Assessing the impact of Canadian primary care research and researchers

Citation analysis

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Abstract

Objective To describe the citation impact and characteristics of Canadian primary care researchers and research publications.

Design Citation analysis.

Setting Canada.

Participants A total of 266 established Canadian primary care researchers.

Main outcome measures The 50 most cited primary care researchers in Canada were identified by analyzing data from the Scopus database. Various parameters, including the number of publications and citations, research themes, Scopus *h* index, content analysis, journal impact factors, and field-weighted citation impact for their publications, were assessed. Information about the characteristics of these researchers was collected using the Google search engine.

Results On average, the 50 most cited primary care researchers produced 51.1 first-author publications (range 13 to 249) and were cited 1864.32 times (range 796 to 9081) over 29 years. Twenty-seven publications were cited more than 500 times. More than half of the researchers were men (60%). Most were clinician scientists (86%) with a primary academic appointment in family medicine (86%) and were affiliated with 5 universities (74%). Career duration was moderately associated with the number of first-author publications (0.35; *P*=.013). Most research focused on family practice, while some addressed health and health care issues (eg, continuing professional education, pharmaceutical policy).

Conclusion Canada is home to a cadre of primary care researchers who are highly cited in the medical literature, suggesting that their work is of high quality and relevance. Building on this foundation, further investments in primary care research could accelerate needed improvements in Canadian primary care policy and practice.

Évaluer l'impact de la recherche et des chercheurs canadiens en soins primaires

Analyse des citations

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Résumé

Objectif Décrire l'impact des citations et les caractéristiques des publications des chercheurs canadiens et de la recherche en soins primaires.

Type d'étude Une analyse des citations.

Contexte Le Canada.

Participants Un total de 266 chercheurs canadiens reconnus en soins primaires.

Principaux paramètres à l'étude Les 50 chercheurs en soins primaires les plus cités au Canada ont été identifiés en analysant les renseignements dans la base de données Scopus. Divers paramètres ont été évalués, y compris le nombre de publications et de citations, les thèmes de recherche, les indices *h* de Scopus, l'analyse du contenu, les facteurs d'impact des revues et l'impact pondéré des citations selon le domaine pour leurs publications. Les renseignements concernant les caractéristiques de ces chercheurs ont été recueillis à l'aide du moteur de recherche Google.

Résultats En moyenne, les 50 chercheurs en soins primaires les plus cités ont produit 51,1 publications à titre de premier auteur (variant entre 13 et 249) et ont été cités 1864,32 fois (variant entre 796 et 9081) sur une période de 29 ans. Quelque 27 publications ont été citées plus de 500 fois. Plus de la moitié des chercheurs étaient des hommes (60 %). La majorité d'entre eux étaient cliniciens chercheurs (86 %) dont le poste universitaire principal était en médecine familiale, et ils étaient affiliés à 5 universités (74 %). La durée de leur carrière était modérément associée au nombre de publications à titre de premier auteur (0,35 ; *p*=,013). La plupart des travaux de recherche concernaient la pratique familiale, et certains se penchaient sur des questions de santé et de soins de santé (p. ex. développement professionnel continu, politique pharmaceutique).

Conclusion Il existe au Canada un groupe de chercheurs en soins primaires abondamment cités dans la littérature médicale, ce qui porte à croire que leurs travaux sont pertinents et d'une grande qualité. En misant sur ce fondement, des investissements plus nombreux dans la recherche en soins primaires pourraient accélérer les améliorations nécessaires dans les politiques et les pratiques en soins primaires au Canada.

High-performing primary care (PC) is widely acknowledged as the cornerstone of effective and efficient health care systems.[1,2] Herein, primary care is defined as an

> [i]nclusive term to cover the spectrum of first-contact healthcare models from those whose focus is comprehensive, person-centered care, sustained over time, to those that also incorporate health promotion, community development and intersectoral action to address the social determinants of health.[1,3]

In 2008, the World Health Organization highlighted the importance of producing knowledge and research to accelerate primary care reform.[4] Despite this recognition, investment in PC research and the number of publications are low in Canada and abroad.[5] The National Academies Committee on Implementing High-Quality Primary Care concluded there is a paucity of published literature on primary care reform and a substantial need for PC-oriented research identifying the practices and approaches to improve the delivery of high-quality PC.[6]

In Canada, investment in PC research has been made through several initiatives: In 2000, the Government of Canada established the $800-million Primary Health Care Transition Fund to support pilot and demonstration projects and research.[7] In 2003, the Canadian Institutes of Health Research (CIHR) launched the Transdisciplinary Understanding and Training on Research–Primary Health Care program; funding ended in 2013.[8,9] In 2012, the CIHR Institute of Health Services and Policy Research and Institute of Population and Public Health launched the Community-Based Primary Health Care Signature Initiative,[10] which provided funding to 12 interdisciplinary, cross-jurisdictional innovation teams to conduct research and provide research training and mentorship.[9] In 2014, the CIHR implemented the Community-Based Primary Health Care pan-Canadian Strategy for Patient-Oriented Research Network in Primary and Integrated Health Care Innovations.[9,11] These initiatives showcase the country's commitment to fostering research excellence in PC. However, total investment in PC research represented only 3% of total CIHR research funding from 2016 to 2017 and from 2017 to 2018.[3]

Canada's underinvestment in PC research now coincides with the current PC crisis. Approximately 14% of Canadians do not have a regular care provider.[12] Among seniors aged 65 or older in 11 Commonwealth countries, Canada has the lowest rate of those who can see a doctor or nurse on the same or the next day and the second highest rate of seniors going to the emergency department for health problems that could have been handled by a PC provider.[13] This underinvestment in PC research, evidence, and knowledge exacerbates our ability to adequately navigate the current crisis.

Despite the low investment in PC research, Canada is home to PC researchers who have received international recognition and have made important contributions to the field.[14-23] However, there is limited awareness of their scholarly productivity and the impact of their research. This study analyzes and describes the research publication impact of PC research and researchers. Specifically, it identifies the 50 most cited Canadian PC researchers and their individual and aggregate citation impact; characteristics of the most cited Canadian PC researchers; and the most cited peer-reviewed publications by Canadian PC researchers. By undertaking this study, we aim to celebrate the achievements of Canadian PC researchers and highlight the knowledge they bring to the field.

Methods

Design

We conducted a citation analysis[24] using quantitative bibliometrics,[25,26] which is exempt from ethics review board approval. One measure of the impact (ie, the scientific contribution of a published work) of research studies is the frequency of manuscript citations by other scholars.[27] Citation analysis has been used to describe and analyze trends in scientific articles, authorship, journals, and different research fields.[28-37]

Sample

To identify Canadian PC researchers, we used a sequential nomination process. The sampling frame included those who were 1 or both of the following: a researcher whose research is focused on PC or a PC clinician who does research. The initial list was created in March 2020 and consisted of recipients of research honours from the College of Family Physicians of Canada.[38-41] Additional researchers were added to the list based on input from senior researchers and leaders. The list was sent to the research directors of the 17 family medicine departments across Canada who provided names of researchers whose first-author peer-reviewed papers are highly cited (ie, researchers who publish multiple papers per year, many as the first author, often in high-impact journals). Finally, 6 additional researchers were added from the Stanford University researcher list of Canadian researchers. We eliminated 26 researchers due to no first-author publications, no research in PC, or limited time spent in Canada. The final list comprised 266 established PC researchers.

Data sources

The Scopus database was used to obtain bibliometric data since it includes a comprehensive overview of science, technology, medicine, social science, and arts and humanities research. For the 266 PC researchers, we produced a list of their respective publications and the number of citations (excluding self-citations) in December 2022.

Data collection and analysis

We identified the 50 most cited researchers (top 20%) based on the number of citations of their first-author publications. To ensure this metric was valid, we confirmed a high correlation between first-author citations and rank as well as first- and last-author citations (ρ=0.803) and rank (ρ=0.814), as well as between first-author citations and rank and first-, second-, and last-author citations (ρ=0.750) and rank (ρ=0.765).

Using a Microsoft Excel spreadsheet, we collected data on the number of first-author publications, number of co-author publications, number of first-author publication citations, number of co-author publication citations, date of initial first-author peer-reviewed publication and date of most recent peer-reviewed publication (either as first author or co-author), research themes, and *h* index.[42] The time between a researcher's first peer-reviewed first-author publication and their most recent peer-reviewed publication was used as a proxy for the duration of their research career to date.

To collect data on the characteristics of these PC researchers, targeted Internet searches were conducted in Google to find the following information: sex, province of residence, university and department affiliation, academic rank, faculty research intensity of current university,[43] graduate degrees, university or institution, discipline or program, researcher type (eg, clinician-researcher [and clinical discipline], health scientist [non-clinician]), and health profession. In our analysis, we have primarily considered researchers' current affiliations; however, it is important to acknowledge that researchers may have multiple affiliations or collaborations throughout their careers, which could influence their research productivity in various contexts.

Using Scopus, we identified peer-reviewed publications with more than 500 citations and recorded contextual information on each article, including title, authors, journal, the number of citations, journal impact factor, field-weighted citation impact,[44] full citation, and abstract. The research team reviewed data extraction. We used point-serial correlation and Pearson correlation tests to examine associations between different variables in **Table 1**.

Results

Table 2 lists the 50 Canadian PC researchers with the highest number of citations of first-author peer-reviewed publications in descending order of the number of first-author citations. Researcher profiles are available in the supplementary material in **CFPlus**.* Collectively, the 50 most cited PC researchers have published 2555 papers as first authors and have been cited 93,216 times. The researcher with the highest number of career citations is Dr Dave Davis from the University of Toronto in Ontario (9081 career citations) followed by Dr Moira Stewart from Western University in London, Ont (6686 career citations).

The characteristics of the most cited PC researchers are provided in **Table 3**. Thirty researchers are male and 20 are female. Most (54%) reside in Ontario, followed by Quebec (22%), British Columbia (12%), and Alberta (8%). One-third are affiliated with the University of Toronto. Family medicine is the primary departmental affiliation (86%). Sixty-four percent are certified family physicians. The number of first-author publications per researcher varies from 13 to 249, with a median of 49 and a mean of 51. The number of first-author citations varies (from 796 to 9081), with a median of 1191 and a mean of 1864. The researchers' *h* index scores range from 15 to 87, with a median value of 37. Statistical analysis found that career duration is moderately associated with the number of first-author publications (**Figure 1**). All other correlations tested were weak and not statistically significant.

The 27 peer-reviewed publications by Canadian PC researchers cited more than 500 times are listed in **Table 4**.[22,45-70] All first authors were among the most cited PC researchers. The year of publication ranged from 1992 to 2018. All but 7 were published in journals with an impact factor greater than 5. The majority of publications were in international journals (**Figure 2**, available from **CFPlus***). One was in the *New England Journal of Medicine*, 4 were in *JAMA*, and 3 publications were in the *Canadian Medical Association Journal*. The *New England Journal of Medicine* stands out due to its exceptionally high impact factor of 158.5, making it one of the most influential medical journals globally. Its widespread citation in scientific literature distinguishes it as a noteworthy platform for disseminating PC research findings.[71] All but 4 publications for which information was available scored greater than 10 for the field-weighted citation impact score, indicating they were cited substantially more often than similar articles. Four had a field-weighted citation impact greater than 50.

The research topics covered are diverse, many focusing on professional education, clinician behaviour change, and patient relationships (see **Figure 3**, available from **CFPlus**,* for a word cloud of key topics). Sixteen publications reported the results of systematic reviews or reviews. Drs Dave Davis, Moira Stewart, Merrick Zwarenstein, Martin Fortin, and Pierre Pluye authored multiple papers that were most cited.

Most researchers were clinician scientists (86%) with their primary academic appointment in family medicine. Forty-two researchers (84%) were found to have graduate degrees (see **Figure 4**, available from **CFPlus**,* for a word cloud of degrees). Most were affiliated with 5 universities (University of Toronto; McGill University in

*__Supplementary material__ and __Figures 2-4__ are available from __https://www.cfp.ca__. Go to the full text of the article online and click on the __CFPlus__ tab.

Table 1. Tests of relationships within the most cited researcher cohort

VARIABLE 1	VARIABLE 2	TEST
Number of first-author publications	Sex	Point-serial
Number of first-author publications and first-author citations	Sex	Point-serial
Duration of research career	Number of first-author publications	Pearson correlation
Duration of research career	Total number of publications	Pearson correlation
Duration of research career	Number of first-author citations	Pearson correlation
Number of first-author publications	Number of first-author citations	Pearson correlation
Total number of publications	Number of first-author citations	Pearson correlation
Faculty research intensity rating	Number of first-author publications	Pearson correlation
Faculty research intensity rating	Total number of publications	Pearson correlation
Faculty research intensity rating	Number of first-author citations	Pearson correlation

Montréal, Que; Western University; University of British Columbia in Vancouver; and McMaster University in Hamilton, Ont).

Discussion

This study suggests that Canada has much to celebrate, showcasing the notable research productivity and impact of Canada's 50 most cited PC researchers despite limited research investments in the field. This research has the potential to influence clinical practice, health care policy, and patient-oriented outcomes. A comparative perspective of citation rate in different disciplines suggests that researchers in physical activity and aging receive fewer citations on highly cited papers compared with citation rates observed among PC researchers in this study, suggesting a notable impact within the field.[72] Future research should focus on examining PC researchers' first-author citation impact across countries and disciplines and the participation of researchers in international collaboration, which can further enrich our understanding of researchers' contributions on a global scale.

While we have highlighted papers with more than 500 citations as a metric of high-impact publications, it is important to note that these citations encompass a spectrum of medical disciplines and health care topics, and not all of them are exclusive to PC research. Future research endeavours may explore research topics in greater depth to provide a more comprehensive understanding of PC research in Canada. Furthermore, most of the highest cited publications were not in PC-specific journals (**Figure 2**) but published in general medical journals. While PC-specific journals are pivotal for discussions within the PC community, the inclusion of PC research in broader medical journals extends its reach and impact by enabling PC researchers to engage with a wider readership, including specialists and policy-makers, who may not regularly peruse PC-specific journals.

The citation impact of PC researchers, despite low levels of research investment in the field, might be explained by an individual's psychological and cognitive characteristics. Psychological and cognitive traits and time spent on research for family medicine faculty are the most predictive of research productivity.[73] These factors included enhancing research skills, establishing a definable research agenda, fostering research networks, having multiple research projects, maintaining in-depth knowledge of a research area, and clearly understanding research expectations for promotion and tenure.[73]

There was substantial heterogeneity in the characteristics of the top 50 PC researchers. This group included more male researchers (60%) than female researchers. Several studies suggest women publish less than men.[74-77] A US study found that female faculty members were underrepresented as first authors in prominent family medicine journals.[78] Female faculty with dependent children are less productive than all males as well as females without children, especially those who are early-career researchers with young children.[79,80] We acknowledge the intersection of sex and career duration, recognizing that there are fewer female researchers and practitioners among those with longer career durations.[81] This intersection may contribute to the observed gender disparity among top researchers. In line with the evolving landscape of academic research, we acknowledge that contemporary academic collaborations increasingly involve interdisciplinary teams, international cooperation, and larger authorship groups. This could influence the traditional importance attributed to the first author's position. However, studies demonstrate female faculty potentially have fewer and smaller collaborations throughout their professional journeys compared with their male counterparts.[82]

Longer career duration was positively associated with the number of first-author citations, underscoring the enduring impact and productivity of these PC researchers. This aligns with the literature, suggesting

Table 2. Fifty most cited Canadian primary care researchers

NAME	NUMBER OF PEER-REVIEWED FIRST-AUTHOR PUBLICATIONS	NUMBER OF PEER-REVIEWED CO-AUTHOR PUBLICATIONS	TOTAL NUMBER OF PEER-REVIEWED PUBLICATIONS	NUMBER OF FIRST-AUTHOR CITATIONS (EXCLUDING SELF-CITATIONS)*	NUMBER OF CO-AUTHOR CITATIONS	TOTAL NUMBER OF CITATIONS	*h* INDEX
1. Dave Davis	52	107	159	9081	9470	18,551	44
2. Moira Stewart	45	150	195	6686	6462	13,148	39
3. France Légaré	71	355	426	4128	14,349	18,477	64
4. Martin Fortin	30	101	131	3721	3465	7186	32
5. Joel Lexchin	249	153	402	3673	5343	9016	39
6. Merrick Zwarenstein	51	264	315	3593	13,558	17,151	58
7. Eva Grunfeld	48	139	187	3533	5096	8629	41
8. Yvonne Steinert	59	106	165	3062	3732	6794	42
9. Bernard Le Foll	58	218	276	2567	5968	8535	47
10. Brian H. Rowe	88	563	651	2508	24,647	27,155	87
11. Margo Mountjoy	53	98	151	2228	5068	7296	37
12. Roger Thomas	87	42	129	2166	1611	3777	33
13. Jeannie Haggerty	29	108	137	2163	2208	4371	29
14. Murray Finkelstein	117	24	141	2109	1464	3573	33
15. Rob Petrella	71	176	247	2057	13,231	15,288	52
16. Pierre Pluye	33	128	161	1945	5572	7517	33
17. Noah Ivers	36	223	259	1790	5605	7395	38
18. Richard H. Glazier	39	303	342	1486	11,509	12,995	59
19. Alba DiCenso	34	95	129	1445	5186	6631	36
20. Annette J. Browne	30	80	110	1429	2057	3486	33
21. Jeff Kwong	27	232	259	1422	4990	6412	41
22. Robert Reid	17	98	115	1387	8236	9623	43
23. Ross E.G. Upshur	68	309	377	1239	9758	10,997	49
24. Stewart B. Harris	41	237	278	1237	11,987	13,224	58
25. Michel Labrecque	50	154	204	1192	5607	6799	42
26. Tanvir Turin Chowdhury	72	165	237	1189	4294	5483	38
27. Martin Dawes	51	112	163	1183	5795	6978	41
28. Howard Bergman	13	223	236	1158	17,635	18,793	59
29. Michael Klein	70	64	134	1145	1616	2761	29
30. Gina Ogilvie	29	246	275	1143	5067	6210	39
31. Judith Belle Brown	50	159	209	1133	5944	7077	39
32. Ellen Wiebe	93	28	121	1079	477	1556	25
33. Brian G. Hutchison	26	87	113	1053	4273	5326	34
34. Andrea Gruneir	23	71	94	1048	3098	4146	36
35. Tony Antoniou	56	83	139	1046	1309	2355	23
36. Lisa Dolovich	24	157	181	1039	4034	5073	37
37. Clare Liddy	54	123	177	1039	1506	2545	24
38. Karen Tu	27	170	197	1038	5152	6190	42
39. Kevin Pottie	53	130	183	1033	4535	5568	33

Table 2 *continued on page 335*

Table 2 *continued from page 334*

NAME	NUMBER OF PEER-REVIEWED FIRST-AUTHOR PUBLICATIONS	NUMBER OF PEER-REVIEWED CO-AUTHOR PUBLICATIONS	TOTAL NUMBER OF PEER-REVIEWED PUBLICATIONS	NUMBER OF FIRST-AUTHOR CITATIONS (EXCLUDING SELF-CITATIONS)*	NUMBER OF CO-AUTHOR CITATIONS	TOTAL NUMBER OF CITATIONS	*h* INDEX
40. Jenny Ploeg	32	191	223	1024	3674	4698	35
41. Neil Andersson	56	167	223	1004	4994	5998	29
42. Anne Cockcroft	67	110	177	985	2031	3016	27
43. Doug Manuel	39	213	252	964	5971	6935	47
44. Mary Ann O'Brien	19	68	87	962	8013	8975	29
45. Ann Macaulay	19	68	87	952	2927	3879	26
46. Graham J. Worrall	60	15	75	887	190	1077	15
47. Ann Burchell	24	171	195	832	4503	5335	31
48. Fred Burge	31	121	152	827	1648	2475	27
49. Richard Fleet	33	57	90	810	703	1513	20
50. Walter Rosser	51	54	105	796	1469	2265	25

*Ranking by number of first-author citations.

that research experience since completing a PhD[83] and tenure-track PC roles increases academic productivity.[84] We also found that most researchers were clinician scientists (86%) with primary academic appointments in family medicine. Forty-two researchers (84%) had graduate degrees (**Figure 4**). Most were affiliated with 1 of 5 universities. Research impact is facilitated by institutional factors such as resources, incentives, and effective leadership.[85-89] A US study revealed that high-capacity family medicine departments are characterized by more research-trained faculty, substantial internal funding investments, and securing substantial external funding.[90] These factors could have shaped research productivity in the most productive institutions. This study also found that all of the 50 most cited researchers were located in the 4 largest provinces (Ontario, Quebec, British Columbia, and Alberta) that offer additional grant funding opportunities.[91-94] This may influence the number of grants awarded to researchers and institutions, leading to greater productivity of researchers.[95] High-quality researchers may be attracted to larger academic centres, a factor that may contribute to research productivity.

Limitations

Despite our best efforts, some researchers meeting the inclusion criteria may have been unintentionally omitted, particularly those not affiliated with a family medicine department, including those affiliated with nursing, public health, epidemiology, and health services. The study focuses on first-author publications. We acknowledge that highly productive research scientists may also be the second or last authors on publications and contribute to research impact by supporting teams and students. Furthermore, Scopus does not have universal coverage of all journals and may have errors or omissions. In addition, the *h* index is captured for the period between 2007 and 2022. The researcher profiles are based on publicly available data and did not permit examination of the role of ethnicity or racialization on research productivity, which requires further investigation. Future studies could consider incorporating additional bibliometric measures, such as the *h* index or *d* index, for a more comprehensive assessment. This study did not include a detailed analysis of research topics and their frequencies. Future research endeavours may explore research topics in greater depth to provide a more comprehensive understanding of PC research in Canada. Finally, it is important to note that bibliometrics alone cannot capture the entirety of a researcher's contributions, clinical impact, patient outcomes, and societal relevance.

Conclusion

While our study celebrates the remarkable contributions of highly productive and cited PC researchers in Canada, we acknowledge the need for further investigation into the broader landscape of PC research. Our analysis has laid a foundation by highlighting the concentration of PC research papers and citations among a select group of researchers, along with their affiliations and their commendable citation rates. However, we recognize the importance of addressing unanswered questions, such as comparisons with PC researchers in other countries and across disciplines; the prevalence of research topics among Canadian PC researchers and international collaborations; evaluating how interdisciplinary teams impact first-author positions; the perspectives of researchers regarding their identification with PC research; and investigation of metrics related to research impact on clinical practice, health care

Table 3. Characteristics of the 50 most cited Canadian primary care researchers

CHARACTERISTIC	VALUE
Sex, n (%)	
• Female	20 (40)
• Male	30 (60)
Duration of research career, y	
• Range	15.0-45.0
• Median	28.5
• Mean	30.4
Province of residence, n (%)	
• Ontario	27 (54)
• Quebec	11 (22)
• British Columbia	6 (12)
• Alberta	4 (8)
• Nova Scotia	1 (2)
• Newfoundland and Labrador	1 (2)
University affiliation, n (%)	
• University of Toronto	15 (30)
• McGill University	7 (14)
• University of British Columbia	6 (12)
• Western University	5 (10)
• McMaster University	4 (8)
• Laval University	3 (6)
• University of Ottawa	2 (4)
• University of Calgary	2 (4)
• University of Alberta	2 (4)
• University of Sherbrooke	1 (2)
• Dalhousie University	1 (2)
• Memorial University of Newfoundland	1 (2)
• Queen's University	1 (2)
Department affiliation, n (%)	
• Family medicine	43 (86)
• Nursing	3 (6)
• Institute of Health Policy, Management and Evaluation, School of Population and Public Health	2 (4)
• Pharmacy	1 (2)
• Emergency medicine	1 (2)
Academic rank, n (%)	
• Professor	40 (80)
• Associate professor	8 (16)
• Assistant professor	2 (4)
Researcher type, n (%)	
• Clinician scientist	43 (86)
• Health scientist (nonclinician)	7 (14)
Graduate degrees, n*	
• PhD	11
• MSc, PhD	10
• MSc	10

Table 3 *continued on next*

Table 3 *continued from previous column*

CHARACTERISTIC	VALUE
Graduate degrees, n*	
• MPH	2
• MSc, MSc, PhD	1
• MA, PhD	1
• MSN, PhD	1
• MPH, PhD	1
• MA, MSc	1
• MS, PhD	1
• MClSc	1
• MScN, PhD	1
• MSc-MPhil, PhD	1
Health profession, if applicable, n (%)	
• Family physician (CCFP, FCFP)	32 (64)
• Physician (non-CCFP, non-FCFP)	6 (12)
• Registered nurse	3 (6)
• Pharmacist	1 (2)
• Social worker	1 (2)
• Clinical psychologist	1 (2)
• Other	6 (12)
Number of first-author publications	
• Range	13.0-249.0
• Median	49.0
• Mean	51.1
Number of co-author publications	
• Range	15.0-563.0
• Median	129.0
• Mean	150.3
Total number of publications	
• Range	75.0-651.0
• Median	179.0
• Mean	201.4
Number of first-author citations (excluding self-citation)	
• Range	796.0-9081.0
• Median	1190.5
• Mean	1864.3
Number of co-author citations	
• Range	190.0-24,647.0
• Median	5030.5
• Mean	5740.7
Total number of citations	
• Range	1077.0-27,155.0
• Median	6521.5
• Mean	7605.1
h index	
• Range	15.0-87.0
• Median	37.0
• Mean	38.4

*For 8 researchers educational background was not available or not found.

Figure 1. Relationship between number of first-author publications and duration of research career

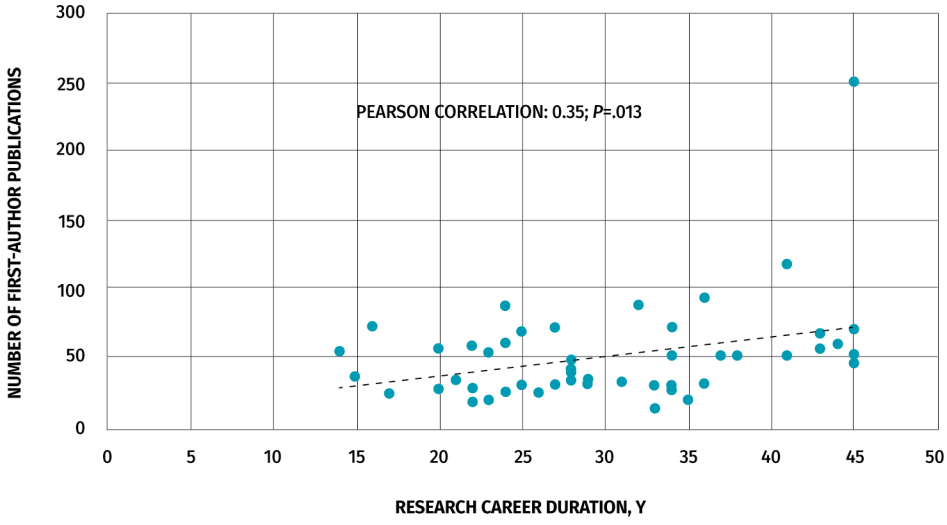

Table 4. Most cited peer-reviewed publications by Canadian primary care researchers

RANK	TITLE	AUTHORSHIP	YEAR OF PUBLICATION	JOURNAL	JOURNAL IMPACT FACTOR	NUMBER OF CITATIONS	FIELD-WEIGHTED CITATION IMPACT*
1	Effective physician-patient communication and health outcomes: a review[22]	Stewart MA	1995	*CMAJ*	17.4	2776	NA
2	Changing physician performance: a systematic review of the effect of continuing medical education strategies[45]	Davis DA, Thomson MA, Oxman AD, Haynes RB	1995	*JAMA*	157.375	2349	NA
3	Impact of formal continuing medical education: do conferences, workshops, rounds, and other traditional continuing education activities change physician behavior or health care outcomes?[46]	Davis D, O'Brien MA, Freemantle N, Wolf FM, Mazmanian P, Taylor-Vaisey A	1999	*JAMA*	157.375	1847	58.37
4	The impact of patient-centered care on outcomes[47]	Stewart M, Brown JB, Donner A, McWhinney IR, Oates J, Weston WW, et al	2000	*J Fam Pract*	0.725	1713	27.6
5	Pharmaceutical industry sponsorship and research outcome and quality: systematic review[48]	Lexchin J, Bero LA, Djulbegovic B, Clark O	2003	*BMJ*	105.7	1595	54.56
6	Accuracy of physician self-assessment compared with observed measures of competence: a systematic review[49]	Davis DA, Mazmanian PE, Fordis M, Van Harrison R, Thorpe KE, Perrier L	2006	*JAMA*	157.375	1547	41.39
7	Continuity of care: a multidisciplinary review[50]	Haggerty JL, Reid RJ, Freeman GK, Starfield BH, Adair CE, McKendry R	2003	*BMJ*	105.7	1294	12.1

Table 4 *continued on page 338*

Table 4 *continued from page 337*

RANK	TITLE	AUTHORSHIP	YEAR OF PUBLICATION	JOURNAL	JOURNAL IMPACT FACTOR	NUMBER OF CITATIONS	FIELD-WEIGHTED CITATION IMPACT*
8	Improving the reporting of pragmatic trials: an extension of the CONSORT statement[51]	Zwarenstein M, Treweek S, Gagnier JJ, Altman DG, Tunis S, Haynes B, et al	2008	*BMJ*	105.7	1134	48.33
9	Translating guidelines into practice. A systematic review of theoretic concepts, practical experience and research evidence in the adoption of clinical practice guidelines[52]	Davis DA, Taylor-Vaisey A	1997	*CMAJ*	17.4	1029	28.03
10	Evidence for the effectiveness of CME. A review of 50 randomized controlled trials[53]	Davis DA, Thomson MA, Oxman AD, Haynes RB	1992	*JAMA*	157.375	894	NA
11	Audit and feedback: effects on professional practice and healthcare outcomes[54]	Ivers N, Jamtvedt G, Flottorp S, Young JM, Odgaard-Jensen J, French SD, et al	2012	*Cochrane Database Syst Rev*	11.874	888	39.85
12	Interprofessional collaboration: effects of practice-based interventions on professional practice and healthcare outcomes[55]	Zwarenstein M, Goldman J, Reeves S	2009	*Cochrane Database Syst Rev*	11.874	823	9.0
13	Frailty: an emerging research and clinical paradigm—issues and controversies[56]	Bergman H, Ferrucci L, Guralnik J, Hogan DB, Hummel S, Karunananthan S, et al	2007	*J Gerontol A Biol Sci Med Sci*	5.1	796	16.18
14	A systematic review of faculty development initiatives designed to improve teaching effectiveness in medical education: BEME guide no. 8[57]	Steinert Y, Mann K, Centeno A, Dolmans D, Spencer J, Gelula M, et al	2006	*Med Teach*	4.277	753	19.11
15	Barriers and facilitators to implementing shared decision-making in clinical practice: update of a systematic review of health professionals' perceptions[58]	Légaré F, Ratté S, Gravel K, Graham ID	2008	*Patient Educ Couns*	3.36	740	56.77
16	Towards a global definition of patient centred care. The patient should be the judge of patient centred care[59]	Stewart M	2001	*BMJ*	105.7	731	15.13
17	The IOC consensus statement: beyond the Female Athlete Triad—Relative Energy Deficiency in Sport (RED-S)[60]	Mountjoy M, Sundgot-Borgen J, Burke L, Carter S, Constantini N, Lebrun C, et al	2014	*Br J Sports Med*	18.479	687	24
18	Educational outreach visits: effects on professional practice and health care outcomes[61]	O'Brien MA, Rogers S, Jamtvedt G, Oxman AD, Odgaard-Jensen J, Kristoffersen DT, et al	2007	*Cochrane Database Syst Rev*	11.874	683	12.79
19	Family caregiver burden: results of a longitudinal study of breast cancer patients and their principal caregivers[62]	Grunfeld E, Coyle D, Whelan T, Clinch J, Reyno L, Earle CC, et al	2004	*CMAJ*	17.4	673	11.46
20	Prevalence of multimorbidity among adults seen in family practice[63]	Fortin M, Bravo G, Hudon C, Vanasse A, Lapointe L	2005	*Ann Fam Med*	4.4	645	10.68

Table 4 *continued on page 339*

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RANK	TITLE	AUTHORSHIP	YEAR OF PUBLICATION	JOURNAL	JOURNAL IMPACT FACTOR	NUMBER OF CITATIONS	FIELD-WEIGHTED CITATION IMPACT*
21	Combining the power of stories and the power of numbers: mixed methods research and mixed studies reviews[64]	Pluye P, Hong QN	2014	*Annu Rev Public Health*	20.8	617	18.91
22	A scoring system for appraising mixed methods research, and concomitantly appraising qualitative, quantitative and mixed methods primary studies in mixed studies reviews[65]	Pluye P, Gagnon MP, Griffiths F, Johnson-Lafleur J	2009	*Int J Nurs Stud*	7.11	602	7.44
23	A systematic review of prevalence studies on multimorbidity: toward a more uniform methodology[66]	Fortin M, Stewart M, Poitras ME, Almirall J, Maddocks H	2012	*Ann Fam Med*	4.4	579	24.95
24	Acute myocardial infarction after laboratory-confirmed influenza infection[67]	Kwong JC, Schwartz KL, Campitelli MA, Chung H, Crowcroft NS, Karnauchow T, et al	2018	*N Engl J Med*	158.5	562	61.49
25	Multimorbidity and quality of life in primary care: a systematic review[68]	Fortin M, Lapointe L, Hudon C, Vanasse A, Ntetu AL, Maltais D	2004	*Health Qual Life Outcomes*	3.65	550	3.59
26	Sicily statement on evidence-based practice[69]	Dawes M, Summerskill W, Glasziou P, Cartabellotta A, Martin J, Hopayian K, et al	2005	*BMC Med Educ*	3.6	535	9.57
27	The case for knowledge translation: shortening the journey from evidence to effect[70]	Davis D, Evans M, Jadad A, Perrier L, Rath D, Ryan D, et al	2003	*BMJ*	105.7	510	14.35

BEME—best evidence medical education, CME—continuing medical education, CONSORT—Consolidated Standards of Reporting Trials, IOC—International Olympic Committee, NA—not available.
*The field-weighted citation impact from Scopus shows how well the document is cited compared with similar documents. A value greater than 1.00 means the document is more frequently cited than expected.

policy, and patient-oriented outcomes, which are vital to advancing PC research in Canada. Further investments in PC research and researchers hold the potential to accelerate the generation of knowledge that supports the Quintuple Aim,[96] enhances health equity, and aligns with patient-oriented outcomes.

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Contributors
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Competing interests
None declared

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