Place-Specific Explanations for the Geographic Patterns of Complementary and Alternative Practitioners: Contrasting Chiropractic, Massage, Holistic, Acupuncture, Naturopathic and Homeopathic Operations in Ontario

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Abstract

Complementary and alternative medicine (CAM) provides choice for those seeking health care and uncovering place-specific criteria that are associated with the spatial distribution of CAM practitioners is warranted and can augment research that addresses health care supply disparities over space. With the use of a negative binomial regression procedure and GIS analysis, this study identifies several place-specific criteria that are associated with CAM office frequency in Ontario communities. Some of the main predictors of CAM office frequency are: urban environments, diverse markets and closeness to other CAM operations (localization economies advantages). However, the magnitude of these general results, and the spatial distribution of the office locations in Ontario, does vary by CAM type.

Keywords: Complementary and alternative medicine, negative binomial regression, acupuncture, chiropractic, holistic, homeopathic, massage, naturopathic

1. Introduction

Even with swelling budgets in Ontario, in which health care comprises 46% of total spending (Priest, 2010), many residents continue to report various medical supply disparities that manifest in distance, resource and time-related health care accessibility disadvantages. The Canadian Institute of Health Information (CIHI) is an independent not-for-profit corporation funded by federal and provincial/territorial governments and is arguably the leading 'think-tank' on health care matters in Canada. It publishes a wide range of studies (from health care spending and delivery to general population health indicators) used by hospitals, government policy-makers and other professional organizations. The focus of organizations like CIHI has been almost exclusively on conventional medicine (CM). This ignores the contribution of the complementary and alternative medicine (CAM) sector and the growing subscription to chiropractic, massage, holistic, acupuncture, homeopathic, naturopathic and other non-conventional medical approaches.

Hollenberg & Bourgeault (2009) acknowledge that CAM has remained 'under the radar', but this is changing with its increasing patronage around the world (Canada included (Park, 2005)) and with its persistent integration into a diverse number of primary health care environments (such as hybrid CAM/CM clinics, growing CM referrals and acceptance of CAM procedures and the teaching of CAM in CM schools) (see also Verhoef, 2004; Fries, 2008; Willms & St.Pierre-Hansen, 2008). CAM *and* CM give people choice in health care service and to get a picture of a location's 'total' medical supply endowment, both sectors should be considered (Meyer, 2010); and as such researchers must continue to uncover the place-specific criteria that attract CM *and* CAM.

2. CAM Users and CAM Suppliers: An Emerging Literature

Although the geography of CAM continues to evolve (Andrews et al, 2004; Andrews & Boon, 2005), much of the empirical research that identifies users or explains the patterns can be classified as demand- or supply- based. There are those analysts who seek to understand the characteristics of people using CAM services and products while other researchers have focused on the spatial properties of CAM proprietors and, in some cases, progress is being made towards explaining location choices.

On the demand side, Bishop& Lewith (2008) present a useful synthesis of the literature and provide insight on the profile of CAM users in terms of demographics and health characteristics. While the 110 papers reviewed contain variation on sample, methodologies and results, the general consensus is that CAM use is linked to being female, middle-aged and Caucasian and having higher levels of education and income. Moreover, most people employ CAM for chronic health problems and not for life-threatening illnesses (see also Millar, 2001). CAM use has also been assessed in terms of: dissatisfaction with conventional care (Avogo et al, 2008), severity of cancer symptoms (Fouladbakhsh et al, 2005), the personalities of CAM consumers (Sirois & Purc-Stephenson, 2008), the characteristics of older-aged CAM users (Andrews, 2003) and those at 'end-of- life' (Tilden et al, 2004).

The analysis of CAM from a supply perspective is also emerging in the literature. The relative location of *other* health care stations can influence the spatial pattern of CAM (Meyer, 2008) as can distance to CAM educational facilities (Albert & Butar, 2004). As with most economic activity, population density and the level of urbanization appears to bias CAM practitioner location choice as well (Verheij et al, 1999; Albert & Butar, 2004; Meyer, 2008). There is also evidence that the spatial pattern of CAM appears to behave according to the rules of contagious and hierarchical diffusion; larger urban areas receive a disproportionate number of CAM operators and with time the pattern of supply fans out from these epicenters (Williams, 2000). Also, it is likely that the location choices of CAM practitioners, who are by-in-large small independent business owners (Andrews & Hammond 2004; Meyer, 2008), are influenced by the wealth of 'markets'.

The literature that focuses on the CAM operator employs an increasingly wide assortment of methodologies that range from descriptive analyses, to summaries of questionnaire data, to the use of regression models, to GIS-based spatial techniques. Brindle & Goodrich (2001) provide a descriptive assessment that traces the temporal pattern of homeopaths and chiropractors in the United States. Williams (2000) demonstrates the diffusion of chiropractic and naturopathic offices in Ontario and British Columbia by classifying the number of practitioners into five categories of urbanization (from town to metropolitan area) and notes the changes over time. By utilizing questionnaires directed to a sample of CAM practitioner, profiles are constructed for acupuncturists, herbalists and naturopaths in Australia (Hale, 2003), chiropractors in Ontario (Waalen, 2005) and chiropractors caring for children in the United States, Canada and Europe (Alcantara et al, 2010). With the use of UK-based survey data, Andrews and his colleagues build the profile of CAM health care providers with a number of perception-based studies that address several topics including: how CAM operators cope with being both a health care provider and a small business owner (Andrews et al, 2003), the rationale for nurses leaving the CM sector in favour of CAM practice (Andrews, 2003a), the attitudes of CAM therapist towards the British National Health Service (Andrews, 2004) and the typical pathways involved in becoming a small CAM-based business (Andrews & Hammond, 2004). Bell et al (2003) also used questionnaire data to profile homeopaths in the western US and their attitudes towards chronic disease treatment. Although focusing mostly on patient characteristics and health outcomes, Sarnat & Winterstein (2004) surveyed chiropractors in Chicago to describe diagnostic, healing and prevention methods.

Empirical research that utilizes the actual locations of CAM operators for subsequent statistical analysis has been less common than descriptive approaches. Nevertheless, examples do exist. Regression analyses were used by Albert & Butar (2004) to establish the statistically significant relationship between the number of naturopaths per county in Arizona and Washington and proximity to naturopathic medical school and population density. In addition to profiling the demographics and patient history of chiropractors in the US (via 815 questionnaires), Smith & Carber's (2002) regression analyses found that health professional shortage areas (that occur frequently in rural counties) are positively related to chiropractic practice volume. By using specialized multilevel logistic regression models, Verheij et al (1999) predicts alternative medical use in the Netherlands (homeopathy, paranormal healing and manual therapy) with settlement characteristics (distance to CAM practitioner and urbanicity), patient traits and perceptions towards alternative medicine and general practitioner (GP) perception of alternative medicine. Meyer (2008) utilizes a general nearest neighbor analysis and a nearest neighbor hierarchical clustering procedure and determined that CAM operators are significantly clustered within four intermediate-sized cities and appear to be affected by agglomeration economies. Meyer (2010) shows that CAM displays a more even pattern across the urban-rural continuum in Ontario in comparison to CM and, via local spatial autocorrelation tests, demonstrates that certain CAM- and CM-specializing municipalities cluster in identifiable areas of the province and are associated with community well-being indicators and urban density measures.

In addition to expanding the possibilities of regression analyses in CAM studies (Verheij et al, 1999; Smith & Carber, 2002; Albert & Butar, 2004), the content of this paper continues the work of Meyer (2008; 2010; 2012) by attempting to explain the patterns of *differing types* of CAM in Ontario using both supply- and demand- based indicators.

3. Methodology and Data Sources

3.1 Overview

Through a negative binomial regression procedure, the frequencies of six different CAM practitioners in Ontario (acupuncture, chiropractic, holistic, homeopathic, massage and naturopathic) were tested against place-specific supply- and demand-based independent variables. The demand-based independent variables are: percent aged 40-59, percent female, percent with university/college degrees, diplomas or certificates, percent visible minority and average family income. The supply-based independent variables, that may influence the CAM operators themselves in terms of proximity to other health operators/resources or more general urbanization factors, are: population density, level of urbanization (as measured by statistical area classification (SAC)), average distance from the closest CAM-specific school, average distance to the fifth closest CAM operator and percent of the labour force in health occupations. There are 471 census subdivisions (CSDs) in Ontario for which 2006 census data are available (from a total 585) and these constitute the cases for each of the variables in the regression procedures. Although no research has considered these six types of CAM within the same analysis and no one has considered the case of Ontario within this light, the independent variables were chosen in accordance with what was commonly assessed in other studies.

3.2 Geocoding Address-Based Datasets

The CAM-based dataset with 4,955 records for 2007 was purchased from InfoCanada (2007). Each record contains the office address of chiropractors, massage therapist, holistic practitioners, acupuncturists, naturopathic doctors and homeopaths in Ontario. Telephone directories are the foundation of InfoCanada's databases, although many additional sources are used in the collection process such as annual reports and government records. InfoCanada contacts each business/office annually by telephone to verify records and to compile supplementary information. Even so, an error of up to 10% is possible. In addition to the point locations of CAM offices, a data file of the addresses of education facilities for chiropractors, naturopaths, homeopaths, acupuncturists and massage therapists was complied from information through CAMline (2010).

The office locations of CAM and educational facilities[1] were geocoded as points to the Ontario road layer (Statistics Canada, 2006a) using ArcGIS version 9.3.1. The 'US streets with zone' style address locator function was used to attach each point (office) to a street segment based on a range of addresses. The zone was classified by census subdivision (CSD). Prior to the geocoding process, it was necessary to use Statistics Canada's (2010) 'Community Profiles' to determine the CSD of each city/town. Roughly 5 percent of the cases contained address information that was inconsistent with the Ontario road network file and/or possessed incomplete mailing details. 'Google Maps' (Google, 2010) and 'The Official Road Map of Ontario' (Ministry of Transportation, 2010) internet sources proved very useful in determining 'alternative' or changed street/highway names and allowed for accurate interactive geocoding. The cases with incomplete address information had to be geocoded in more approximate terms to the centroids of postal code polygons (DMTI, 2006a; DMTI, 2006b). In addition to the layers needed to geocode points to the roads layer, digital cartographic boundary files for census subdivisions, census divisions and CMAs (Statistics Canada, 2006a) were also used.

3.3 The Independent Variables

Seven independent variables tested in the regression procedures (percent aged 40-59, percent female, percent with university/college degrees, diplomas or certificates, percent visible minority, average family income, population density and percent of labour force in health occupations) were downloaded from Statistics Canada (2006b) and then converted to rates in SPSS 17.0. Three others require additional explanation. With the 'Network Analyst' extension of the ArcGIS software package, a network was built from the Ontario road layer and via the 'closest facility' function it was possible to measure road distances from CAM to CAM and CAM to education facility points. This application was useful for constructing the two distance-related independent variables.

[1] There are no certified education facilities for holistic providers in Ontario. Thus, a distance to education facility independent variable could not be evaluated as a significant predictor of holistic provider frequency.

Each CSD was assigned distance measures that were distinct for each of the six dependent variables. For example, the distance of all chiropractor offices in a particular CSD was based on the average distance to the fifth closest CAM operator and the average distance to the single closest education facility. If the CSD did not contain a chiropractic office, than the centroid of the CSD was used to compute distances. For 52 (or 8.9 percent) of the province's most remote CSDs, route measures were estimated by adding 'network road' to 'straight line/crow fly' distances from where road connections became discontinuous[2]. The level of urbanization independent variables ranges from 1 to 7; this reflect its SAC or level of 'metropolitan/urban influence'. As such, a CSD is classified as: part of a census metropolitan area (1), part of a census agglomeration (either divided by census tract (2) or not (3)) or influenced (strongly, moderately, weakly or not at all) by a CMA or CA (4, 5, 6 and 7 respectively). Influence is based on the proportion of a CSD's resident population that travels to work in a CMA or CA (Statistics Canada, 2007).

3.4 The Dependent Variables and the Negative Binomial Regression Procedure

The CSD histogram distribution for all six dependent variables is very positively skewed and leptokurtic. So much so, that any transformation (logarithmic for example) would only marginally 'normalize' the distribution making ordinary least-squares regression inappropriate. Thus, determining significant predictors for the six CAM types needed to be pursued in light of these 'Poisson-like' frequencies. Literally, it is rare for a CSD to have *many* chiropractic, massage, acupuncture, holistic, naturopathic and/or homeopathic offices and zero outcomes are common (ranging from 62.9% for chiropractors to 96.1% for homeopaths). Even though Poisson regression is well suited for highly skewed count data, it is not recommended for dependent variables exhibiting over-dispersion (in which the mean value is far less than the variance) (Fox, 2008). Like the Poisson approach, the negative binominal regression model belongs to a family of generalized linear models suited for count data, but the derived coefficient estimates are not tainted by over-dispersion (Elhai et al, 2008). Moreover, the more specialized 'zero-inflated negative binomial regression model' may be indicated for a count dependent variable with 'excessive zeros' and with predictor variables that are continuously-scaled and/or binary coded (Elhai et al, 2008). Along with Elhai et al (2008), see also Jones (2007) for excellent overviews of regression methods used for count data and health-related studies.

But what constitutes excessive zeros? In theoretical terms, a zero-inflated model assumes that zero counts occur for two reasons: that a case has no chance of a non-zero occurrence or that a non-zero count *could* occur but, for reasons explained (ideally) by the predictor variables, has not (Jones, 2007; Fox, 2008; UCLA: Academic Technology Services, Statistical Consulting Group, 2010). In the case of CAM office frequency, there would be very few, if any, municipalities (CSDs) that theoretically could not sustain one or more CAM proprietors. Even though the histogram distributions give the *appearance* of excessive zeros, there is no intuitive basis for assuming there are structural reasons that completely prevent CAM settlement in any given Ontario CSD (as even the most remote CSDs have small settlements). Thus, because of high positive skewness and over-dispersion that is not theoretically linked to excess zeros, the negative binomial regression procedure was deemed the most appropriate option and run for each dependent variable. A syntax-based routine was created in SPSS 17.0 with the following characteristics:

1) Each CAM type (the number of chiropractic, massage, acupuncture, holistic, naturopathic and homeopathic) was run, in turn, as the dependent variable for 471 of the province's 585 CSDs with census data.
2) The independent variables tested in each of the negative binomial regression procedures are continuous; except the level of urbanization which ranges from 1 to 7.
3) Each negative binomial regression model was fitted with an intercept and used a maximum likelihood estimate with a log link to calibrate the coefficients of the independent variables (covariates). Statistical significance (at 95%) of the independent variables was determined by the Wald chi-square test.

As shown on Table 1, five of the six CAM types yielded results in terms of which independent variables were statistically significant predictors. Due to an insufficient number of cases, the homeopath regression run could not be completed.

[2] Ultimately, the distance measuring approach for these 52 cases was of little consequence. All but five of these CSDs were excluded for the analysis because of missing data in other census-based independent variables.

Even though the negative binomial procedure is well equipped to handle very positively skewed and leptokurtic distributions, the routine in SPSS requires that a minimum level of non-zero cases occur for model convergence to be achieved in this iterative process. It is also important to report that multicollinearity amongst the independent variables did not appear to be problematic. Prior to building the regression models, a Pearson correlation analysis was run and most correlation coefficients had low to moderate r values (0.6 or below). Only correlations between the variables average distance from CAM-specific school, average distance from closest 5 CAM operators and percent with a university/college degree reached the 0.70 to 0.72 range. These values could be interpreted as moderate associations, although certainly not high enough to indicate multicollinearity issues. Nevertheless, for diagnostic purposes, when these variables were omitted from the regression runs, the general behaviors of the remaining independent variables were consistent (with no change in the direction of effect on the B coefficient, for example).

4. Results

Table 2 shows average values for the independent variables that were statistically significant in the negative binomial regression analysis. Figure 1 displays the location of metropolitan areas and provincial districts in Ontario.

Acupuncture office presence is explained by declining proportions of the middle-aged and distance to other CAM operators and increasing percentages of visible minorities and levels of urbanization. Regarding these independent variables, acupuncturists display the most distinctiveness and appear to be most influenced by urbanization. Notice that the deviation between the overall average and the CAM specific averages is highest for acupuncture in comparison to other CAM categories. Particularly, acupuncture offices tend to be highly attracted to metropolitan areas, are very close to other CAM operators (which is likely to be most possible in urban areas), and exist in CSDs with the highest proportions of visibility minorities (another 'big city' trait). The map of acupuncture activity (Figure 2) shows that aside from arguably the southwest, almost all acupuncture offices are in the CMAs with Toronto and adjacent metropolitan areas being most outstanding.

Of the CAM types assessed with the negative binomial regression procedure, the place-specific profiles for chiropractor and massage therapists were most similar. Aside from the percentage with university/college degree independent variable being significant for chiropractors (and not message therapists), both of these CAM types shared the same significant place-specific predictors and also display highly similar deviations between overall and CAM-specific averages. The maps (Figures 2 and 3) also reveal strikingly parallel point distributions: metropolitan and southern biases, but with a number of office locations in the peripheral locales of all four districts (notably including the north). Chiropractors and message therapists were the only CAM types to be significantly associated with areas of higher family income; and this most directly shows the importance of wealth (in contrast to some of the other variables which imply wealth in a more indirect way, such as proportion of degree holders). It is equally important to note that the percent female independent variable was only significant for these two CAM types as well. Perhaps the 'wealth' analogy can be extended: chiropractors and massage therapists tend to reside in locations populated disproportionately with wealthy females. Conversely, chiropractor and massage therapist office frequencies were *not* unique in being associated with places featuring higher levels of urbanization, proximity to other CAM, greater visible minority proportions and declining percentage of the middle-aged.

While holistic providers are comparatively more dispersed throughout Ontario and its four districts, it is interesting that the profile of significant independent variables is very similar to acupuncture offices, apart from for the significance of the 'degree holders' variable and the more modest deviations between overall and CAM-specific averages. Indeed, the two maps (Figure 2 and Figure 5) reveal very similar patterns with relatively few points beyond the CMAs (except in the southwest). Thus, 'urbanization' is important to holistic providers (like acupuncturists), but the more dispersed pattern indicates that holistic providers are spread more evenly *amongst* and *within* metropolitan areas. For instance, both holistic providers and acupuncturists are extremely well represented in Toronto and adjacent CMAs, but visual inspection of the maps shows that acupuncture offices are more tightly clustered within this area. The same is true for Kitchener, Guelph, London, Windsor, Kingston and Greater Sudbury. Otherwise, holistic providers are associated with the other 'unanimous statistically significant' variables (lower middle-aged proportions, stronger visible minor percentages and proximity to other CAM).

The frequency of naturopathic offices is also linked with the aforementioned three 'unanimous' variables and the overall and CAM-specific averages show reasonably strong relative differences as well. Like homeopaths, naturopaths are generally less clustered than most other CAM types, but as the maps show (Figures 6 and 7) homeopaths are almost exclusively stationed in CMAs and are exceedingly rare in the north by comparison. While far fewer in numbers, naturopaths share some characteristics with chiropractors and massage therapist in terms of being well represented in metropolitan areas though not at the almost complete expense of more peripheral locales. In fact, given that the level of urbanization independent variable was uniquely insignificant for naturopaths, it is possible that the necessity for an urban location practice is less important to naturopaths by comparison.

5. Conclusions

At least four conclusions from this study, that link various types of CAM with place, have implications for policy and/or future research: the importance of the urban environment, the apparent attraction of diverse markets, nearness to like practitioners and localization economies and the seeming irrelevance of proximate school facilities on office location.

The population density of a municipality was not linked with *any* of the CAM types analyzed, but being part of the urban environment (metropolitan or smaller city) was in *all* cases. In other words, CAM office activity is not necessarily attracted to busy downtown districts, areas near high density suburbs or, more generally, high density settlement, but being within the urban or metropolitan milieu is a prerequisite for office settlement for many CAM operators. While this subtle difference is quite intriguing, it does nevertheless reinforce that the competition for CAM resources are similar to those for conventional medical doctors: underserviced peripheral communities will require strategies that offset the more 'natural' pull of larger urban areas. Still, allocation strategies might be more effective with naturopaths (particularly) and to some degree chiropractors and massage therapists; these forms of health care are already reasonably well represented in some peripheral locations in Ontario. In comparison, it may be far more difficult to entice acupuncturists, holistic providers and homeopaths to locate in areas beyond the metropolitan and/or urban environment. A specific questionnaire aimed at CAM practitioners may provide greater insight on urban/rural preferences.

The literature often stereotypes the most frequent CAM user as 'wealthy, highly educated, white, middle-aged and female', yet very little of this profile could be confirmed for the case of Ontario. Although the specific case of chiropractor office frequency comes closest and appears to be associated with communities scoring highly in some of these categories (female, high education and wealthy), it is striking that *all* of the assessed CAM types were associated with declining proportions of people aged 40-59 and increasing visible minorities. This suggests that CAM offices are attracted to diverse markets in terms of age and ethnicity; traits most commonly found in metropolitan areas, but not exclusively so. Smaller cities that are reasonably varied in population traits might do well to emphasize this when promoting. Keeping in mind that CAM operators are also small business owners, future research could more completely assess if diverse markets are more lucrative and if this does influence location decisions. It would also be interesting to follow up the observation that only chiropractors and massage therapists were associated with locations of higher income. Are people more cost sensitive to the services of chiropractors and message therapists, compared to acupuncture, holistic providers, naturopaths and possibly homeopaths, and does this cause these business owners to seek out 'wealthier' locations? It is also worth emphasizing that persons of the aforementioned stereotypical profile may still frequent CAM offices in strong numbers, yet it is instructive that locations emphasizing these traits are generally not catalytic to CAM office activity in Ontario.

Localization economies refer to the advantages that similar businesses enjoy while being in close geographic space. Importantly, all CAM types analyzed herein showed a significant propensity to be near other CAM operators. Business-specific benefits could include sharing office resources (chiropractors with massage therapist for example), divulging tacit knowledge (such as acupuncturists exchanging therapeutic strategies with naturopaths) and patient referrals. All of these relationships are most effective when the operations are close in proximity. Meyer (2008) found many of these localization advantages (that are usually also associated with urbanization economies) to be true for CAM in general and this study builds on these findings and reiterates that business proximity advantages appear strong regardless of CAM type.

Recruiting and supply-crisis strategies in the CM sector are starting to incorporate 'heath team' approaches (which may be particularly useful for people with multiple health issues) and this could be promoted on the CAM side with health care centers containing a range of alternative medical providers. This builds on business-specific localization economies advantages that many CAM operators appear to 'naturally' be attracted to and, as such, could be promoted as a place-specific attribute to attract new talent into underserviced communities.

Many regions in Canada have a variety of incentives programs in place to attract and retain conventional medical professionals (CIHI, 2010) which may include setting up medical schools in underserviced regions. One might think a similar strategy could be employed to stimulate CAM in more peripheral locations, but the evidence from this study does not reinforce this notion. No CAM type analyzed was statically associated with distance from a school which suggests that graduates are not necessarily setting up their practice in communities from which they were accredited. Does this indicate a notable difference in the location tendencies between CAM and CM operators or does this point to an over-rating of the supposed 'graduation-first job' spatial link in more general terms? Certainly this requires more consideration.

6. References

Albert, D.P.& Butar, F.B. (2004). Distribution, concentration and health care implications of naturopathic physicians in the United States. Complementary Health Practice Review, 9, 103-117.

Alcantara, J., Ohm, J. & Kunz, D. (2010). The chiropractic care of children. The Journal of Alternative and Complementary Medicine, 16, 621-626.

Andrews, G.J. (2003a). Placing the consumption of private complementary medicine: everyday geographies of older peoples' use. Health & Place, 9, 337-349.

Andrews, G.J. (2003b). Nurses who left the British NHS for private complementary medical practice: why did they leave? Would they return? Journal of Advanced Nursing, 41, 403-415.

Andrews, G.J. (2004). Sharing the spirit of the policy agenda? Private complementary therapists' attitudes towards practicing in the British NHS. Complementary Therapies in Nursing & Midwifery, 10, 217-228.

Andrews, G.J. & Boon, H. (2005). CAM in Canada: places, practices and research. Complementary Therapies in Clinic Practice, 11, 21-27.

Andrews, G.J. & Hammond, R. (2004). Small business complementary medicine: a profile of British therapists and their pathways to practice. Primary Health Care Research and Development, 5, 40-51.

Andrews, G.J., Peter, E. & Hammond, R. (2003). Receiving money for medicine: some tensions and resolutions for community-based private complementary therapists. Health and Social Care in the Community, 11, 155-167.

Andrews, G.J., Wiles, J. & Miller, K. (2004). The geography of complementary medicine: perspectives and prospects. Complementary Therapies in Nursing and Midwifery, 10, 175-185.

Avogo, W., Frimpong, J.A., Rivers, P.A. & Kim, S.S. (2008). The effects of health status on the utilization of complementary and alternative medicine. Health Education Journal, 67, 258-275.

Bell, I.R., Koithan, M., Gorman, M.M. & Baldwin, C.M. (2003). Homeopathic practitioner views of changes in patients undergoing constitutional treatment for chronic disease. The Journal of Alternative and Complementary Medicine, 9, 39-50.

Bishop, F.L. & Lewith, G.T. (2008). Who uses CAM? A narrative review of demographic characteristics and health factors associated with CAM use. Advance Access Publications, 13, 11-28.

Brindle, M. & Goodrick, E. (2001). Revisiting maverick medical sects: the role of identity in comparing homeopaths and chiropractics. Journal of Social History, 34, 569-589.

CAMline (2010). CAM therapies/practitioners. (Online) Available: http://www.camline.ca/index.html (May 21, 2010).

CIHI (Canadian Institute of Health Information) (2010). Supply, distribution and migration of Canadian physicians, 2009. (Online) Available: https://secure.cihi.ca/estore/productFamily.htm?locale=en&pf=PFC1567 (June 19, 2011)

DMTI (2006a). DMTI platinum postal suite version 2006.4: Ontario postal codes (MEP) points. Markham, ON: DMTI Spatial.

DMTI (2006b). DMTI platinum postal suite version 2006.4: Ontario local delivery unit area (LDU boundaries). Markham, ON: DMTI Spatial.

Elhai, J.D., Calhoun, P.S. & Ford, J.D. (2008). Statistical procedures for analyzing mental health services data. Psychiatry Research, 160, 129-136.

Fox, J. (2008). Applied Regression Analysis and Generalized Linear Models. Thousand Oaks, CA: Sage.

Fries, C.J. (2008). Classification of complementary and alternative medical practices: family physicians' ratings of effectiveness. Canadian Family Physician, 54, 1-7.

Fouladbakhsh, J.M., Given, B.A. & Given, C.W. (2005) Predictors of use of complementary and alternative therapies among patients with cancer. Oncology Nursing Forum, 32, 1115-1122.

Google (2010). Google maps. (Online) Available: http://maps.google.com/ (July 1 2010).

Hale, A. (2003). 2002 combined survey of ATMS and ANTA acupuncturists, herbalists and naturopaths. Journal of Australian Traditional Medicine Society, 9, 9-15.

Hollenberg, D. & Bourgeault, I. (2009). New health geographies of complementary and alternative health care. In V.A. Crooks and G.J. Andrews (Eds.), Primary Health Care: People, Practice, Place (pp. 167-182). Surrey, UK: Ashgate.

InfoCanada (2007). Canadian business directory: 2007 October edition. Mississauga, ON: InfoCanada.

Jones, A. (2007). Applied Econometrics for Health Economists. Abingdon, UK: Office of Health Economics.

Meyer, S.P. (2008). The spatial pattern of complementary and alternative medical offices across Ontario and within intermediate-sized metropolitan areas. Urban Geography, 29, 1-21.

Meyer, S.P. (2010). A geographic assessment of 'total' health care supply in Ontario: complementary and alternative medicine and conventional medicine. The Canadian Geographer, 54, 104-122.

Meyer, S.P. (2012). Comparing spatial accessibility to conventional medicine and complementary and alternative medicine in Ontario, Canada. Health & Place, 18, 305-314.

Millar, W.J. (2001). Patterns of use: alternative health care practitioners. Health Reports, Statistics Canada, 13, 9-21.

Ministry of Transportation (2010). The official road map of Ontario. (Online) Available: http://www.mto.gov.on.ca/english/traveller/map/ (July 1, 2010).

Park, J. (2005). Use of alternative health care. Health Reports, Statistics Canada, 16, 39-42.

Priest, L. (2010). Inefficiency wasting health resources: new report. The Globe and Mail, June 4, 2010.

Sarnat, R.L. & Winterstein, J. (2004). Clinical and cost outcomes of an integrative medicine IPA. Journal of Manipulative and Physiological Therapeutics, 27, 336-347.

Sirois, F.M. & Purc-Stephenson, R.J. (2008). Personality and consultations with complementary and alternative medicine practitioners: a five-factor model investigation of the degree of use and motives. The Journal of Complementary and Alternative Medicine, 14, 1151-1158.

Smith, M. & Carber, L. (2002). Chiropractic health care in health professional shortage areas in the United States. American Journal of Public Health, 92, 2001-2009.

Statistics Canada (2006a). Census of Canada, 2006, cartographic boundary, digital boundary, ecumene, road network and geographic attribute. Ottawa, ON: Statistics Canada.

Statistics Canada (2006b). Census of population 2006, profile for Canada, provinces, territories, census divisions, census subdivisions and dissemination areas (table 94-581-XCB2006002). Ottawa, ON: Statistics Canada.

Statistics Canada (2007). 2006 census dictionary (catalogue number 92-566-XWE). Ottawa, ON: Statistics Canada.

Statistics Canada (2010). Community profiles. (Online) Available: http://www.statcan.gc.ca/start-debut-eng.html (July 1, 2010).

Tilden, V.P., Drach, L.L. & Tolle, S.W. (2004). Complementary and alternative therapy use at end-of-life in community settings. The Journal of Complementary and Alternative Medicine, 19, 811-817.

UCLA: Academic Technology Services, Statistical Consulting Group (2010). SAS annotated 0utput: zero-inflated negative binomial regression. (Online) Available: http://www.ats.ucla.edu/stat/sas/output/sas_zinbreg.htm (July 6, 2010).

Verheij, R.A., de Bakker, D.H.& Groenewgen, P.P. (1999). Is there a geography of alternative medical treatment in the Netherlands? Health & Place, 5, 83-97.

Verhoef, M, Brundin-Mather, R., Jones, A., Boon, H. & Epstein, M. (2004). Complementary and alternative medicine in undergraduate medical education. Canadian Family Physician, 50, 847-849.

Waalen, J.K. (2005). Practice patterns of 692 Ontario chiropractors (2000-2001). Journal of Canadian Chiropractor Association, 49, 21-31.

Williams, A.M. (2000). The diffusion of alternative health care: a Canadian case study of chiropractic and naturopathic practices. The Canadian Geographer, 44, 152-166.

Willms, L. & St Pierre-Hansen, N. (2008). Blending in: is integrative medicine the future of family medicine? Canadian Family Physician, 54, 1085-1087.

Table 1: Negative Binomial Regression Results: Showing B Coefficients for Significant Variables[1]

	Acupuncture	Chiropractor	Holistic	Massage	Naturopath
Demand-based:					
% aged 40-59	-0.183	-0.117	-0.140	-.0134	-0.190
% female		0.488		0.489	
% with university/college degree		0.017	0.053		
% visible minority	0.060	0.064	0.050	0.050	0.041
Average family income		0.00002		0.00003	
Supply-based:					
Population density					
Level of urbanization	-0.201	-0.199	-0.162	-0.183	
Average km distance from CAM-specific school			Not tested		
Average km distance from closest 5 CAM operators	-0.149	-0.010	-0.044	-0.016	-0.168
% labour force in health occupations					

Note: [1]The variables are significant at a 99% confidence interval and the number of cases (n) is 471, of 585, census subdivisions with complete variable information.

Table 2: Average Values for Significant Independent Variables: Showing CAM-Specific Weighted Average[1], CAM-Specific Average[2] and Overall Average

	Acupuncture	Chiropractor	Holistic	Massage	Naturopath
Number of relevant cases	acupuncture offices, n=465; acupuncture CSDs, n=73; all CSDs, n=471	chiropractor offices, n=2117; chiropractor CSDs, n=216; all CSDs, n=471	holistic offices, n=513; holistic CSDs, n=106; all CSDs, n=471	massage offices, n=1567; massage CSDs, n=193; all CSDs, n=471	naturopath offices, n=234; naturopath CSDs, n=58; all CSDs, n=471
% aged 40-59	29.69 30.14 31.34	29.97 30.99 31.34	29.76 30.19 31.34	29.93 31.12 31.34	29.62 30.27 31.34
% female		51.43 50.66 50.00		51.43 50.89 50.00	
% with university/college degree		86.51 82.39 77.59	87.03 82.59 77.59		
% visible minority	29.42 10.27 2.55	21.19 4.61 2.55	25.57 7.66 2.55	18.18 5.02 2.55	24.82 11.40 2.55
Average family income		90700.97 80768.61 72023.72		89033.89 82588.56 72023.72	
Population density					
Level of urbanization	1.27 2.29 4.18	1.61 3.38 4.18	1.46 2.68 4.18	1.68 3.24 4.18	
Average km distance from CAM-specific school			Not tested		
Average km distance from closest 5 CAM operators	1.53 3.99 57.28	5.07 22.25 57.54	3.29 9.32 57.51	4.31 3.24 57.63	1.91 3.94 57.60
% labour force in health occupations					

Note: [1]Census subdivision (CSD) values are weighted by the frequency of office counts (essentially, this is an average of office points), [2]an average from CSDs with at least one office.

Figure 1: Census Metropolitan Areas (CMAs), Census Subdivisions (CSD) and Provincial Districts in Ontario

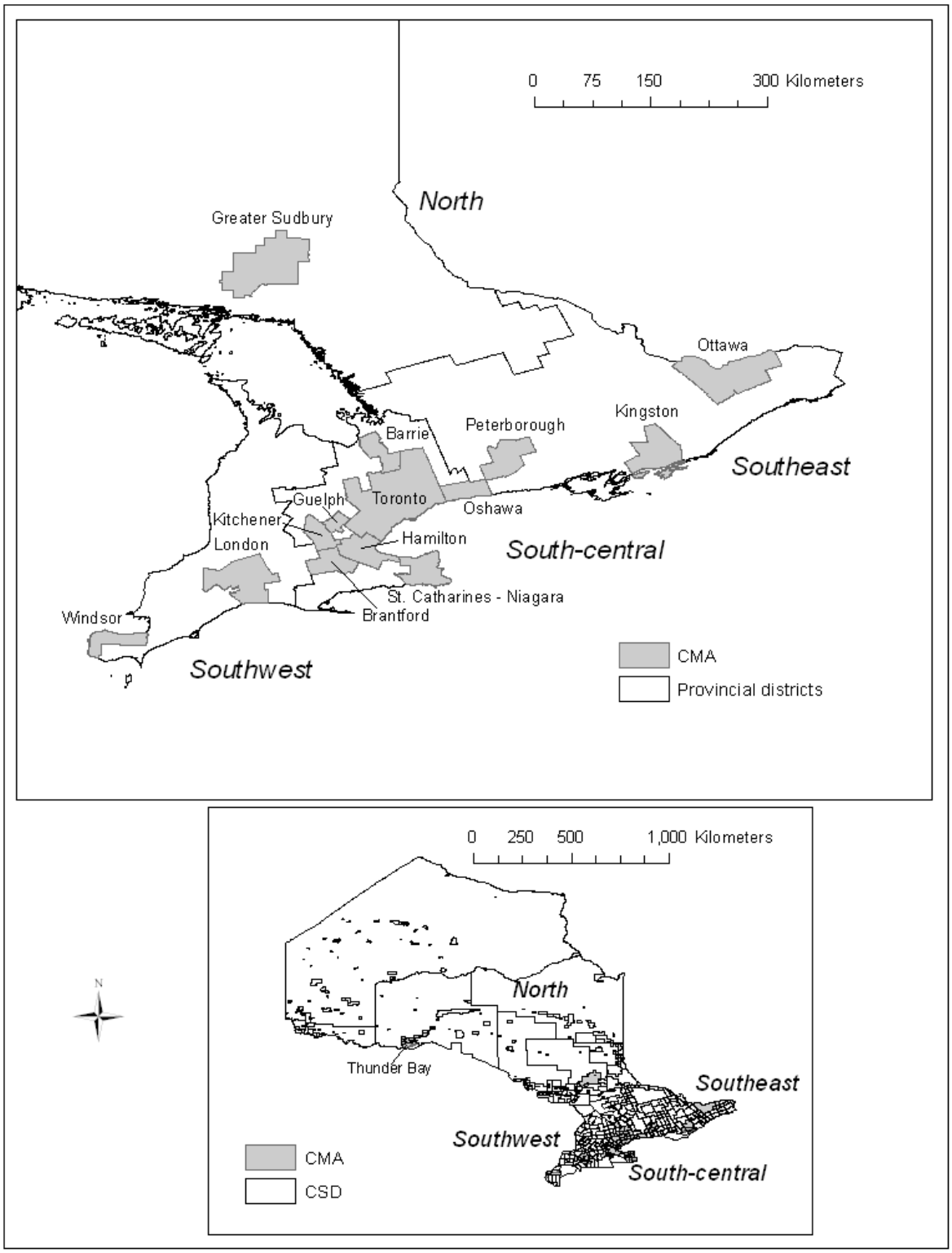

Figure 2: Acupuncture Offices in Ontario

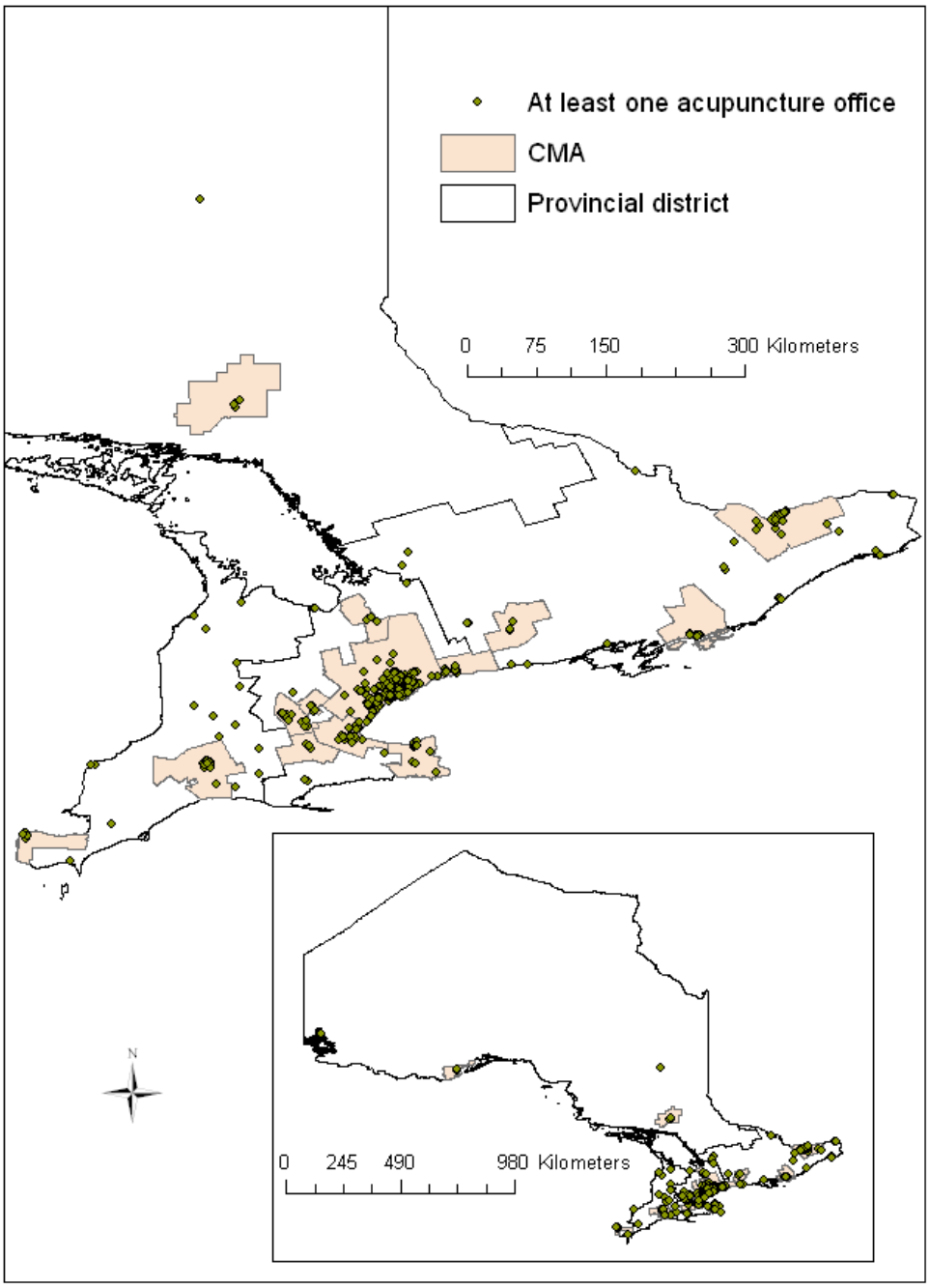

Figure 3: Chiropractor Offices in Ontario

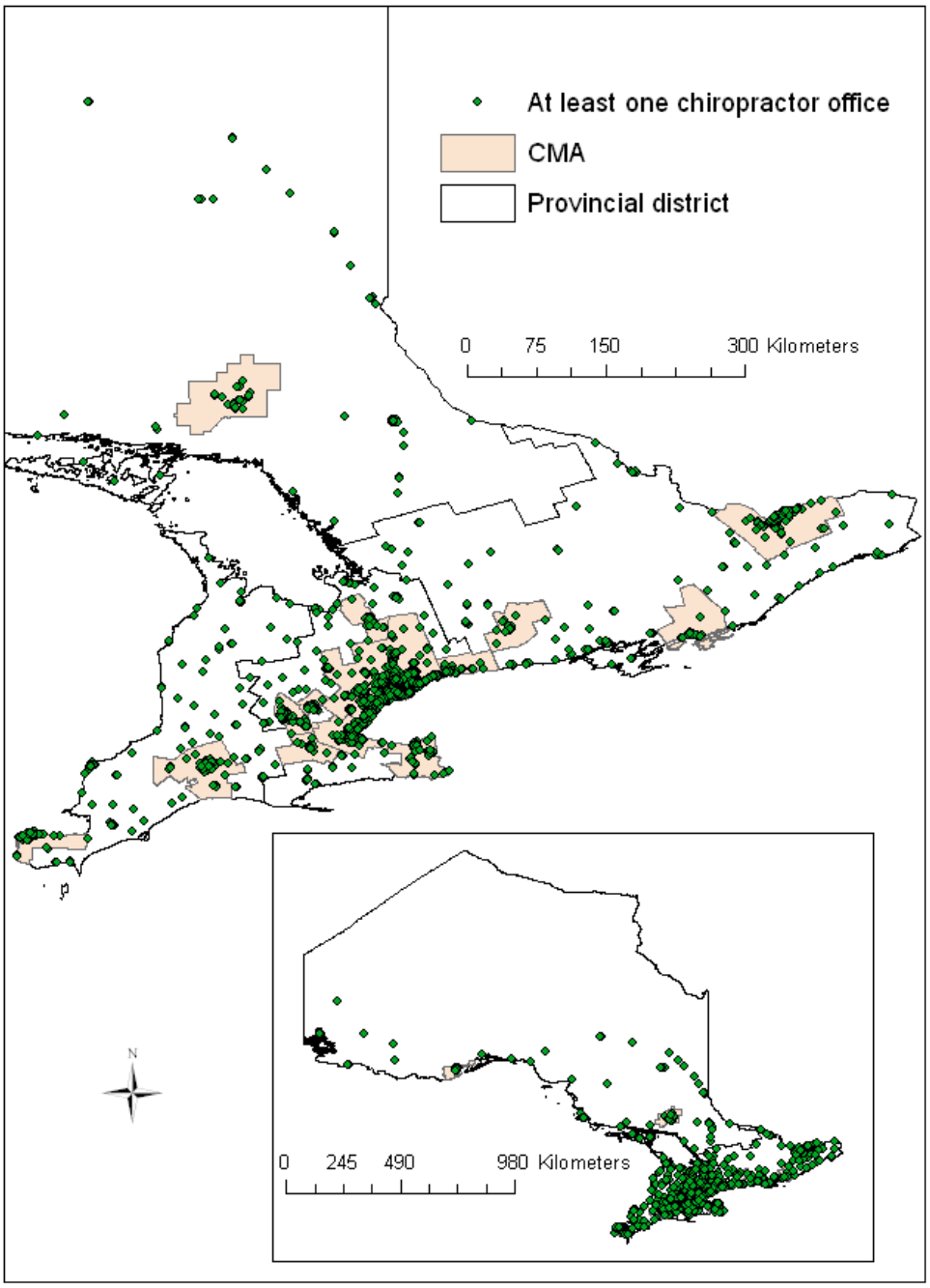

Figure 4: Massage Offices in Ontario

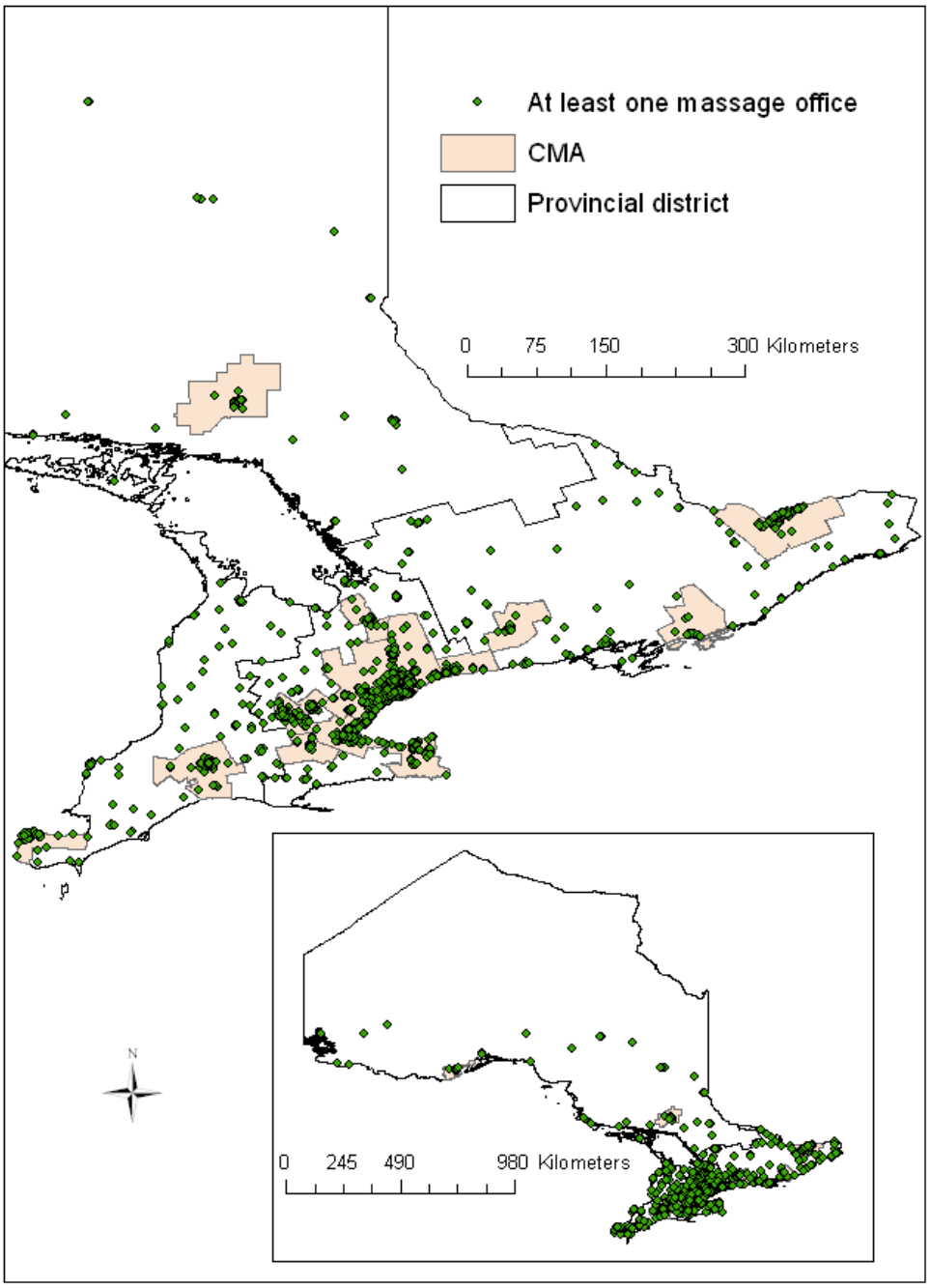

Figure 5: Holistic Offices in Ontario

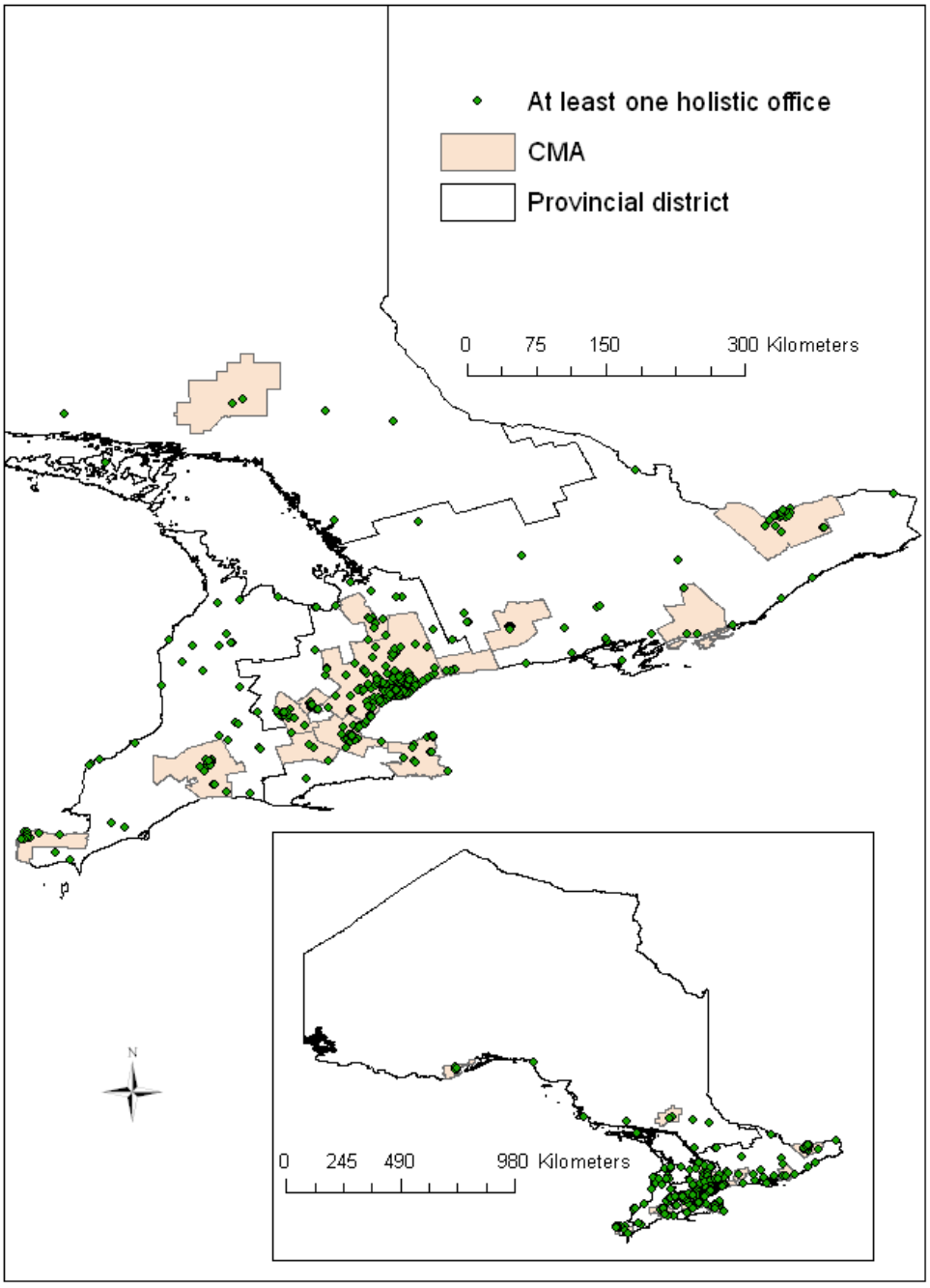

Figure 6: Naturopath Offices in Ontario

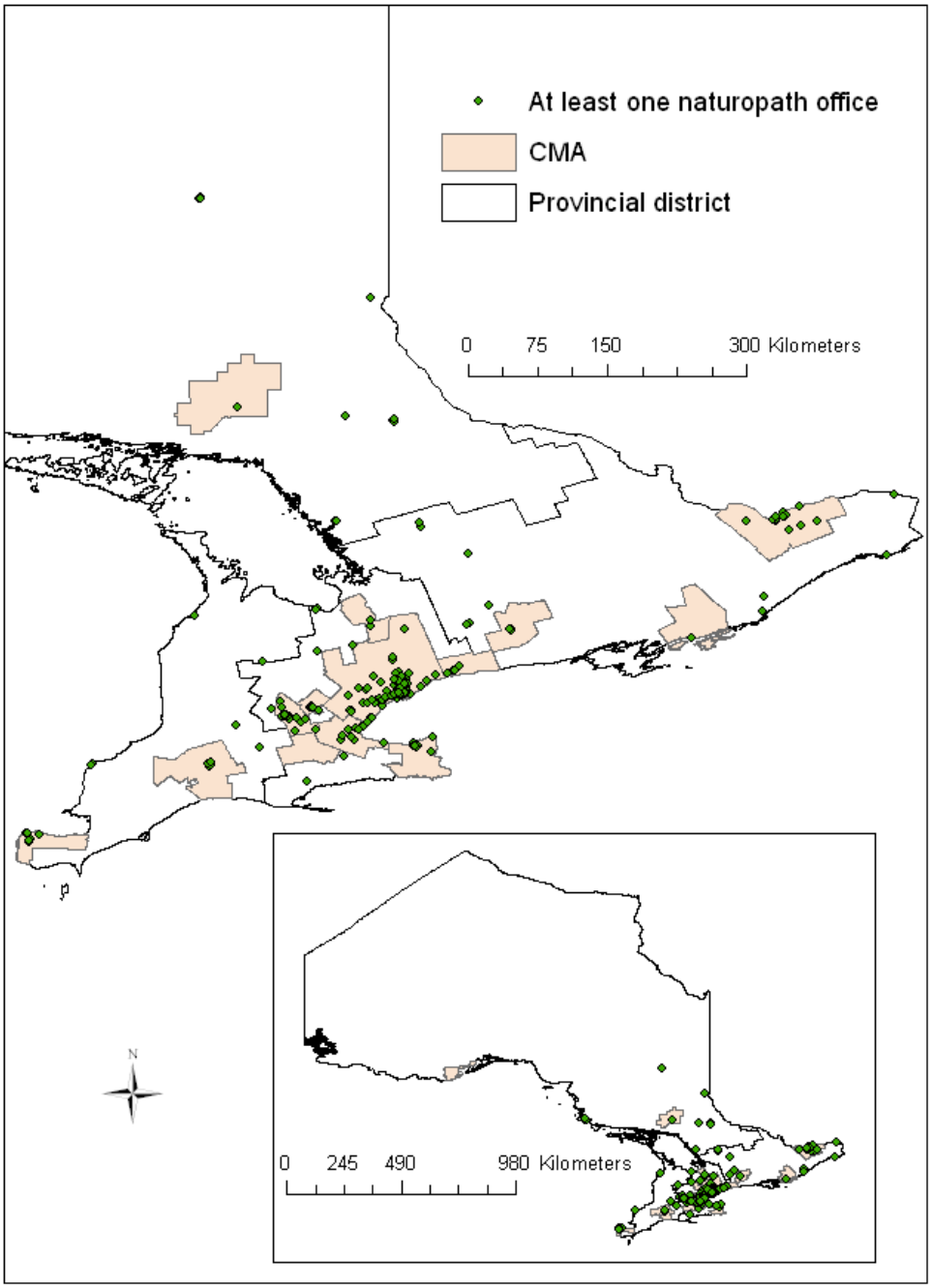

Figure 7: Homeopath Offices in Ontario