The Vancouver Area Neighbourhood Deprivation Index (VANDIX): A Census-based Tool for Assessing Small-area Variations in Health Status

Nathaniel Bell, PhD,1 Michael V. Hayes, PhD2

ABSTRACT

Objective: The Vancouver Area Neighbourhood Deprivation Index (VANDIX) is a census-based measure of socio-economic status (SES). It was designed to serve as an accessible and representative proxy marker of population health status without requiring more extensive health data. This paper describes the structure and previous applications of the VANDIX for measuring relative variations in health outcomes in British Columbia, Canada.

Methods: The VANDIX was constructed from a 2005 survey of provincial medical health officers asking them to comment on the best census markers of health status in British Columbia. The VANDIX is based on the weighted summation of seven socio-economic variables from the census, including in order of weighted importance: proportion without high school completion; proportion without university completion; unemployment rate; proportion of lone-parent families; average income; proportion of home owners; and employment ratio.

Results: The VANDIX has been applied in numerous research and policy settings across the province against several distributions of health status, including self-rated health, injury and access to health care services. In each assessment, the VANDIX has shown that socio-economic inequities parallel health inequities.

Conclusion: SES is one of the most influential factors that shape population patterns of health outcomes. Census-based indicators of SES such as the VANDIX can serve as easily accessible and representative markers of population health status, and have application for policy, research and public health promotion.

Key words: Socio-economic factors; censuses; health status indicators; British Columbia

Population patterns of mortality, disease, injury and access to health services are widely known to be influenced by socio-economic circumstances.1-5 Summary measures of the distribution of social and economic characteristics taken from the census help us to identify systematic variations in the health status of populations. These measures also provide a means to inform policymakers, service providers and the public at large about relative inequalities in health status.

There is long-established and comprehensive research dedicated to the development of area-based measures of social class and other aspects of socio-economic position for public health research and surveillance both in Canada and abroad.6-12 The Vancouver Area Neighbourhood Deprivation Index (VANDIX) is a census-based measure of socio-economic status that was constructed for the purpose of analyzing small-area distribution of health status within urban populations of British Columbia.13 Specifically, the VANDIX was designed to serve as an easily accessible and representative proxy measure of the health status of the population at a more granular geographic scale than provincial health authority boundaries. The organization of the Vancouver Coastal and Fraser Health Authorities shown in Figure 1 created the impetus for this work, as both administrative areas straddle the Vancouver Census Metropolitan Area (CMA), which severely affects attempts to understand the distribution of health status at an intra-region level. This limitation not only restricts the generation of valid data for testing hypotheses about population health, but also severely limits the ability to organize collective attention toward managing common health concerns.

The overriding issue when constructing the VANDIX was deciding how best to build cooperative links with decision-makers who could help frame an understanding of health disparities and advance a health equity agenda, and how to do so in a way that would allow for a more representative view of local health outcomes that was not constrained by the boundaries of the provincial health authorities. To address these challenges, we constructed the VANDIX from a survey of provincial medical health officers (MHOs). This was an effort to evaluate an empirical measure of health status based upon perspectives on the determinants of health held by individuals who have the professional responsibility to provide leadership in addressing issues relating to health disparities. Thus, the VANDIX is based on what public health experts believe are the best census markers of health status.

Author Affiliations

1. Department of Surgery, University of British Columbia, Vancouver, BC
2. School of Public Health and Social Policy, and Department of Geography, University of Victoria, Victoria, BC

Correspondence: Michael V. Hayes, PhD, HSD Rm B202E, University of Victoria, Victoria, BC. V8W 2Y2, Tel: 250-853-3108, E-mail: mhayes@uvic.ca

Acknowledgements: Funding for N. Bell is provided by a postdoctoral fellowship awarded by the Canadian Institutes of Health Research.

Conflict of Interest: None to declare.
Constructing the VANDIX

The VANDIX was developed using the results of a 2005 survey circulated to the MHOs in British Columbia. The VANDIX incorporated 21 indicators covering material wealth, housing, demographic factors, mobility, education, employment and culture. The survey was approved by the Research Ethics Board of Simon Fraser University and distributed by BC’s Provincial Health Officer. Each MHO was asked to comment on which of the 21 indicators they felt best characterized poor health outcomes throughout the province. Variables included in the survey were identified from a literature review according to their association with health outcomes, their representation of both social and material deprivation, and the ability to construct each indicator directly or indirectly using Canadian census data. Respondents were asked to rate the importance of each indicator for characterizing poor health outcomes using a five-point Likert Scale (strongly agree responses=5, agree responses=4, neutral responses=3, disagree responses=2 and strongly disagree responses=1). A total of 10 of the province’s 27 MHOs returned a completed survey for a response rate of 37%. Table 1 lists all 21 variables originally included in the survey.

Our interest was to assess the variables felt by the majority of MHOs to most influence poor health outcomes against other indices and measures (described below). We administered a cut-off score of 31 to determine that the indicator received an overall “non-neutral” response (10 times a neutral response [value=3] + 1). Seven variables were identified from this process, including in order of weighted importance: the proportion of persons without high school completion; proportion of persons without a university degree; unemployment rate; proportion of lone-parent families; average income; proportion of home owners; and employment ratio.

The VANDIX is an additive index constructed from the summation of the standardized (z-score) values for each of the seven variables. Before summation, preference weights were assigned to each variable on the basis of the response frequency of MHOs’ selection rankings regarding its influence as a determinant of health. The VANDIX weights were assigned by ordering each variable according to total response scores from all 10 MHOs. The variable that received the highest aggregate response score was assigned a ranking of 1, the next highest score was assigned a rank of 2, etc. The proportional weights were calculated by the following equation:

\[ w_i = \frac{n - r_i + 1}{\sum (n - r_i + 1)} \]

where \( w_i \) is the standardized proportional weight for the selected variable, \( n \) is the total number of variables in the index (n=7) and \( r_i \) is the ordinal position of the variable. The preference weight assigned to each variable was obtained by dividing its ordinal position by 28, which is the sum of all ranking values. The seven

Table 1. The 21 Variables That Provincial MHOs Were Asked to Characterize Regarding Their Link With Health Outcomes in BC
weights in order of importance were 0.25, 0.214, 0.179, 0.143, 0.107, 0.714 and 0.035. Both “average income” and “home ownership” received identical scores from the MHOs, and so the final index assigned a rank of 2.5 to both indicators and a weight of 0.089 to ensure that all weights summed to 1.

The VANDIX was designed to be replicated using data available from the Canadian census. Canadian census data are accessible to anyone associated with an academic organization through Statistics Canada’s Data Liberation Initiative (DLI). Under the DLI agreement, academic institutions pay a fixed fee that allows students, faculty and staff of Canadian universities to access DLI products. Variables used to build the VANDIX can be accessed using the Canadian Census Analyzer, which is an online electronic database distributed by the Computing in the Humanities and Social Sciences centre at the University of Toronto. The Census Analyzer is accessible from any university library’s electronic index and database collections.

Table 2 outlines how each VANDIX data category was calculated using the data categories of the 2001 and 2006 Canadian census. The final score was created from the summation of each of the seven standardized and weighted variables, with positive weighted z-scores reflecting “greater disadvantage” or poorer health and negative scores representing “lesser disadvantage” or better health. The standardized z-scores of four variables – average income, university degree, employment ratio and home ownership – were multiplied by -1 before summation to maintain the association between positive z-scores and greater disadvantage. Once constructed, the final VANDIX score could be linked to spatially referenced census data using the unique identifier associated with each dissemination area, census tract or census subdivision for purposes of mapping, geocoding or spatial analysis.

**Uptake and use**

The VANDIX has repeatedly reaffirmed the relation between both the social and economic environment and health status throughout British Columbia. It has been assessed against trends in individual perceptions of self-rated health, and intentional and unintentional injury, and it has been combined with ancillary geographic data to measure disparities in access to emergency medical care services. Further uptake includes assessments by the Canadian Institute for Health Information as well as members of British Columbia’s Interior Health Authority for evaluating variations in health status and local social service delivery. Methodological assessments of the VANDIX variables, the strength of agreement in MHO responses, the weighting scheme assigned to the variables, as well as the effect of the modifiable areal unit problem, have been also been tested. In the initial assessment, we compared the effect size of the VANDIX score against a
subset of data taken from the Canadian Community Health Survey (CCHS) Cycle 2.1 questionnaire on self-rated health with two additional Canadian deprivation indices: Frohlich and Mustard's socio-economic factor index and Pampalon and Raymond's Derivation Index for Health and Welfare Planning in Quebec. The results from this assessment are shown in Figure 2. All three indices similarly produced a social gradient in health status within the Vancouver CMA when contrasted against self-rated health response scores from the CCHS. At the very minimum, the results supported the effectiveness of integrating into the construction of health indices the perspectives of decision-makers who could advance a health equity agenda, which is in contrast to the current preference for data-driven socio-economic indices (e.g., principal component analysis), a trend that largely emerged from past critiques of the UPA8 constructed by Jarman et al. in the UK for allocating general practitioner resources.

While the observations identified from the VANDIX strongly reinforce the view that social and economic inequalities parallel health inequalities, no area-based measure of deprivation or health status is without its limitations. First, the VANDIX has not yet been assessed against individual-level socio-economic data representative of all seven area-level variables because of the difficulty of replicating each variable outside of the census. Rather, its assessments have been used to draw attention to socio-economic conditions that tend to make whole populations healthier than others, which may not necessarily reflect the factors that lead some individuals to be healthier than others. However, as the VANDIX score has repeatedly demonstrated correlation with health outcomes both over time and by case mix, the VANDIX findings provide evidence of at least some type of causal process between socio-economic characteristics and health status. Furthermore, the much broader literature on the determinants of health points to the effect of area- or neighbourhood-level socio-economic conditions on health, even after adjustment for the characteristics of the individuals therein. Although the development of comparable, individual-level variables representative of the VANDIX may further define how socio-economic position reflects population health status, it is highly likely that such an effort would largely confirm rather than challenge findings from previous studies.

A second concern is that the VANDIX as a relative measure of health inequity is primarily reflective of the material conditions that are important for health, such as adequate income, housing or employment as opposed to the social factors that reflect dimensions of cohesion and fragmentation that similarly underpin disparities in health status. An additional concern is that by combining measures of income, education, employment and family demographic structure into a single index, we run the risk of conflating or potentially nullifying the various social and economic pathways thought to modify health outcomes. This is an issue that may be further compounded by defining health status using geographic boundaries, which may not meaningfully reflect the scale of social processes. While valuing each of the seven variables with a specified weight reduces this potential limitation it does not necessarily reduce the “averaging out” effect that two or more measures may incur (e.g., high income with low university graduation among persons in skilled trades; low income with home ownership). Such a limitation, however, is universally problematic for area-based deprivation measures, as most, if not all, markers incorporate multiple constructs representative of income, poverty or wealth, or proxy measures of social or material status or class. The simplifying alternative is to employ income as a proxy marker of health status, given its strong relation with the unequal distribution of mortality rates. Although income distribution is generally a fairly clear indicator to interpret and is widely found to parallel health status, reinforcing the perception that health status is merely a reflection of income distribution detracts from addressing the importance of social conditions of everyday life as the crucial pathway that leads to excess morbidity and mortality.

**CONCLUSION**

Assessing the health experiences of populations against social and economic variables carries information about the characteristics of the social environment that are determinants of health. This association has been repeatedly demonstrated by the VANDIX as well as other census-based socio-economic measures both in Canada and abroad. One of the prevailing strengths of these tools is the ability to produce a readily available and representative marker of health status that enables leaders and researchers engaged in health policy and promotion to obtain a broader understanding of the distribution of health status at an inter-regional scale. This strength is largely due to the availability, structure and representativeness of national censuses, which remain the principal data sources for drawing attention to this association. While the health patterns raised by these studies clearly have limitations because of the reliance on area-level data to define individual health experiences, the fact that this pattern is recurrent is evidence of some underlying causal processes within our socio-economic environment that are fundamentally important in shaping health experiences. However, the value of the VANDIX, as well as other Canadian health measures, faces substantial challenges given the federal government’s recent decision to abolish the mandatory long-form census for the 2011 census year. Such a change will undoubtedly affect our ability to rely on the census as a rich, centralized data source given the widespread apprehension that its representativeness, particularly among the more vulnerable and marginalized populations, has now been significantly reduced.

**REFERENCES**


