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Linking the Canadian Immigrant Landing File to Hospital Data: A New Data Source for Immigrant Health Research

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^{p} preliminary
^{r} revised
x suppressed to meet the confidentiality requirements of the *Statistics Act*
^{E} use with caution
F too unreliable to be published
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Linking the Canadian Immigrant Landing File to Hospital Data: A New Data Source for Immigrant Health Research

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Table of contents

Abstract

This report summarizes the linkage of the Immigrant Landing File (ILF) for all provinces and territories, excluding Quebec, to hospital data from the Discharge Abstract Database (DAD), a national database containing information about hospital inpatient and day-surgery events. A deterministic exact-matching approach was used to link data from the 1980-to-2006 ILF and from the DAD (2006/2007, 2007/2008 and 2008/2009) with the 2006 Census, which served as a "bridge" file. This was a secondary linkage in that it used linkage keys created in two previous projects (primary linkages) that separately linked the ILF and the DAD to the 2006 Census. The ILF–DAD linked data were validated by means of a representative sample of 2006 Census records containing immigrant information previously linked to the DAD.

A total of 2,623,620 ILF records (79%) were eligible for linkage to the DAD. Overall, 10% of ILF records linked to at least one DAD record for the 2006/2007-to-2008/2009 period. Linkage rates varied by immigrant characteristics, reflecting differences in hospitalization rates. Rates were higher among older immigrants and among females (13.9%) compared with males (5.7%). Variation in linkage rates was also noted by birthplace, landing year, and immigrant category. Validation indicated that the linkage results were similar to those derived from the comparable 2006 Census linkage cohort. This project demonstrates the effectiveness of linking information from immigrant landing records and hospital data to create a new data source with which to examine the health of immigrant populations.

Key words: Data linkage, immigrant, hospital data

1 Introduction

Immigrants comprise an ever-increasing percentage of the Canadian population—at more than 20%, which is the highest percentage among the G8 countries (Statistics Canada 2013a). This figure is expected to rise to 25% to 28% by 2031, when at least one in four people living in Canada will be foreign-born (Statistics Canada 2010).

The composition of immigrants to Canada has changed over time: most now come from non-European sources, such as China and India (Chui, Tran and Maheux 2007). As well, the categories under which individuals immigrate are changing. In 2010, 22% were admitted to Canada under the family reunification-class, and 9% were admitted as refugees (Citizenship and Immigration Canada 2013). The majority of the foreign-born population (86%) have acquired Canadian citizenship (Statistics Canada 2013b).

Understanding the health impacts of this growing population is often limited by data that do not contain information on immigrant status and related details such as source country and admission category. Record linkage, however, offers an opportunity to bring together information about immigrant status and health outcomes. In Denmark, for example, population-based registries containing data on immigrant status have been linked to mortality and patient registries in order to identify differences in mortality between local-born and immigrant groups, including refugees (Norredam et al. 2012a; Norredam et al. 2012b; Norredam et al. 2014). In Canada, a pilot study commissioned by Citizenship and Immigration Canada linked data from the immigrant landing file with British Columbia and Manitoba population registration and health administrative databases (Kliewer and Kazanjian 2000). This pilot study was followed by a multi-province initiative led by federal departments responsible for health and immigrants, which resulted in the linkage of immigrant landing records to health administrative data in Ontario, British Columbia and Quebec in order to analyze health care outcomes by immigrant status (DesMeules et al. 2004; McDermott et al. 2010; Wang et al. 2012; McDermott et al. 2011).

More recently at the national level, mortality and hospital data were linked to a representative 20% sample of census respondents (Wilkins et al. 2008; Rotermann et al. 2015). Analyses of these data revealed differences between immigrants and non-immigrants, as well as variations among immigrants by source country, in both mortality and hospital outcomes (Ng 2011), (Ng et al. 2014). These data include period of immigration and source country, but not immigrant category. Furthermore, small sample sizes limit the study of rare outcomes, such as infectious disease.

The purpose of the present project is to link the Immigrant Landing File (ILF) to hospital information from the Discharge Abstract Database (DAD) for all provinces and territories (excluding Quebec). The ILF is a database of all individuals who landed in Canada since 1980. It contains comprehensive information, including landing date, source country, and immigrant category (for example, economic, refugee). The DAD is a census of all hospital discharges (excluding Quebec). This report describes the data inputs, linkage methodology, results, and validation of the project. The linkage was approved by Statistics Canada's Executive Management Board (Statistics Canada 2015). Use of the linked data is governed by the *Directive on Record Linkage* (Statistics Canada 2011).

2 Data

2.1 Immigrant Landing File

The ILF is an administrative census of immigrants who have landed in Canada since 1980, and includes information on the application and selection process (Statistics Canada, n.d.). Each year, Immigration, Refugees and Citizenship Canada (IRCC) (formerly Citizenship and Immigration Canada) provides an update of the ILF to Statistics Canada for the purpose of preparing the Longitudinal Immigration Database (IMDB). The ILF data include landing date, admission category (e.g, economic immigrant, refugee, family reunification), intended destination, intended occupation, education, and knowledge of official languages. The ILF has no health-related information.

2.2 Discharge Abstract Database

The DAD contains demographic, administrative, and clinical data for all acute care and some psychiatric, chronic rehabilitation and day-surgery hospital discharges for all provinces and territories except Quebec (Canadian Institute for Health Information 2015).

DAD data are provided to Statistics Canada by the Canadian Institute for Health Information annually. For each year, the DAD consolidates about 3 million hospital records for events that occurred from April 1 through March 31 (fiscal year). Hospital discharges that occurred in the 2006/2007-to-2008/2009 period were used in the linkage.

3 Methods

3.1 Linkage methodology

A deterministic exact-matching approach used the 2006 Census as a “bridge” file to link the ILF and DAD. This was a secondary linkage using linkage keys created in two previous linkage projects, in which the ILF and the DAD were separately linked to the 2006 Census (primary linkages).

3.2 Primary linkages

The 1980-to-2008 ILF was linked to the 2006 Census through a hierarchical deterministic linkage using variables common to both databases—given and surname, date of birth, gender, postal code, landing year, country of birth, and mother tongue. Individuals were grouped into families based on information in the immigration application and on census dwelling information. Additional postal code information and name changes were derived from historical tax files. The linkage was conducted in an iterative process using 43 sets of matching rules allowing variation in matches across the different variables. A total of 5.606 million ILF records were available for linkage, but only about 70% (3.9 million) were considered to be in-scope, according to estimates from the 2006 Census long form (weighted). The remaining records pertained to individuals who were out of the country, were institutionalized, or had died before Census Day (May 16, 2006). More than half (59.2%; n=3.32 million) of all ILF records were linked to the 2006 Census; the adjusted linkage rate for those who were likely to be in-scope was estimated at 88%.

Validation of the linked data was conducted on a subsample of records representing immigrants who arrived since 1980 and who responded to the census long form. The linkage rate for this

group was 88%—higher than the overall linkage rate, because they represented in-scope respondents (immigrants in Canada on Census Day). Linkage rates were consistent across most age groups except those younger than age 9 (71%) or age 90 or older (75%). Linkage rates varied by year of landing from 71% (1980) to 90% for more recent years. Rates were consistent across source countries.

The 2006/2007-to-2008/2009 DAD data were linked to the 2006 Census through a hierarchical deterministic linkage based on unique combinations of date of birth, sex, and postal code used to derive linkage keys for all provinces and territories excluding Quebec. The linkage was enhanced with postal code information from historical tax summary files to account for changes in residence. The full census file was used for record linkage (n=23.39 million). The long-form records (n=4.65 million) were used for validation. One in five Canadian households received the long form, which contained an extensive list of questions on topics such as education, ethnicity, mobility, income, and immigration status (Statistics Canada 2006). The linkage was conducted in an iterative process using 28 sets of matching rules among eligible keys in the DAD (n=6.17 million) and the census (n=23.37 million). Keys were considered to be eligible if they had non-missing information for date of birth and were unique (no duplicates) in the respective datasets. DAD keys also had to reflect birth dates on or before Census Day. About 80% of eligible DAD keys were linked to the 2006 Census. Comparisons of the percentage of hospitalization records represented in the linked data with the DAD alone indicated reasonably high coverage levels (78% to 80%). Validation results using census long-form respondents confirmed that the linked file is suitable for health-related research and is broadly representative of most subgroups in Canada including immigrants. Additional information about the linkage process and results is available elsewhere (Rotermann et al. 2015).

3.3 Secondary linkage

The correspondence files with linkage keys resulting from the primary linkages were used to link the ILF to the DAD. From the ILF–2006 Census linkage, a correspondence file linking the serial number and census identifier for all matched pairs was created. The serial number is a unique number from an individual applicant's IMM1000, the Immigrant Visa and Record of Landing, which serves as a visa for admission into Canada. From the 2006 Census–DAD linkage, the census identifier was added to all DAD records that linked to the census. The census identifier, therefore, was the bridge key to link the ILF to DAD records.

ILF records eligible for linkage to the DAD were those that linked to the 2006 Census, excluding those who identified Quebec as the intended destination and those who had not obtained landed immigrant status by Census Day. DAD records eligible for linkage to the ILF were those that linked to the 2006 Census.

3.4 Validation

Validation was conducted to assess the quality of the ILF–DAD linkage and the fitness of the linked data for use in research. First, the representativeness of the ILF cohort available for linkage to the DAD was assessed by comparing its demographic characteristics and immigrant profile with those of a sample of 2006 Census long-form respondents. This sample, who reported arriving in Canada between 1980 and 2006 and who resided outside Quebec (2006 Census linkage cohort), was eligible for linkage to the DAD. Immigrant characteristics including place of birth and landing year were compared; immigrant category, which is not asked on the census, could not be compared. Second, a head-to-head comparison of demographic and immigrant-specific information between the ILF and the 2006 Census (long form) was conducted. Third, linkage rates and age-standardized rates for all-cause hospitalization (with and without pregnancy) derived from the ILF–DAD linked data were compared with rates derived from a representative sample of immigrants from the 2006 Census–DAD linkage cohort data.

3.5 Respecting respondent privacy

Statistics Canada ensures respondent privacy during the linkage process and subsequent use of linked files. Only employees directly involved in the process have access to the unique identifying information (such as names and health insurance numbers); they do not access health-related information. When the linkage is completed, an analytical file is created from which the identifying information is removed. This de-identified file is accessed by analysts for validation and analysis.

4 Results

The 2,623,620 ILF records eligible for linkage to the DAD represented 79% of all ILF records that linked to the 2006 Census (Table 1). Results of the descriptive analysis reveal similar distributions of demographic and immigrant-specific characteristics compared with estimates (unweighted and weighted) from the 2006 Census (long form) linkage cohort.

A head-to-head comparison of the ILF and census (long form) records at the respondent level revealed high agreement (98%) on gender and place of birth. Agreement on age ranged from 99% among those younger than 10 to 77% among those aged 100 or older. Agreement on place of residence varied from a low of 30% among immigrants who indicated Newfoundland and Labrador as their destination on the ILF to 92% among those who indicated Ontario (data not shown).

Overall, 10% (n=258,672) of ILF records linked to at least one DAD record for the 2006/2007-to 2008/2009 period (Table 2). As expected, linkage rates varied by age from less than 5% among those younger than age 20 to 30% among those aged 80 or older. Linkage rates were also higher among females than males (13.9% versus 5.7%). Variation in rates by birthplace and landing year was also noted. Linkage rates were similar to those for the comparable 2006 Census linkage cohort.

Approximately 5% of DAD records eligible for linkage (n=359,471) were associated with an ILF record (data not shown). All-cause hospitalization rates (with and without pregnancy) are comparable between the ILF and 2006 Census linkage cohorts (Table 3).

Table 1
Comparison of the characteristics of the Immigrant Landing File linkage cohort and of the 2006 Census (long form) linkage cohort

Characteristics	Immigrant Landing File linkage cohort		2006 Census linkage cohort	
			Unweighted	Weighted
	number	percent	percent	
Total	**2,623,620**	**...**	**100.0**	**100.0**
Age group				
0 to 9 years	76,225	2.9	4.1	4.1
10 to 19 years	265,040	10.1	11.0	10.9
20 to 29 years	399,435	15.2	15.9	16.1
30 to 39 years	568,930	21.7	21.6	21.7
40 to 49 years	643,870	24.5	23.6	23.5
50 to 59 years	373,585	14.2	13.3	13.2
60 to 69 years	153,295	5.8	5.5	5.5
70 to 79 years	98,145	3.7	3.5	3.5
80 to 89 years	39,535	1.5	1.3	1.3
90 to 99 years	5,415	0.2	0.2	0.2
100 years and older	140	0.0	0.0	0.0
Sex				
Female	1,367,335	52.1	52.5	52.4
Male	1,255,870	47.9	47.5	47.6
Place of birth (top 10 in 2006 Census)				
China	283,740	10.8	11.1	11.1
India	288,950	11.0	10.3	10.5
Philippines	205,535	7.8	7.2	7.3
Pakistan	93,685	3.6	3.4	3.4
United States	64,180	2.5	3.6	3.3
South Korea	62,630	2.4	2.5	2.5
Romania	39,740	1.5	1.5	1.4
Iran	66,740	2.5	2.4	2.4
United Kingdom	96,570	3.7	3.9	3.8
Colombia	19,080	0.7	0.7	0.7
Landing year				
1980 to 1984	250,365	9.5	10.4	10.3
1985 to 1989	338,975	12.9	14.1	14.0
1990 to 1994	593,785	22.6	21.7	21.7
1995 to 1999	561,925	21.4	21.1	21.2
2000 to 2004	668,325	25.5	25.7	25.8
2005 to 2006	210,240	8.0	7.0	7.0
Province of residence				
Newfoundland and Labrador	7,480	0.3	0.1	0.1
Prince Edward Island	2,620	0.1	0.1	0.1
Nova Scotia	24,830	1.0	0.7	0.7
New Brunswick	11,225	0.4	0.4	0.4
Ontario	1,690,670	64.4	64.0	64.1
Manitoba	90,665	3.5	2.6	2.6
Saskatchewan	35,010	1.3	0.8	0.8
Alberta	257,655	9.8	10.2	10.1
British Columbia	503,470	19.2	21.1	21.2
Immigrant class				
Economic, principal adult parent	406,620	15.5	...	...
Economic, spouse, child	626,355	23.9	...	...
Family	871,745	33.2	...	...
Refugee	383,370	14.6	...	...
Other, unknown, missing	335,535	12.8	...	...

… not applicable

Note: Figures may not add up to 100 because of rounding.

Sources: Statistics Canada, Immigrant Landing File (1980 to 2006) linked to Discharge Abstract Database (2006/2007 to 2008/2009) and 2006 Census of Population linked to Discharge Abstract Database (2006/2007 to 2008/2009).

Table 2
Comparison of linkage rates to the Discharge Abstract Database, Immigrant Landing File linkage cohort and 2006 Census (long form) linkage cohort (excluding Quebec)

	Immigrant Landing File linkage cohort	2006 Census linkage cohort	
		Unweighted	Weighted
	percent	percent	
Total	**10.0**	**9.4**	**9.4**
Age group			
0 to 9 years	2.5	2.3	2.3
10 to 19 years	3.0	3.1	3.2
20 to 29 years	13.0	13.0	12.9
30 to 39 years	14.0	12.7	12.6
40 to 49 years	6.1	5.9	5.9
50 to 59 years	7.6	7.5	7.6
60 to 69 years	12.7	12.4	12.5
70 to 79 years	19.5	18.8	18.9
80 to 89 years	29.1	26.3	26.7
90 to 99 years	38.4	34.9	34.4
100 years and older	37.1	27.6	28.4
Sex			
Male	5.7	5.4	5.4
Female	13.9	13.1	13.1
Place of birth (top 10 in 2006 Census)			
China	9.3	8.36	8.4
India	11.8	11.14	11.2
Philippines	9.8	9.46	9.6
Pakistan	11.3	10.66	10.5
United States	11.9	10.28	10.1
South Korea	5.9	5.64	5.6
Romania	9.7	9.36	9.4
Iran	8.7	7.85	7.9
United Kingdom	12.2	11.36	11.3
Colombia	10.0	9.19	9.0
Landing year			
1980 to 1984	11.6	10.7	10.7
1985 to 1989	9.9	9.4	9.4
1990 to 1994	9.2	8.9	9.0
1995 to 1999	8.8	8.4	8.4
2000 to 2004	10.7	9.8	9.8
2005 to 2006	11.7	10.5	10.5
Province of residence			
Newfoundland and Labrador	9.5	10.8	10.7
Prince Edward Island	11.2	12.2	11.9
Nova Scotia	9.2	9.9	9.5
New Brunswick	11.5	12.1	11.8
Ontario	10.0	9.3	9.3
Manitoba	9.8	10.2	10.2
Saskatchewan	10.5	11.4	10.8
Alberta	10.9	10.7	10.8
British Columbia	9.6	8.9	8.9
Immigrant class			
Economic, principal adult parent	7.3	...	...
Economic, spouse, child	7.6	...	...
Family	14.1	...	...
Refugee	9.0	...	...
Other, unknown, missing	9.0	...	...

… not applicable

Sources: Statistics Canada, Immigrant Landing File (1980 to 2006) linked to Discharge Abstract Database (2006/2007 to 2008/2009) and 2006 Census of Population linked to Discharge Abstract Database (2006/2007 to 2008/2009).

Table 3
Comparing all-cause hospitalization rates (per 10,000 population) for the Immigrant Landing File linkage cohort and the 2006 Census (long form) linkage cohort

	All-cause hospitalization rates		All-cause hospitalization rates (excluding pregnancy)	
	Immigrant Landing File linkage cohort	2006 Census linkage cohort	Immigrant Landing File linkage cohort	2006 Census linkage cohort
	rate per 10,000 population			
Total	**1,385**	**1,307**	**921**	**867**
Age group				
0 to 19 years	369	374	339	332
20 to 45 years	1,674	1,600	519	489
46 to 64 years	1,002	980	952	922
65 years and older	3,492	3,247	3,491	3,243
Sex				
Male	881	829	880	828
Female	1,848	1,740	958	902
Place of birth (top 10 in 2006 Census)				
China	1,238	1,107	782	713
India	1,630	1,553	1,013	973
Philippines	1,336	1,287	842	804
Pakistan	1,513	1,421	732	698
United States	1,823	1,551	1,408	1,165
South Korea	800	733	568	509
Romania	1,326	1,282	868	802
Iran	1,174	1,084	893	841
United Kingdom	1,824	1,710	1,482	1,376
Colombia	1,288	1,116	768	703
Landing year				
1980 to 1989	1,613	1,497	1,377	1,237
1990 to 1999	1,252	1,211	900	862
2000 to 2006	1,408	1,291	633	599
Immigrant class				
Economic, principal adult parent	1,018	...	798	...
Economic, spouse, child	983	...	551	...
Family	1,948	...	1,260	...
Refugee	1,248	...	875	...
Other, unknown, missing	1,271	...	930	...

… not applicable

Sources: Statistics Canada, Immigrant Landing File (1980 to 2006) linked to Discharge Abstract Database (2006/2007 to 2008/2009) and 2006 Census of Population linked to Discharge Abstract Database (2006/2007 to 2008/2009).

5 Discussion

This project demonstrates the effectiveness of linking information from immigrant landing records and hospital data to create a new data source with which to examine the health of immigrant populations. The project also demonstrates the value of building on past linkages. The ILF linkage cohort eligible for linkage to the DAD was representative of immigrants who entered Canada from 1980 through 2006, as determined from comparisons with the 2006 Census. The validation confirms that hospitalization rates derived from the ILF–DAD linked data are comparable with rates derived from previously linked data for a similar immigrant cohort.

Linkage of the ILF to the 2006 Census is in line with several provincial efforts to link province-specific immigrant data from IRCC with provincial insurance registries for the purpose of linkage to health administrative data. The adjusted linkage rate of ILF respondents to the census was 88%, which is comparable to rates achieved in those provinces—78% to 95%. A 2010 study reported that linkage of the Ontario portion of the ILF to the Ontario health insurance registry resulted in 84% of immigrant records in which Ontario was identified as the initial place of landing being linked (Urquia et al. 2010); this linkage would exclude immigrants who identified another province as the place of landing, but subsequently moved to Ontario. In the present analysis, about 10% of eligible ILF records linked to at least one hospital record over a three-year period, which is comparable to similar record linkages involving hospital data.

5.1 Limitations

Only IFL records that linked to the 2006 Census were eligible for linkage to the DAD. Although this reduces the size of the cohort available for analysis, validation results provide no evidence of bias. The linkage first to the 2006 Census is, in fact, an advantage of this dataset. Previous research linking the ILF directly to health care records lacked information about attrition; that is, the immigrant could have left Canada. Efforts were made to use tax-file data to detect the continuing presence of these immigrants, but the 2006 Census provides stronger evidence for their presence in Canada.

The availability of the 2006 Census linkage cohort offers an opportunity to validate the results of the ILF–DAD linked data. Estimates are expected to differ because the 2006 Census linkage cohort represents the household population, whereas the ILF–DAD cohort includes the institutionalized population.

Immigrants who arrived in Canada before 1980 are not represented in the linked data. As well, comparable data for non-immigrants are not available.

The head-to-head comparison of records that were linked from the ILF and the 2006 Census provides important information about the use of the ILF with the hospitalization data. The high rate of disagreement on place of residence likely reflects mobility among immigrants—ILF information pertains to intended destination upon admission to Canada, which can differ from place of residence at the time of the census or subsequent hospitalizations. Differences in age were also noted among the oldest immigrants. This information should be used with caution in jurisdictional analyses. Analysis of hospitalization among immigrants by age and geography should be based on the date-of-birth and place-of-residence recorded in the hospital data.

6 Conclusion

Because immigrants constitute an ever-growing percentage of the Canadian population, understanding their patterns of health care use and outcomes is important. The linkage of the Immigrant Landing File to data from the Discharge Abstract Database addresses a critical data gap in health research by creating a unique dataset with which to study this segment of population and the heterogeneity within it.

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