

An Analysis of the Postal Code Conversion File's Use in Research

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Abstract

This research paper examines how the Statistics Canada Postal Code Conversion File (PCCF) is being used by researchers. The study used a systematic search strategy to locate publications that incorporated the use of the PCCF into the underlying research process. The retrieved publications were then reviewed, and data was collected for several variables such as year of publication, type of publication, researcher's discipline or field, and category of PCCF usage.

Analysis of the results found that the Data Liberation Initiative program was definitely a factor in increasing the use of the PCCF among academic researchers. It also established that researchers from the health sciences and medical fields were the predominant users of the PCCF. With regards to the category of usage, the study has discovered that most researchers use the PCCF for the following purposes: 1) to aggregate research data to census geographic units; 2) to link research data (individual or aggregated) with the corresponding census data; 3) to determine the rural/urban geographic location of their subjects; 4) to measure distance; and, 5) to map data.

Keywords: Postal Code Conversion File, Fichiers de Conversion des Codes Postaux, PCCF, PCCF+, FCCP, geocoding, geographical coding, postal codes, census

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Introduction

The objective of this study is to gain an understanding of how Statistics Canada's Postal Code Conversion File (PCCF) has been used by researchers. Several factors will be examined: the level of usage of the PCCF in research, the purposes for which it is being used, and the breakdown of use by discipline. This information will hopefully raise awareness among data librarians of the potential uses and users of the PCCF as well as demonstrate the importance of this tool.

Background

The postal code was implemented in Canada in the early 1970s (Canadian Museum of Civilization, 2010). Not long after, the idea for some kind of conversion file that would automate the assignment of geographical codes to data items (with postal codes) on user files was thought up by Nelson Kopustas of Statistics Canada (Haydu, 1979). The actual creation of the "postal code – geographical code conversion file" was described in detail by George Haydu in a 1979 paper presented at the Annual Meeting of the Canadian Association of Geographers. This early tool assigned the following geographic codes to postal codes: Standard Geographical Classification Codes, Census Tract Codes, Enumeration Area Codes and Census Street Index Agglomeration Codes. "In April 1983 the Geography Division [of Statistics Canada] released the first version of the Postal Code Conversion File (PCCF) which linked postal codes to 1981 Census geographic areas and included geographic coordinates" (Statistics Canada, 2011b, p. 7).

The Postal Code Conversion File (PCCF) is a digital file which provides a correspondence between Canada Post's 6-character postal codes and Statistics Canada's

census geography (dissemination blocks, dissemination areas, census tracts, census subdivisions, census divisions, census metropolitan areas and census agglomerations); it also provides latitude/longitude coordinates for each postal code (Statistics Canada, 2011a). This makes the PCCF both a very useful geocoding tool and a nearly complete census geographic database.¹

Each new census spawns a new PCCF due to changes in census geography, and between censuses the PCCF file is updated on a regular basis – approximately twice a year – and released each time as a new file. These updates are necessary because of constant changes to postal codes: the addition of new postal codes, the retirement of postal codes, and the reinstatement of retired postal codes. In addition to these changes, the linkage between postal codes and their corresponding census geographic units is always being improved.

For more information regarding the methodology used to create the PCCF and its detailed specifications, the reader is directed to the following two publications in the reference list: *Postal Code Conversion File (PCCF), Reference Guide* (Statistics Canada, 2011b) and *How Postal Codes Map to Geographic Areas* (Mechanda & Puderer, 2007).

In addition to the PCCF there is also the PCCF+. This is a collection of SAS-based programs and references files derived from the PCCF and the postal code population weight file (Wilkins & Khan, 2011). It was developed to deal with some of the limitations of the PCCF: ambiguity of rural postal codes and the need to identify postal codes used by businesses and other institutions, as well as postal codes linked to post office locations (Wilkins, 2010). The PCCF+ uses population-weighted random

¹ For a complete geographic list (including unpopulated areas, unenumerated Indian reserves, and other places without direct postal service) researchers should use the Statistics Canada Geographic Attributes File or GeoSuite

allocation to assign dissemination areas to postal codes that serve more than one dissemination area. Besides the geocoding function it also assigns income quintiles based on dissemination area census data and health regions based on reference lists maintained by Statistics Canada's Health Statistics Division (Statistics Canada, 2009).

Method

The methodology for this study was adapted from Hamilton and Humphrey's study of the life cycle of the National Population Health Survey (2006). General and specialized academic research databases were used along with Google Scholar to locate publications that indicated the use of the PCCF. See Appendix 1 for a full list of the databases used. Both the English and French variations – “postal code conversion file” and “fichier de conversion des codes postaux” – were searched in singular and plural forms along with the abbreviations PCCF, PCCF+ and FCCP.² As it became obvious that the PCCF was not always explicitly referred to in publications, the search was expanded to combining the phrase “postal code” with the following terms: census, income, rural, dissemination areas, enumeration areas, census tracts, neighbourhoods, geographic coding and socioeconomic/socio-economic.³ A search was also done on all the “cited by” references of the PCCF/PCCF+ manuals. All the references to the publications found were imported into RefWorks where duplicates were removed. These references were then each searched in the University of Calgary's Summon system so that the full text of these references could be analyzed. Summon is a web-based discovery service that provides Google-like searching of the University of Calgary's catalogue and the majority

² To reduce the number of false hits, these abbreviations were searched in conjunction with the phrase “postal code.”

³ This expanded search retrieved thousands of hits but only the most relevant results were reviewed for inclusion in the study.

of its databases. Items not found using Summon or items for which the University of Calgary did not have full text were then searched in Google Scholar. Electronic full text for all but one of the items was located using this process. The full text for that single item was retrieved from the print collection. Many of the French references – especially the Statistics Canada publications – turned out to be duplicates of English references. These duplicates were also removed. A few of the references also turned out to be false hits; they only incidentally mentioned the PCCF but were not using it, reviewing it or analyzing it. These references were also removed from the analysis. The end result was a total of 622 unique references retrieved.

The remaining publications were all reviewed, in particular the abstract, introduction, methods and then searched for all occurrences of the term “postal code.” The following information was extracted and compiled into a spreadsheet for each referenced publication: item type, title of article, year of publication, title of periodical (where applicable), the discipline of the primary or corresponding author, the purposes (up to three) that the PCCF performed in the research, the type of PCCF used (regular PCCF or PCCF+), and the presence or lack of a citation for the PCCF in the reference list of the publication.

Item types were classified as journal article, book chapter, conference proceedings, dissertation/thesis, or report. Where the item type was not a journal article, the title of the periodical field was used for the following purposes depending on the item type:

- a) Book chapter – title of book
- b) Conference proceedings – name of conference

- c) Dissertation/thesis – to identify Master (Arts or Science), PhD
- d) Report – report title

The researcher's discipline was recorded rather than the actual subject of the publication because the former was found to be much less subjective. To keep the number of disciplines manageable, some disciplines were absorbed into broader categories. One particular example is the public health category which includes epidemiology, population health, community health, public health, and a few other variations. The same process was applied to the discipline of medicine which includes all its sub-disciplines.

Up to three different purposes of PCCF usage were identified where applicable for each retrieved publication. Here is a list of the purposes that were used; a few cases did not fall neatly into these categories and were assigned "Exception" as a purpose with an explanatory note.

- a) Aggregate – to group individual user data records into census geographic units for purposes of analysis (ie. changing the unit of analysis); this purpose is frequently combined with the "Link to Census" purpose but not always.
- b) Distance Measurement – using the latitude and longitude coordinates to measure distances from one point to another (ex/ home to hospital)
- c) Link to Census – to assign census geographic codes to individual records for the purpose of linking neighbourhood (census tract, dissemination area, etc.) census data to the individual often as a proxy for the uncollected corresponding individual data; also used to link census data to records aggregated to census geographic units

- d) Map – to assign latitude and longitude geographic coordinates to display individual user records on a map often in conjunction with the “Distance Measurement” purpose; also used to create thematic maps derived from linked census data or from records aggregated to census geographic units
- e) Methodology – research on the accuracy of the PCCF; analysis of how it is created; analysis of the PCCF’s limitations
- f) Review – an item that discusses the PCCF and its uses
- g) Urban Rural – to assign an urban or rural geographic indicator to individual records; sometimes used with the “Link to Census” purpose
- h) Exception – purpose that does not fall into any of the other categories

Since there are two different types of postal code conversion tools – the regular PCCF and the PCCF+ – this information was also recorded. Where the use of the PCCF+ was specifically identified or fairly obvious this information was added to the analyzed reference; otherwise, it was assumed that the regular PCCF was used. As for the citation of the PCCF, both footnotes and reference lists of the publications were checked.

Results

Figure 1 shows the breakdown by item type of the unique 622 published items found. The 465 journal articles found appeared in 233 different periodical titles. The majority of the periodicals only had one article using the PCCF in them; however, there were some titles that did have more articles. See Appendix 2 for a list of the top twenty-five journals by the number of references. There were 74 theses/dissertations in the analyzed list of references. The breakdown of these was as follows: six Masters of Arts, 34 Masters of Science and 34 PhDs.

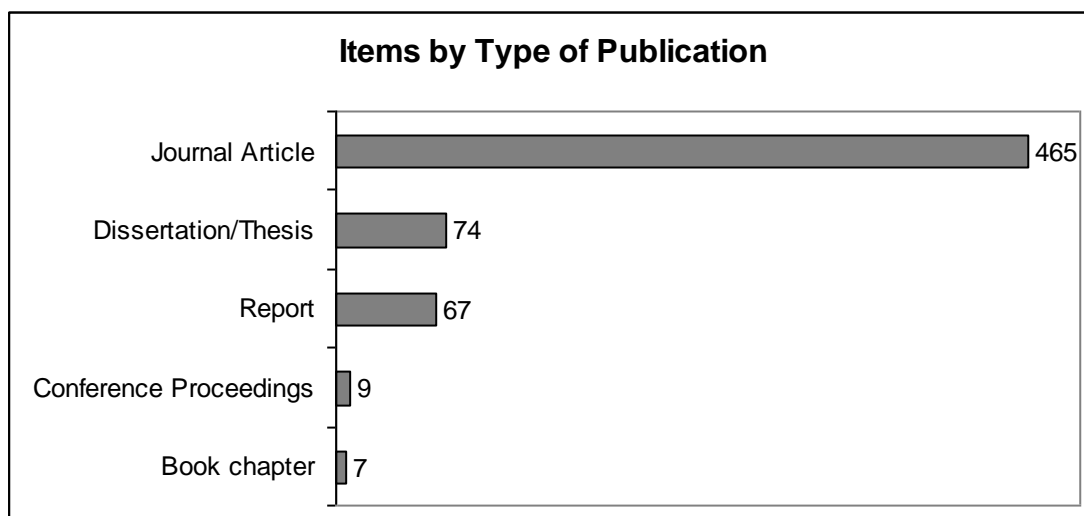


Figure 1

Figure 2 shows the breakdown of the published items found by the year of publication. The number of references each year from 1989 until 1997 is minimal. From 1999 until 2003 there is gradual growth in the number of references followed by a large jump in 2004 and another jump in 2010.

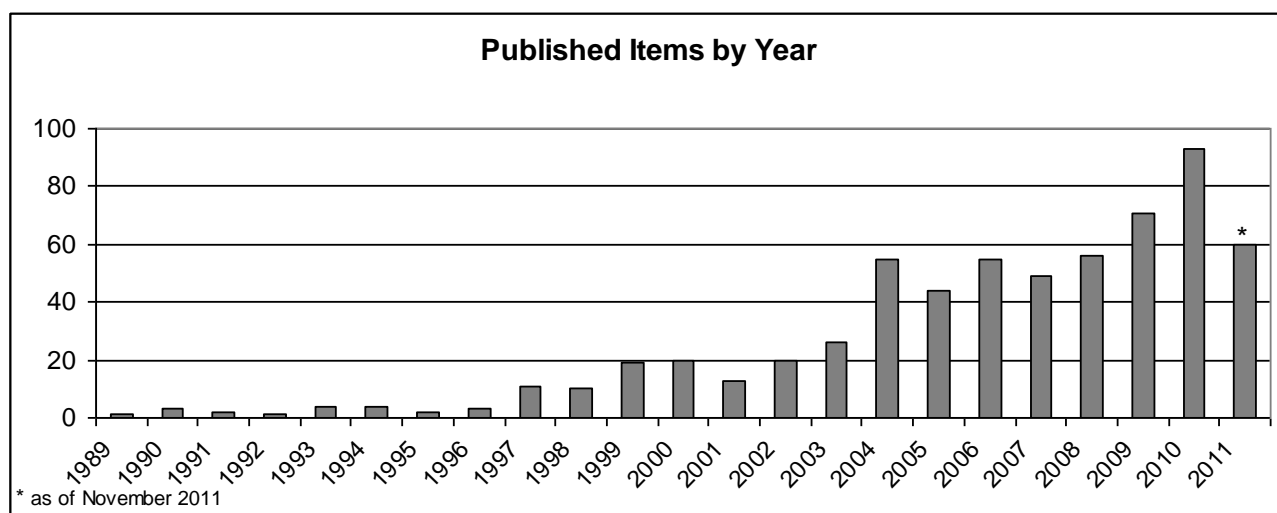


Figure 2

The majority of the published items using the PCCF (462 from 622 or 75%) were written by researchers in the health and medical disciplines. It was also noted that the

subject of many of the publications written by individuals outside of these disciplines (such as economics, geography, sociology, statistics, etc.) were also health related; however, as indicated in the methodology section, the subjects of the publications were not quantitatively recorded. Other significant users of the PCCF belonged to the geography, economics, business, education, and sociology disciplines. For a detailed breakdown of use of the PCCF by discipline see Appendix 3.

Figure 3 shows the breakdown of the items by the category of use of the PCCF tool. Many of the published items utilized the PCCF for more than one purpose. The eight usage categories were applied 813 times to the 622 published items.

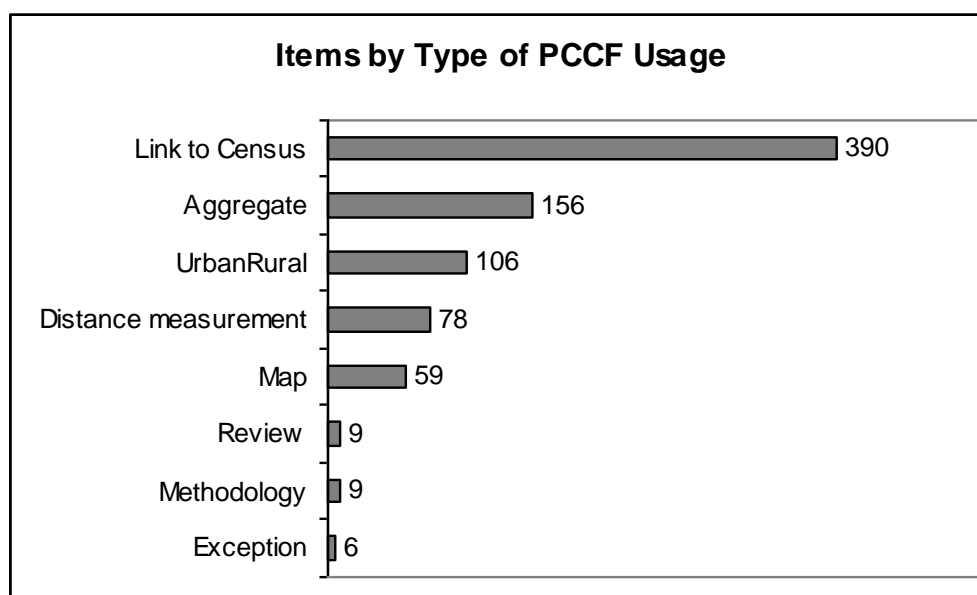


Figure 3

The major use of the PCCF in these published items was to link a researcher's data (individual or aggregated records) to the census. It was observed that in a majority of cases, the link was simply to the income or income quintile variable in the census. The second highest type of usage was to aggregate the researcher's records into census geographic areas for further analysis. This aggregation was frequently coupled with the

link to census usage. Here are some examples of this type of use: the linkage of socioeconomic status to disease incidence, morbidity, caesarean section rates, surgery wait times, childhood obesity, maintenance enforcement, post-secondary retention, low birth weight, cancer survival, hospital use, etc.

Many researchers also used the PCCF to geocode their data with latitude and longitude geographic coordinates so that distance measurements could be calculated, usually in a straight line fashion. Some examples of these distance measurements were home to medical treatment, home to educational institutions, home to playgrounds and parks, etc. Quite a few researchers were interested in the urban/rural aspects of their research subjects which covered a variety of areas including diseases and injuries, medical screening, health care, birth outcomes, employment insurance, nurses, physician supply, drinking water, etc. The mapping of research data was also a significant use of the geocoding aspect of the PCCF and was naturally often associated with the spatial analysis of such data as disease occurrence, prevalence of drug use, location of corporate headquarters, access to health care, equity of playgrounds, choice of schools, youth gambling, etc.

Although less frequently done, an interesting use of the PCCF was to add aggregate level census data to microdata master files such as the Canadian Community Health Survey (CCHS). The postal code in the records of the master file was used to look up the corresponding census data at either the census tract or dissemination area level. In fact, a few publications used the PCCF to bridge – at the aggregate level – between Statistics Canada master files and other master files or provincial administrative files. One example involved using the PCCF to allow calculation of unemployment rates

at the level of economic regions, using the Labour Force Survey master file, and then adding those rates to records from the National Apprenticeship Survey, based on economic regions also coded using the PCCF. The process involved in using the postal codes in master files is well documented in the Research Data Centre article by Gonthier, Hotton, Cook and Wilkins (2006).

The PCCF+ was either implicitly or explicitly used in the research described in 188 of the publications (30%). Researchers cited the regular PCCF in either a footnote or the reference list in 254 of the publications (41%). When checking the references, it was noted that the following two articles were frequently cited by a large number of the publications found: Wilkins (1993), and Ng, Wilkins and Perras (1993).

Discussion

The PCCF is a well used tool in research as the results have shown. Although the search of the databases attempted to be comprehensive, several factors may have limited the number of results found. The search terms rarely occurred in the title, abstract or descriptor/keyword fields, so the search was largely dependent on finding the terms in the full text of the published item. Therefore, the results would probably be skewed toward more current publications which are more likely to have searchable full text than earlier publications. This is evident from the simple observation that no publications earlier than 1989 were found even though the first edition of the PCCF was released in 1983. Another example of this would be earlier dissertations and theses which were scanned and are only pdf image files rather than searchable pdf files, particularly within the Dissertation Abstracts database. Also, by focusing on academic databases and Google Scholar, the reported results would likely be biased toward more traditional academic publications

such as journal articles, conference proceedings and dissertations/theses and would miss some of the reports falling into the gray literature category. This gray literature can be notoriously hard to find. This possibly explains the breakdown of the results by item type in Figure 1. The big issue, however, was that the use of the PCCF in the research process was not always explicitly stated and frequently had to be inferred from the research description. This made it very time-consuming and difficult to conduct an exhaustive search; the search had to finally come to an end at a certain point due to diminishing returns. Nevertheless, it is felt that the search retrieved a significant portion of the published literature that had used the PCCF in its research and that those results would shed valuable light on its use.

The significant increase in the number of annual published items starting in 1997 (see Figure 2) is interpreted as a direct result of the Data Liberation Initiative (DLI) program which began in 1996. The DLI program provides access for participating academic institutions to Statistics Canada's public use microdata files, aggregate files and geospatial layers for a low annual subscription fee which is paid for by the institution rather than the individual researcher. The PCCF was added to the DLI collection in 1997. Prior to that, academic researchers had to pay the full cost for files such as the PCCF. Currently, the initial cost for the PCCF for all of Canada is \$9000; for individual provinces and territories the cost varies between \$200-\$3550; and, for individual census metropolitan areas and census agglomerations the cost varies between \$200-\$1450 (Statistics Canada, 2011a). Without the DLI it is thought that this cost would be a barrier to the use of the PCCF in academic research.

Another factor that might explain some of the increase in published items starting in 1997 was the release of the 1996 census data, which as we will see shortly is strongly related to the PCCF's use; however, it should be noted that the DLI program was also responsible for providing easier and much less expensive access to the 1996 census data for academic researchers. There were three significant jumps in the number of annual publications: 1999, 2004, and 2009. These all occurred three years after a census (1996, 2001, 2006). The dissemination of the bulk of the data coming out of a census takes about a year. When combined with the research, writing and publishing time, it is logical to assume that it would take close to three years for the earliest published results to appear.

The domination of the use of the PCCF by health sciences and medical researchers was an interesting finding in this study. All but one of the top 25 journals publishing articles that had used the PCCF fell into the health sciences and medical disciplines. The articles by Wilkins (1993) and Ng, Wilkins and Perras (1993) definitely had an early and continuing impact on raising the awareness of the PCCF and its potential applications amongst health science and medical researchers. This conclusion was reached from the observation – as was previously mentioned – that many of these researchers' publications cited these two seminal works.

Another element in explaining the predominance of health and medical related uses of the PCCF relates to the development of the PCCF+. In many ways this tool was developed with those disciplines in mind. With its inclusion of income quintile data and improved rural geocoding, it has become a popular tool for many health professionals, although its use is limited to those researchers using the SAS statistical software.

The PCCF+ and PCCF have also been licensed for redistribution by the Public Health Agency of Canada “for health professionals in all levels of government across Canada, and those in NGOs and universities (excepting those in the private sector)” (Wilkins & Kahn, 2011, p. 2).⁴ Both tools have also been licensed by the Ontario Ministry of Health and Long Term Care “for redistribution to their affiliated health agencies across Ontario” (Wilkins & Kahn, 2011, p. 2). These initiatives have most likely raised awareness and ultimately use of the PCCF/PCCF+ in the health and medical fields.

There is a large amount of patient and administrative health data collected through provincial health services and much of this data comes with postal code information. Although it is often difficult for researchers to access, the existence of this data puts health and medical researchers at a bit of an advantage over researchers in other disciplines that would usually have to collect their own data at a considerable cost. However, individual-level data with postal codes is also collected by other public and non-profit organizations such as schools, universities, museums, as well as by many private sector enterprises. So, there are probably other factors influencing the higher use of the PCCF by health and medical researchers such as the amount of funding that is available for research in those areas as compared to other areas, but those factors were beyond the scope of this study to investigate.

From the results in Figure 3 there is no doubt that the PCCF tool is most frequently used to aggregate study respondents to census geographic areas, link them to their corresponding neighbourhood census data, and map the resulting data by census

⁴ The author recently contacted the Public Health Agency regarding this program and discovered that it has been discontinued.

geographic area. The determination of whether their location is rural or urban is sometimes used in conjunction with census population characteristics data, but is more often used independently. For these purposes the PCCF is a unique tool. The other uses of the PCCF to geocode respondents and places (playgrounds, supermarkets, hospitals, etc.) to their geographic coordinates (latitude/longitude) for mapping or distance measurements, although significant, are not unique to the PCCF. These latter geocoding functions can be accomplished with other tools such as the DMTI Spatial GeoPinpoint software which might explain why this type of use was lower than expected.

From a librarian's viewpoint it was surprising that less than half of the published items formally cited the PCCF as a source of information. This may have something to do with the fact that many researchers consider it more like a widely used software package or a generic coding tool rather than as something that needs to be cited in a bibliography. As well, in many of the publications' acknowledgements sections it was often noted that the PCCF geocoding was actually performed by someone outside the research team. This arm's length relationship between the PCCF geocoding and the research process may also be part of the explanation for the lower than expected level of PCCF citation.

Even though the data were collected, it is difficult to draw any real conclusions regarding the use of the PCCF+ in relation to the regular PCCF. Due to the fairly low occurrence of PCCF/PCCF+ citations in the publications, this information was mostly collected from methods sections and footnotes. Rarely was there any indication as to which version/release of the PCCF/PCCF+ was used, let alone distinguishing between the two tools. Therefore, the thirty percent figure for the use of the PCCF+ must be

treated as a minimum. In any event even with the uncertainty, the use of the PCCF+ for research is significant.

The analysis of the results that were retrieved through this study has demonstrated that the PCCF is a valuable geocoding tool, and that it has been used in a variety of creative applications. In the health sciences it has become standard practice to use postal codes to create additional data for analysis purposes (R. Wilkins, personal communication, November 9, 2011). Over the past eight years there have been 40-90 publications a year that have used the PCCF in their research. Nevertheless, the author believes that there is still room for considerable growth in the use of the PCCF, particularly by the non-health disciplines. By raising awareness of the PCCF through promotion as well as by acting as a catalyst through training researchers on how to use it, data librarians can play an important role with regards to the PCCF.

What does the future hold for the PCCF? The elimination of the long-form component of the 2011 Census will probably have an impact on PCCF use, especially since it has been observed that the main uses of the PCCF are census related (Collier, 2010). Hopefully, this will be mitigated to some extent by dissemination area level data from the National Household Survey, but that remains to be seen.

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Appendix 1 – Database Search Results (November 2011)
See Methods for Search Strategy

Database Searched	Number of Results
ABI/Inform	4
Academic Search Complete	60
Business Source Complete	3
CBCA	70
CPI Quarterly	21
CINAHL	6
Dissertation Abstracts	48
EconLit	1
ERIC	0
GeoBase	7
Google Books	99
Google Scholar	701
PAIS	0
Psychology and Behavioral Science Collection/ SocIndex with FullText	11
PsycInfo	20
PubMed	6
Science Direct	57
Social Work Abstracts	0
Sociological Abstracts	0
Urban Studies Abstracts	0
Web of Science	2

Appendix 2 – Top 25 Journals with Published Articles Using the PCCF

Title of Journal	Number of Articles
Canadian Medical Association Journal	23
Canadian Journal of Public Health	19
Health Reports	17
Social Science & Medicine	13
Journal of Epidemiology and Community Health	12
Health & Place	9
International Journal of Health Geographics	9
Chronic Diseases in Canada	8
Medical Care	8
Healthcare Policy	6
Pediatrics	6
Annals of Epidemiology	5
BMC Health Services Research	5
Cancer	5
Journal of Clinical Oncology	5
Stroke	5
The Open Women's Health Journal	5
American Journal of Epidemiology	4
American Journal of Public Health	4
BMC Public Health	4
Canadian Geographer	4
Canadian Journal of Surgery	4
Epidemiology and Infection	4
Gynecologic Oncology	4
Journal of the American Society of Nephrology	4

Appendix 3 – Published Items using the PCCF by Research Discipline

Category	Discipline	Number of Publications
Education, Data Access and Statistics	Education	14
	Physical Education	8
	Early Childhood Development	4
	Statistics	4
	Data Librarianship	2
	Adult Training	1
	Research Data Centres	1
	Total	34
Health Sciences	Public Health	216
	Medicine	196
	Health Policy	19
	Psychiatry	6
	Mental Health	5
	Veterinary Medicine	5
	Nursing	4
	Dentistry	3
	Health Information	3
	Pharmaceutical Sciences	2
	Environmental Health	1
	Gerontology	1
	Health Economics	1
	Women's Health	1
	Total	463
Natural and Applied Sciences	Engineering	4
	Earth Sciences	3
	Forestry	3
	Agriculture	2
	Total	12

Category	Discipline	Number of Publications
Social Sciences and Economics	Geography	45
	Economics	29
	Sociology	8
	Political Science	6
	Social Work	3
	Criminology	1
	Psychology	1
	Total	93
Other	Business	16
	Finance	1
	Law	1
	Planning	1
	Transportation Studies	1
	Total	20
	Grand Total	622