

Landmark Studies in Radiation Oncology: Has the Pattern of Publication Changed?

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Abstract

The purpose of this study was to identify current pattern of publication of the most influential radiation oncology research, and to compare these to previous pattern. From several potential measures of impact and relevance of research, we selected article citation rate because landmark or practice-changing research is likely to be cited frequently. The citation database Scopus was used to identify the 100 most frequently cited articles published between 2009 and 2011, and 1999-2001, respectively. Current top 100 articles achieved a median of 57 citations (range 181-38). Top 100 articles from the time period 1999-2001 achieved a median of 208 citations (range 1149-121). The number of authors per highly cited article has increased significantly. Recently, 58% of articles were written by more than 10 authors (1999-2001: only 25%). Significantly fewer articles were published by authors from the US and/or Canada (53% versus 73%). Pure European contributions increased from 20% to 33%. The proportion of publications related to breast, lung or lower gastrointestinal tract cancer increased, while that related to prostate or gynecological cancer decreased significantly. Irrespective of time period, pattern of publication was dominated by only two scientific journals: the Journal of Clinical Oncology and the International Journal of Radiation Oncology Biology and Physics. Several newly launched journals have managed to attract highly cited articles. Fifteen of the 20 journals (75%) that featured top 100 articles from the time period 1999-2001 were no longer represented on the recent top 100 list. In spite of changing pattern of publication, relatively few well established journals dominate.

Keywords: Radiation oncology; Radiotherapy; Research evaluation; Scientific publishing; Citation

Introduction

Dissemination of scientific results has never been easier and faster than in recent years. With the advent of web-based publication channels and search engines, the number of options has increased rapidly. In parallel, more and more peer-reviewed journals with focus on different aspects of cancer treatment have entered the arena. For several reasons including but not limited to tenure track or likelihood of future funding, researchers attempt to publish their results in a way that ensures high visibility and allows for broad adoption of the progress achieved. Landmark studies often appear in traditional and prestigious high impact journals. However, the impact factor of and criteria for acceptance of manuscripts in scientific journals might change over time. All of these developments might have resulted in changing pattern of publication. The purpose of this study was to identify current pattern of publication of the most influential radiation oncology research, and to compare these to previous pattern. Ideally, the definition and selection of influential research should not depend on subjective preferences. From several potential measures of impact and relevance of research, we selected article citation rate because landmark or practice-changing research is likely to be cited by successor trials, editorials, review articles, guidelines etc.

Methods

A systematic search of the citation database Scopus (Elsevier B.V., www.scopus.com) by use of the function 'document search' and the term search for 'radiotherapy OR radiation oncology' in all fields was performed on 30th November 2012. Articles published during the time period 2009-2011 were selected irrespective of subject area, language, document and article type (review, clinical study, experimental study

etc.). Then, these articles were ranked by number of citations (field 'times cited' in the Scopus citation database) in order to create a list (top 100) of articles with the highest number of citations. For these top 100 publications the following parameters were evaluated: journal in which an article was published, region of origin, number of authors, topic, and type of research. The same methods were applied to extract and analyze the top 100 publications of the time period 1999-2001. The Chi square test was used to compare pattern of publication. A complete list of top 100 articles is provided as a supplement at the end of this article.

Results

Between 2009 and 2011, 5772 articles related to different aspects of radiation oncology were published (1999-2001: only 2352 articles). Current top 100 articles achieved a median of 57 citations (range 181-38). Top 100 articles from the period 1999-2001 achieved a median of 208 citations (range 1149-121). The references [1-20] represent the 10 most cited articles per time period. Table 1 show that the number of authors per highly cited article has increased significantly. Recently, 58% of articles were written by more than 10 authors (1999-2001: only

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25%). Significantly fewer articles were published by authors from the US and/or Canada (53% versus 73%; statistics shown in Table 2). Pure European contributions increased from 20% to 33%. The proportion of publications related to breast, lung or lower gastrointestinal tract cancer increased, while that related to prostate or gynecological cancer decreased significantly. No significant differences were found with regard to research or study type. The majority of articles reported on non-phase III clinical trials, and very few on radiobiology or physics research. Irrespective of time period, pattern of publication was dominated by only two scientific journals: the Journal of Clinical Oncology and the International Journal of Radiation Oncology Biology and Physics. However, the Journal of Clinical Oncology has strengthened its leading role (60% versus 47%). As presented in table 1, several newly launched journals have managed to attract highly cited

Parameter	2009-2011	1999-2001
No of authors		
1-3	5	10
4-6	13	23
7-10	24	42
>10	58	25
Geographic region		
United States/Canada	53	73
Europe	33	20
Asia/Middle East	6	2
Australia/New Zealand	1	2
Multiple regions	7	3
Type of publication		
Meta-analysis	3	2
Randomized phase III trial	14	21
Other clinical trial	59	60
Review	11	8
Guideline/consensus paper	10	5
Other incl. physics, radiobiology	3	4
Topic of publication		
Breast cancer	24	10
Prostate cancer	11	21
Brain tumor/metastases	12	12
Head and neck cancer	11	14
Lung cancer	12	8
Lower gastrointestinal cancer	9	3
Gynecological cancer	3	8
Scientific journal		
J Clin Oncol	60	47
Int J Radiat Oncol Biol Phys	15	29
JNCCN	3	0
Radiother Oncol	3	3
Lancet	2	2
N Engl J Med	0	2
Cancer Res	0	2
Cancer	0	2
Ann Oncol	2	0

Table 1: Comparison of top 100 radiation oncology publications.

Parameter and tested strata	p-value
Number of authors: 1-3, 4-6, 7-10, >10	<0.0001
Topic: Breast, Prostate, Lung, others	0.017
Region: USA/Canada, Europe, multiple, others	0.032
Journal: JCO, IJROBP, all others combined	0.049
Type of article: Phase III, other clinical, others	>0.2

Table 2: Statistical comparisons (Chi square test).

articles. Fifteen of the 20 journals (75%) that featured top 100 articles from the time period 1999-2001 were no longer represented on the recent top 100 list.

Discussion

During the time period between 1999 and 2011, major progress has been achieved in the areas of multimodal treatment [21], implementation of highly conformal radiotherapy techniques [22,23], and imaging for treatment planning [24]. Several articles on these subjects were among those with the highest numbers of citations [1-3,6,14-17]. The objective of this review was to identify longitudinal changes in pattern of scientific publication of influential, highly cited radiation oncology research. After arbitrary decisions about which database to search (only those providing citation numbers could be considered for the purpose of our review) and which keywords to use, we performed a systematic literature search and applied a broad definition of radiation oncology related publication, including for example general reviews and guidelines on local treatment of breast or prostate cancer where radiotherapy is part of the armamentarium [20]. Citation rate of published articles was chosen to define the most prestigious and important contributions (top 100). Articles with high numbers of citations are likely those that impressed other clinicians/scientists and had profound influence on clinical practice or future developments in the field. Other definitions might have been possible but none of these is free from disadvantages and subjective judgment. It should be noticed that searches in different databases or with different key words will result in more or less variable citation counts and that the present results therefore provide only a snapshot. Self citation is likely to influence the final citation count of sparsely cited articles, whereas its impact on highly cited articles might be less pronounced. It was recently estimated that 6.4% of all citations per article (interquartile range 2.8–11.3, mean 8.4) were self citations [25]. Studies most vulnerable to this effect were those with more authors and small sample size.

Our results are consistent with previous analyses demonstrating that citation rate is gradually increasing for several years after publication [26,27]. However, the purpose of this overview was not to explore dynamics of citation count. Given the fact that most scientific oncology journals had steady increases in the number of published issues and articles, and that each article contains a certain number of references, the increase over time in total number of publications is expected to lead to a parallel increase in citation rates. It is also interesting to note that highly cited research (top 100) was published in a large number of different scientific journals (n=21 and 20 during the two time periods, respectively) with or without high impact factor, but always in the English language. In a previous study of radio surgery for various conditions, 1.5% of all articles (time period 1951-2010) achieved more than 100 citations [28]. These 85 articles were published in 19 separate journals. In a previous analysis restricted to German radiation oncology publications, most citations per year since publication were recorded for meta-analyses and randomized phase III trials [26]. The lowest figures were recorded for review articles, non-phase III prospective clinical trials, and retrospective clinical studies.

One of the most relevant findings from the present analysis, which clearly revealed changing pattern, is that the number of authors per highly cited article has increased significantly (>10 authors in 58% vs. 25% of studies). This trend could be explained by the increasing complexity and multi-disciplinarity of radiation oncology and oncology in general. A previous study of authorship distribution limited to 4

journals (Int J Radiat Oncol Biol Phys, J Clin Oncol, N Engl J Med, and Radiology) showed that radiation oncology publications (1975-2011) had a mean of 5.7 authors per publication [29]. Those published in the Journal of Clinical Oncology had significantly more authors (mean 8.9). Time trends were not explored.

Significantly fewer current top 100 articles (2009-2011) were published by authors from the US and/or Canada (53% versus 73%), while pure European contributions increased from 20% to 33%. The proportion of publications related to breast, lung or lower gastrointestinal tract cancer increased, while that related to prostate or gynecological cancer decreased significantly. This should not be interpreted as general decrease in research activity related to these cancers. It is not uncommon that publication of landmark trials follows somewhat irregular time pattern where high activity might be followed by fewer completed studies. During both time periods, the majority of articles (59 and 60%, respectively) reported on non-phase III clinical trials, and very few on radiobiology or physics research. Irrespective of time period, pattern of publication was dominated by only two scientific journals: the Journal of Clinical Oncology and the International Journal of Radiation Oncology Biology and Physics. However, the Journal of Clinical Oncology has strengthened its leading role (60% versus 47%). Several newly launched journals (first issue after 1999) have managed to attract highly cited articles but the overall pattern of publication remains dominated by well established journals. Given that some of the newer journals, e.g. Lancet Oncology, Nature Reviews Clinical Oncology, or Nature Reviews Cancer, had rapidly increasing impact factors (currently approximately 12-35), one might speculate that pattern of publication could continue to evolve in the years to come. Apparently, despite controversy around impact factors and optimal evaluation of research productivity and quality [30,31], researchers still find it attractive and desirable to publish their most important radiation oncology related work in the top journals of the field.

Conclusions

Highly cited research was published in a large number of different scientific journals with or without high impact factor. However, the majority of articles appeared in relatively few well established journals. Important changes in pattern of publication, for example a considerable increase (more than double) in the proportion of articles written by more than 10 authors, were found.

The remaining articles (2009-2011) were published in 15 different journals (1 each). For the time period 1999-2001, the remaining articles were published in 13 different journals (1 each). Only one journal (Gynecol Oncol) featured remaining articles from both time periods. Several newly founded journals featured current top 100 articles, e.g. Radiat Oncol, JNCN, Lancet Oncol, Nat Rev Cancer and Nat Rev Clin Oncol.

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