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Review

The evolution of smoke-free spaces policy literature: A bibliometric analysis

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ABSTRACT

Objectives: This paper describes patterns in the international published literature regarding smoke-free spaces policy through a bibliometric analysis of journals, articles and authors from 1990 to 2009.
Methods: Secondary data from a recent systematic literature review were analyzed. Bibliometric techniques included statistical analysis of publication counts and co-citation analysis. Findings were generated through calculations of frequencies of journals, authors, and articles published per year. Analysis was conducted for five policy-relevant domains: public place, schools, private space, workplace, and tobacco industry tactics.
Results: Of the 5656 total articles examined, scientific articles written for the public place and workplace domains far outweighed those for schools, private spaces, and tobacco industry. This bibliometric analysis indicated that publication patterns aligned with patterns of policy activity and increasing sophistication in the evolution of smoke-free spaces policy development. This finding held for analyses by article, journal, and author over all years. The analysis also revealed relatively high numbers of unique authors publishing on smoke-free spaces policy each year.
Conclusions: This study identified patterns regarding the publication of scientific articles, by varying journals and authors, and illustrated sub-field priorities both recently and for the entire 20-year period examined.

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1. Introduction

One of the most compelling successes contributing to the impact of recent comprehensive tobacco control efforts has been the propagation of smoke-free spaces policy as an environmental-level population health intervention. Public health policies such as these contribute to creation of environments that support health for all. Smoke-free spaces policies can be implemented in a range of settings (such as schools and workplaces) and jurisdictional levels (organizational, municipal, provincial/state). Ever-growing policy activity around the world suggests a co-incident increase in the scientific literature providing evidence, whether descriptive or evaluative, in support of the smoke-free spaces approach. A parallel, if not consequential, growth is expected in the breadth of researchers working in the area as well as in publication venues. Here, we report on a bibliometric examination of the evolution of smoke-free spaces policy representation in the scientific literature.

This work constituted a sub-study of a larger systematic review of the scientific and practice-based evidence concerning smoke-free spaces policy development and implementation processes in four settings: homes, schools, workplaces, and public places [1]. For the purposes of this review, the term *policy* was operationalized to include those instruments referred to in the literature as: policy, bylaw, ordinance, regulation, or legislation. This knowledge synthesis review was conducted using the *better practices* approach developed by the Canadian Tobacco Control Research Initiative (CTCRI) in collaboration with individuals and organizations from the Canadian tobacco control community [2]. This approach emphasizes the parallel influences of science and practice in contributing to the world of evidence. The review identified those smoke-free spaces policy elements that were setting-specific, those that translated across settings and gaps that remain unaddressed. Results led to a series of recommendations for research and action, which were then discussed and contextualized by Canadian smoke-free spaces policy experts representing the domains of research, practice and policy. These discussions confirmed the results of the review and suggested that there were distinct patterns in the evolution of the smoke-free spaces policy in both practice and the scientific literature.

The following is based on a sub-study of the systematic review search results in the form of a bibliometric analysis through which we examined patterns in publication through an examination of journal titles, article counts, and authors reporting on smoke-free spaces policy from the years 1990 to 2009. Bibliometric analyses are familiar to the realm of health research and have been described as efficient methods by which to track the progression of a given area of study [3,4]. The purpose of this paper is to contribute to the continued development of this mode of investigation and to a more comprehensive understanding of smoke-free spaces policy as a distinct field of inquiry within the broader scope of tobacco control policy and public health.

2. Materials and methods

2.1. Procedure—systematic literature search of scientific evidence

The systematic review for the primary knowledge synthesis project examined three sources of evidence: (1) peer-reviewed scientific literature; (2) unpublished applied (grey) literature, typically generated by practitioners, advocacy coalitions, think tanks, or government bodies; and, (3) knowledge obtained from a series of expert consultations representing policy, practice and research in each of the smoke-free spaces settings. For the purposes of this sub-study, only the scientific literature review of smoke-free spaces policy development in the settings and jurisdictions of interest was used. The literature search began with the generation of a master list of search terms originating from keywords: generated by field experts, research team members, and seminal articles in the area. This initial list was expanded and refined prior to grouping the terms into three central concepts, 'second-hand smoke', 'policy', and 'settings where smoke-free spaces policies might be implemented' from which a search strategy was generated (Table 1).

The scientific literature search employed several research databases. Medline (PubMed), CINAHL, PAIS International, Sociological Abstracts, and Web of Science. Medline (PubMed), CINAHL, and Web of Science were included as databases commonly used for health research, while PAIS and Sociological Abstracts were also searched in an effort to include political science and policy research that may not have otherwise been captured in the health and science databases. The master list of terms was refined to include various terms and keywords specific to each of the various search engines and databases (e.g., controlled vocabulary terms such as Medical Subject Headings) so as to best delimit the search.

Table 1
Scientific literature search strategy and master list of search terms.

Literature search stage	Search terms
1	Tobacco OR tobacco control OR smok* OR second*hand smoke OR environmental tobacco smoke OR ETS OR passive smoke OR involuntary smok* OR clean indoor air
2	1+ Polic* OR rule* OR smoke*free OR enforce* OR legislat* OR ban OR bylaw OR ordinance OR prevent* OR protect* OR regulat* OR restrict*
3a	1+2+ Work*
3b	1+2+ Bars OR restaurants OR bingo OR casinos OR designated smoking room OR DSR OR separately*ventilated smoking rooms OR public OR patios
3c	1+2+ Home OR long*term care OR residen* OR apartment* OR multi*unit dwelling OR car* OR vehicle*
3d	1+2+ School* OR educ* OR campus* OR college* OR universit*

Articles were deemed appropriate for inclusion in the review if they met the following criteria: (i) published in 1990 through to 2009 (i.e., the timeframe for the conduct of the primary review); (ii) published in the English language; and (iii) related to development and implementation processes of smoke-free spaces policy in homes, schools, workplaces, or public places in North America, United Kingdom, or Australia.

2.2. Procedure—bibliometric analysis

A bibliometric analysis is the quantitative study of the communication and utilization of literature, and is a central means to evaluate scholarly publications and their producers [5,6]. Bibliometric studies have been applied primarily to scientific fields and are based principally on the bibliographies and citations related to scholarly publications within the disciplines. There are five principal assessment foci of bibliometric studies: (i) the relationship of characteristics of scholarly products to impact in the field; (ii) the contribution of individual author-scientists; (iii) the influence of particular articles or ideas; (iv) the relative prestige or utility of various journals in a field; and, (v) the productivity of particular institutions, academic departments, or invisible colleges. Our work focused primarily on assessing impact in the field (i.e., through number and type of journals, appearance of new authors, and disciplines represented), the relative contribution of authors, and the utility of various journals in the smoke-free spaces policy literature, which is a sub-area of the multidisciplinary field of tobacco control.

The systematic search of the scientific literature yielded 565 peer-reviewed articles eligible for review, delimited from an original set of 5786 unique articles identified. This set of articles constituted the data set for the bibliometric analysis, the purpose of which was to gain insights on the development of smoke-free spaces policy evidence within the broader field of tobacco control. Endnote bibliographic software was used to organize the references for ease of indexing, cross referencing, and bibliographical classification of the information of interest.

To get a sense of the overall growth of this policy specialty within tobacco control, data were tallied as overall totals of publications by: journal, author name, and year (from 1990 to 2009). Within each of the categories of journals, authors, and articles per year, sub-tallies were generated for the policy-relevant domains of public place, schools, private space, workplace, and tobacco industry (i.e., tobacco industry tactics used to oppose smoke-free spaces policy development or implementation). This allowed our team to examine the focus of published research across policy domains over time. In addition, the total number of new journals and new authors represented per year was also calculated overall and for each policy domain. This analysis of publication patterns within and across years facilitated a better understanding of the growth and development of a smoke-free spaces policy focus as represented by the appearance of "new" contributors and "new" venues over time.

3. Results

The review of the 565 smoke-free spaces policy articles from 1990 to 2009 coincided with a tremendously active and dynamic period of evolution for comprehensive tobacco control. This 20-year period of interest revealed interesting variation in the scientific literature marking the growth of smoke-free spaces policy as a distinct area of interest within the field. When examining articles from all journal sources combined, the overall volume of scientific articles written for the public place ($n = 234$) and workplace ($n = 178$) domains far outweighed the other three categories marked in the literature. Remaining articles were evenly distributed across the schools ($n = 53$), private spaces ($n = 53$), and tobacco industry tactics ($n = 51$) domains. (*Note*: Four of the 565 articles fell into multiple categories and thus were 'double-counted' for impact, i.e., two within private spaces and workplace, and two within workplace and public places.) Further, the latter three domains (i.e., schools, private spaces, and tobacco industry tactics) demonstrated relatively consistent frequencies of articles by year, with a peak in publications in 2003–2004. The workplace domain demonstrated a strong presence in the literature, with a particularly high proportion ($n = 67$) of the articles published in the early policy years between 1990 and 1994. After this time, the workplace domain showed relative consistency in producing a large proportion of the smoke-free spaces policy knowledge, including a large publication peak in 2004. This was followed by very few publications from 2006 to 2009 ($n = 13$), reflecting the shift of smoke-free spaces policy interest to another domain–public places. Within the public places domain 73.5% ($n = 172$) of publications were from the last decade of analysis (i.e., 2000–2009), peaking in 2008 with 30 publications. In the last 5 years, a large proportion of the articles from the public places domain focused on the development and implementation of smoke-free spaces policies in psychiatric wards ($n = 14$ or 13.9%) and hospitals ($n = 13$ or 12.9%). This represents another policy shift toward regulating exposure to second-hand smoke in clinical settings, which are complexity of public spaces interacting with personal freedoms. Fig. 1 provides an illustration of patterns of articles published by year and domain, all journal sources combined.

In the first decade of articles analyzed (1990–1999), the total number of articles peaked in 1995. Following a decrease in the late 1990s, the volume of articles demonstrated a steady increase, with a dramatic peak in 2004, and then a return to moderate publication levels from 2005 through 2009. Literature pertaining to private spaces (e.g., homes and personal vehicles) and tobacco industry tactics also began to show increases in the late 1990s and early 2000s, reflecting new areas of emphasis within the broader dialogue pertaining to smoke-free spaces policy.

3.1. Publication venue patterns

The steady increase in smoke-free spaces policy articles from 1990 to 2009, which is indicative of the general growth of interest in this sub-field of tobacco control policy, while the peaks of publications in certain years

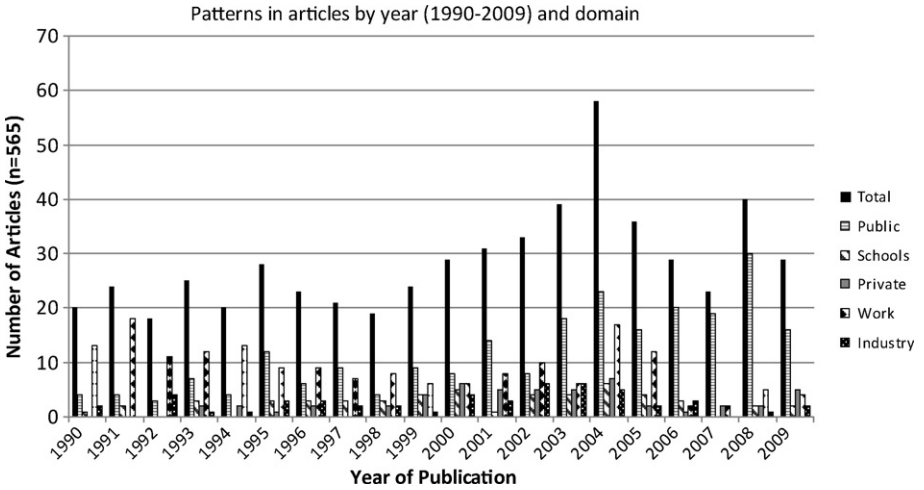

Fig. 1. Patterns in articles by year (1990–2009) and domain.

reflect pinnacle moments of smoke-free spaces policy in the international context, for example, the Master Settlement Agreement in the US during the early 2000s, the WHO Framework Convention on Tobacco Control opened for signatures in June 2003, and Ireland's national workplace smoking ban in March 2004. However, further analysis of publication venues for these articles was required to gain a better understanding of the scope of disciplines engaged in scholarly discussion of smoke-free spaces policy (i.e., as represented by nature and breadth of journals represented).

Analysis indicated that the 565 articles on smoke-free policy development and implementation discussed above were published in 216 distinct peer-reviewed journals. Most of the journals (88.0%, $n = 190$) published five articles or fewer between 1990 and 2009, with the largest proportion of journals (60.6%, $n = 131$) having published only one article on smoke-free spaces policy during that time. Another 14 journals (6.5%) published 5–10 papers, and a notable five others published between 13 and 62 papers during the 20-year time period. The vast majority of the journals (85.2%, $n = 184$) represented health-related fields such as public health, health promotion, medicine, nursing, cancer care, etc. Tobacco control journals ($n = 2$) were assessed separately from the other health-related fields, but despite low journal numbers, included a relatively large proportion of articles (12.2%, $n = 69$), which is not surprising given the specificity of the journals to this field. Other disciplines represented by the journals were broadly categorized as: policy, economics, law, and business (8.3%, $n = 18$); and, social sciences, including history and geography (3.2%, $n = 7$).

Fourteen most common publication venues for smoke-free spaces policy articles, in descending order, were: *Tobacco Control* ($n = 62$); *American Journal of Public Health* ($n = 32$); *British Medical Journal* ($n = 28$); *Preventive Medicine* ($n = 14$); *Journal of School Health* ($n = 13$); *American Journal of Preventive Medicine* ($n = 10$); *Australian and New Zealand Journal of Public Health* ($n = 10$); *Canadian Journal of Public Health* ($n = 9$); *Journal of Public Health Policy* ($n = 9$); *Journal of the American Medical Association* (*JAMA*; $n = 7$); *Journal of Public Health Management and Practice* ($n = 7$); *Morbidity and Mortality Weekly Report* ($n = 7$); *Nicotine and Tobacco Research* ($n = 7$); *Psychiatric Services* ($n = 7$); *American Journal of Health Promotion* ($n = 6$); *Health Education and Research* ($n = 6$); *Medical Journal of Australia* ($n = 6$); *The New Zealand Medical Journal* ($n = 6$); and *Preventing Chronic Disease* ($n = 6$).

In addition to description of publication venue over time, our team also conducted a detailed examination of patterns of unique journal appearances by year of publication. Journals that appeared in previous years were excluded and multiple appearances of a journal in a single year were counted only once in order to accurately represent the growth of the sub-field. There was an initial peak of unique journals appearances in 1990 and 1991, which was expected as it coincided with the emergence of the smoke-free spaces policy phenomenon. Another notable peak of smoke-free spaces papers appearing in "new" venues occurred in 2003, 2004 and 2008. Again, this coincided with peaks of smoke-free spaces activity around the world (e.g., Smoke-free Ireland in 2004) and echoed the emergence of the gold-standard bylaw for smoke-free public places [7], the landmark Master Settlement Agreement [8] and the Framework Convention on Tobacco Control [9] in the early 2000s, as well as increasing calls for regulatory action in the emerging policy domain of smoke-free vehicles in the late 2000s. Fig. 2 provides an illustrative summary of the appearance of smoke-free spaces literature in a steadily increasing variety of peer-reviewed journals through the entire time period of 1990–2009.

Of all five smoke-free spaces policy domains examined, the public places domain revealed the most dramatic changes in publication patterns. Fig. 2 shows an increase in the number of unique journal publications in the public places domain from 2003 to 2009 ($n = 121$). Prior to 2003 there was a steady progression of between four and 11 new journals appearing each year. Within the workplace domain there were a number of unique journal publications from 1990 to 1994 ($n = 60$), with a peak in unique publications in 2004 ($n = 15$). These publication patterns are consistent with what was previously discussed with

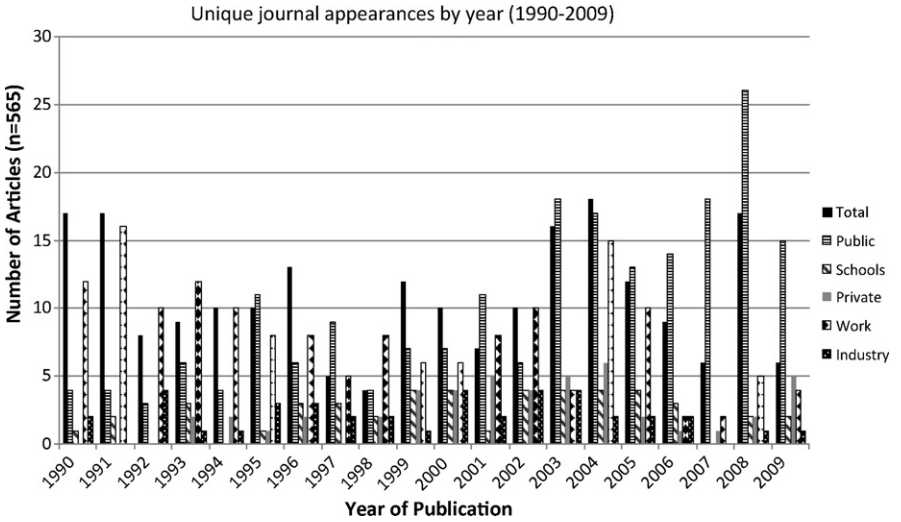

Fig. 2. Unique journal appearances by year (1990–2009).

respect to the number of articles published each year within the workplace domain. In contrast, the schools domain presents no vivid peaks in activity, yet it does present consistent growth within the sub-field with up to four new journals appearing each year. The private spaces domain does not appear for the first few years of analysis, as this had not yet emerged as an activity area for smoke-free spaces policy development. This changed in 1993, and the sub-field began to grow to include this domain. The lack of peaks for this sub-field into the early 2000s suggest subdued spread of the private spaces dialogue into new publication venues, and, when taken in the context of new articles per year, further indicates repetition in the journals that published in this area. The unique publication venues seem to grow in scope in a manner that is aligned with increases in private spaces as a priority issue for smoke-free spaces policy advocacy. Finally, the tobacco industry tactics domain reveals no notable patterns with a consistent range of zero to four unique journals per year.

3.2. Authorship patterns

The analysis of publication venues demonstrated the evolution of the smoke-free spaces policy dialogue in the broad scope of public health (and related disciplines), tobacco control, policy, economic, and social science bodies of literature. While this is certainly indicative of the growth of dissemination venues, it neither speaks to the variation in authorship over time nor to the relative prolificacy of authors publishing in this sub-field. Thus, the final phase of analysis was that of unique authors by year, to facilitate a better understanding of the scope of investigators publishing in the field of smoke-free spaces policy.

This analysis included those investigators that published as primary or secondary authors in peer-reviewed journals, and that had not yet published in previous years. Each unique author was counted only once in each calendar year, regardless of multiple appearances. Overall, this analysis revealed relatively high numbers of unique authors publishing on smoke-free spaces policy each year (Fig. 3). The total number of unique authors peaked in 2004, where 55 different authors appeared in a total of 58 articles published that year. Further, 46 of the 55 authors were "new" to smoke-free spaces policy, showing a potential expansion of academics working in this sub-field.

While substantial variation in unique authors is apparent in the first decade under investigation (1990–1999), the analysis of the smoke-free spaces policy literature from 2000 to 2009 revealed a steady and dramatic increase from year to year. Again, this could be reflective of growing academic interest in the advances of smoke-free spaces policy and comprehensive tobacco control strategies that were occurring in this time period. It may also reflect increased grant funding and new graduate-level training programs during this time that were intended to foster a growing and scientifically robust tobacco control community of academics linked with practitioners and policy-makers.

Analysis also revealed several interesting patterns in unique authors represented within the five smoke-free spaces policy domains examined. For the public places domain authorship peaked in 1995, 2001 and 2003, and then was steady through to 2009, aligning with the overall trends of articles published within the domain. Similarly, for the workplace domain, the largest number of unique authors occurred between 1990 and 1994, and then again in 2004. This suggests that the authors of workplace literature were at the forefront of the smoke-free spaces sub-field, and then continued to have a strong presence with resurgences of publication activity. The public place and workplace surges echo advances in the field of tobacco control and may be indicative of the growing success (and popularity) of policy as a population health intervention. This was supported through the introduction of comprehensive tobacco control strategies at the provincial and federal levels in Canada and state levels in the United States during this 20-year time period. Thus, the publication patterns reflect the scientific aftermath of intense periods of smoke-free public places policy activities (e.g., advocacy, policy diffusion, media attention) [10], while the overall positive growth of the body of knowledge demonstrates

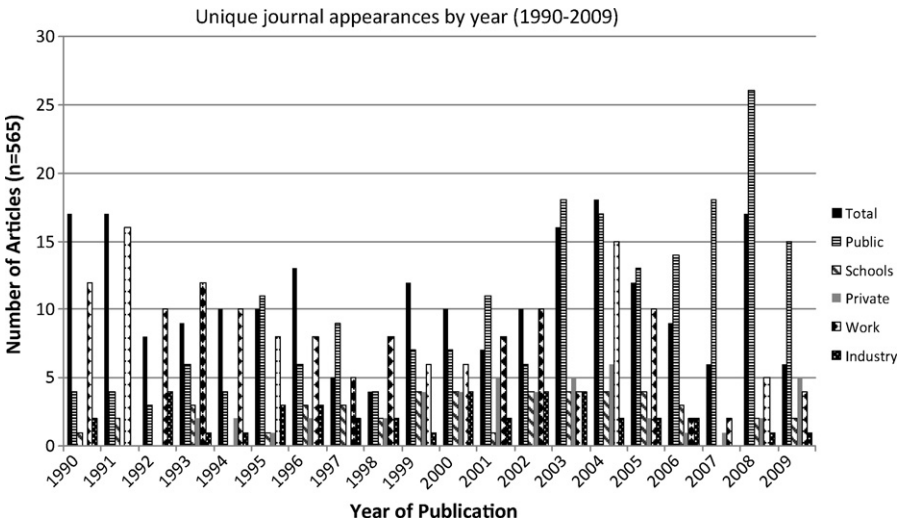

Fig. 3. Unique author appearances by year (1990–2009).

a growing interest in smoke-fee public places. While the patterns for the schools domain are less dramatic, it still shows consistent and regular development with upto four unique authors appearing each year. Again, this is reflective of activity among practitioners and echoes the consistent and ongoing refinement of school smoking bans. The private spaces and tobacco industry tactic domains also reflect occurrences in practice, showing consistency in numbers of unique authors over the years, with a bulk of activity occurring from 1999 onwards.

4. Discussion

The results of this bibliometric analysis of the smoke-free spaces policy literature suggest that publication patterns mirror patterns of activity and increasing sophistication in the evolution of smoke-free spaces policy development processes. For example, the development of gold-standard bylaws and policy templates in Canada, the United States and the United Kingdom, the WHO Framework Convention on Tobacco Control, and Ireland's unprecedented implementation of national smoke-free regulations all occurred in the early 2000s and correspond with peaks of publication patterns in the same time period, given an expected time lag associated with publication timelines. This finding held for analyses by article, journal, and author over the 20-year period included in this investigation. Yet the literature also must be considered in light of the distribution of the Master Settlement Agreement [8] funds in the US, which saw hundreds of millions of dollars each year in the early 2000s devoted directly and indirectly to tobacco control, including smoke-free policy development, implementation, and research. Thus, an increase in the measured data may be because of an increase in funding, not due to an increase in activity or a change in policy practices (e.g., success with current policy practices as a result of more funding).

Evolution of the literature by policy domain also echoed the events of smoke-free spaces policy development in practice. Early smoke-free spaces implementation emerged in workplaces and public places in the form of policies and bylaws banning smoking to protect the health of the public. Workplaces and public places were also the first policy domains represented in discussions of smoke-free spaces policy in the tobacco control and public health literatures. While the schools domain was featured less prominently throughout the full scope of literature, it grew consistently in contributions to the smoke-free spaces policy sub-field of tobacco control.

The study findings also suggest that the breadth and scope of the scientific evidence facilitates shifts in policy focus. For example, experience and success in workplace and public place smoke-free policy initiatives in the late 1990s preceded a shift in smoke-free advocacy efforts to private spaces (e.g., long term care facilities, homes, vehicles) and counteracting tobacco industry anti-regulation efforts, areas of interest that saw an increased profile in the literature of the 2000s. While our findings suggest that the emphasis in the literature seems to correspond with changes in policy priorities we cannot be certain of the nature of this relationship. The positive growth in all domains of the sub-field, as well as expansion into new domains of interest, suggest a certain responsiveness either on the part of researchers to generate published evidence in a policy-relevant area or on the part of policy advocates and policy-makers to translate of policy-relevant evidence into action.

It must be noted that the systematic literature search and analysis reported here was limited to articles from North America, the United Kingdom, and Australia. Future research should be expanded to include literature from developing countries, particularly to see if the publication patterns echo policy development processes in these areas.

5. Conclusions

Bibliometric analysis is an effective way to examine how a body of literature evolves within a particular area

of interest, as exemplified by this case of smoke-free spaces policy. This study identified patterns regarding the publication of scientific articles, by varying journals and authors, and illustrated sub-field patterns both recently and for the entire 20-year period examined. Smoke-free spaces policy researchers have most commonly, and appropriately, published their work in health-related and tobacco control journals, but also added to the disciplinary dialogue in journals devoted to policy, economics, business, and the social sciences. The lessons learned from smoke-free spaces policy research are clearly relevant to an interdisciplinary audience.

This research contributes to the ongoing dialogue of smoke-free spaces policy, which is an important, and required, facet of tobacco control and public health literatures pertaining to population-level interventions. The study findings also contribute to our understanding of knowledge exchange, particularly in tobacco control, where the scope and nature of the evidence presented in the scientific literature evolves in response to fluctuations in the practice of policy development and informs emerging policy priorities. These patterns of exchange between policy, research and practice may be echoed throughout public health policy, and should be attended to by those interested in policy as a tool for population health intervention.

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