Bone and Joint (18 articles [16.5% of Irish total]), Injury (18 articles [16.5% of Irish total), and Journal of Orthopaedic Research (15 articles [13.7% of Irish total) [Table 2]. Ireland published in 16 of the top 20 journals, 9 of these were of European origin, and 1 of the top 5 were of American origin. A total of 38 individual institutions contributed to publication productivity over the study period. The Mater Spinal/Orthopaedic Unit and Cappagh National Orthopaedic hospital were the main contributors with 15 (13.7% of Irish total) and 14 (12.8% of Irish total) publications respectively, however, it must be noted that University College Dublin (UCD), with its various affiliated departments contributed 14 (12.8% of Irish total) publications over the study period [Table 3]. With regards to specialty contribution, 61 articles were assignable to clinical orthopaedic units. Remaining contributors included research affiliated institutions (33), physiotherapy departments (10), and clinical neurosurgery units (5) [Table 3].

With regards article type, the largest subcategory of articles was clinical observational studies (65, 60%), this subcategory included cohort studies, case–control studies, and case series. Clinical based studies (randomised controlled trials, observational, and epidemiology/bibliometric articles) and research based studies (In vivo, In vitro, and biomechanical) numbered 76 (69.7%) and 33 (30.2%) articles, respectively [Fig. 1]. Thus 70% of article yield originated from clinical orthopaedic units.

Discussion

Our aim was to elicit the current state of Irelands orthopaedic research output in terms of quantity and quality. Irelands

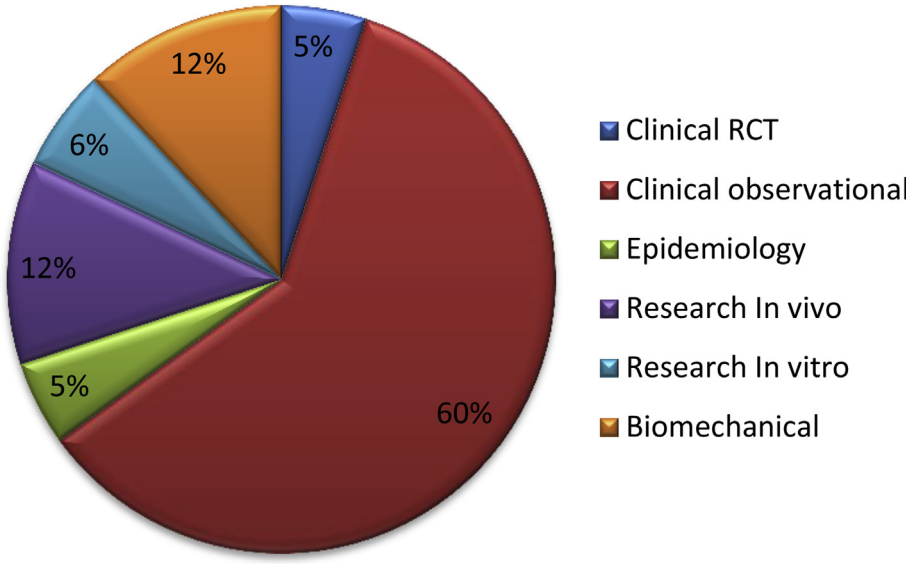

Fig. 1 – Pie chart of article content over the study period.

ranking according to PmP was 10th worldwide, with a mean IF of 2.91 resulting in a worldwide ranking of 18th.Bosker B.H et al. previously observed Irelands ranking according to publication yield from the top 15 orthopaedic journals between 2000 and 2004 to be 12th and 23rd relative to PMP and mean IF, respectively [1]. This demonstrates Irish productivity has improved over the past decade, furthermore our results mirror Bosker B.H el in terms of the proficient performance of the Scandinavian countries, Holland and the USA. The scientific productivity of a country is invariably comparable to population size, GDP, and research resources; however other important contributory factors include education, training, number of teaching hospitals, and English proficiency.[7,8]

It is noteworthy that in a period that has seen a dramatic shift in economic prosperity, with a sizable reduction in national funding capacity, Irelands Orthopaedic research productivity has flourished. Ireland ranked 17th overall as adjusted for GDP expenditure on research, this relatively limited funding capacity in comparison to other countries, emphasizes Irelands performance and contribution over the past 5 years. Obviously the reason is multifactorial and not attributable to any one factor alone. If national GDP and research resources have being diminished over the study period, then the authors suggest the ethos of promoting academic publishing among our trainees is a key determinant for our improved publication productivity. Irelands higher surgical training in orthopaedics has being previously viewed as a modernised Calman system with a strong emphasis on academic research.[9] This premise is highlighted by 70% of all Irish articles originated from clinical orthopaedic units, and all primary authors were represented by junior or higher orthopaedic trainees. Furthermore, entry to higher surgical training in Ireland is very competitive with most successful candidates having previously obtained a PhD/MD/MCh degree. As a result we observed 13 of the 33 research affiliated articles to be attributable to current higher surgical trainees.

We observed a wide distribution of Irish articles in European and American journals, however a much higher proportion of Irish articles were accepted to European journals. This trend is not unique to Ireland, as in a variety of subspecialities Europeans do not prefer to publish exclusively in European journals; in comparison Americans tend to submit their work to native journals.[10] We perceived clinical orthopaedic units with an affiliated university, to have a greater number of publications in comparison to stand alone clinical units. This is expected since these university affiliated units would have superior resources and funding available.

Randomised controlled trials (RCT's) are traditionally viewed as a high index of publication quality.[11] Interestingly only 5% of Irish publications were RCT's. We the authors suggest this does not reflect a deficiency in quality, but merely represents a certain degree of ambivalence to RCT's within surgical specialities. It is accepted that within orthoapedics several methological issues exist that prevent well conducted RCT's being performed.[12]These include surgeon preference for a specific implant or technique, blinding, external validity, funding and time. Therefore, Ireland's limited involvement in RCT's may possibly reflect methological challenges that exist within the clinical surgical environment.

This study has limitations that should be highlighted. Firstly, this study only evaluated MEDLINE indexed articles. This may not reflect Irish orthopaedic related research in its entirety, however MEDLINE is a comprehensive resource, and most relevant research publications are widely accepted to be referenced in MEDLINE. Secondly, the country of origin was based on the affiliated institution of primary author. We accept this may underweigh the contributions of other institutions and authors, however we viewed this affiliation as the only means of standardising the selection process. Thirdly, classically the prestige of biomedical journals has being measured by their impact factor (IF). We acknowledge the limitations of using impact factor as a marker of research quality; this discussion is beyond the scope of this

study.[13]Evaluation of the number of citations a publication receives may be a more accurate measure of scientific value; however citation rates have potential selection bias.[14]We, therefore, utilised a journals impact factor, which remains the most accessible measure of quantifying and qualifying scientific research. We accept, by selecting the top 20 orthopaedic journals a broader overview of publication productivity is not evident, as described by Murphy C et al.[3]Conversely, our focus on publication quality allows for a superior and more concise evaluation of Irish productivity within the orthopaedic community. Lastly, only 6 of the top 20 countries recognise English has their spoken language. This may account for the relative underperformance of major developed countries such as France, Germany, Belgium and Italy. Germany and France in particular have their own orthopaedic journals published in the native language exclusively, such as Revue de Chirurgie Orthopédique et Traumatologique and Deutsche Zeitschrift fur Sportmedizin. Owing to their low impact factor, these journals may account for a sizable proportion of research output, which has not being accounted for in our analysis.

In conclusion, this bibliometric analysis provides a novel overview of current Irish orthopaedic related research, and how our standards translate to the worldwide orthopaedic community. These insights may be helpful to benchmark our orthopaedic scientific output and aid the allocation of future research funding. In order to maintain our publication productivity, academic research should continue to be encouraged at post graduate level and remain a requisite for entry to higher surgical orthopaedic training.

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