

Development of New Zealand's Deprivation Index (NZDep) and Its Uptake as a National Policy Tool

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ABSTRACT

Objectives: To outline the development and uses of the census-based New Zealand small-area index of relative socio-economic deprivation, NZDep.

Methods: NZDep has been created from four 5-yearly censuses using theory developed from international deprivation research, a standard statistical procedure (principal component analysis) and both construct and criterion validation.

Results: The latest index was based on nine socio-economic deprivation variables available for just over 4 million people. It was calculated from a basis of 24,000 small areas containing a median of approximately 90 people. The deprivation index has a value from 1 (low) to 10 (high). It is mapped to standard administrative areas and is available free of charge. The index is easy to visualize, and deprivation maps are widely used. The index is used in many applications in research and social epidemiology, and routinely by the country's Ministry of Health, both to explore health variations across the country and to allocate central government funds to local health care providers. Geographers in local government were quick to recognize the index as a good tool for visualizing the diversity and neediness of local communities, and hence as a tool for town and service planning.

Conclusion: The national NZDep index of small-area deprivation has been used widely in research on mortality, morbidity and determinants of ill health, and in needs assessment, resource allocation and advocacy.

Key words: Socio-economic status; New Zealand; resource allocation; inequalities

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The New Zealand small-area index of relative socio-economic deprivation (NZDep) is a national index derived from census data. To date, it has been created from four censuses: 1991, 1996, 2001 and 2006. The purpose of this paper is to outline the development of NZDep and indicate its uses, especially those related to policy development.

The need for some form of index of socio-economic conditions at a fine geographic scale was identified at a meeting in Wellington in 1994 attended by representatives from a number of government and social agencies as well as by health researchers. Area indices were already available, such as the Health and Equity index of deprivation.¹ This had been used in funding allocations and health needs assessments, but the geographic scale for the index generally contained upwards of 1,000 people, thereby missing smaller pockets of deprivation. The meeting identified potential new uses for a small-area based index – for example, differential funding for schools, subnational health organizations and police districts – and insisted that a standard measure was required that could be updated regularly and used across a range of sectors.

A 1995 Health Research Council grant enabled the development of the initial small-area index, NZDep91, from anonymized unit record data from the 1991 New Zealand Census. Statistics New Zealand provided access to these census data in accordance with the security and confidentiality provisions of the *New Zealand Statistics Act 1975* (as it has done for the indices created from subsequent censuses).

The theoretical basis for deprivation is well established. Deprivation is “a state of observable and demonstrable disadvantage relative to the local community or the wider society or nation to which an individual, family or group belongs”.² It can include both material and social deprivation, material deprivation involving the material apparatus, goods, services, resources, amenities and physical environment and location of life, and social deprivation involving the roles, relationships, functions, customs, rights and responsibilities of membership of society and its subgroups.² As a result, some people may be thought of as experiencing multiple deprivation and others as experiencing only a single form of deprivation. Deprivation indices have been used widely, especially in the UK.³ The New Zealand deprivation index was intended to inform resource allocation, research and advocacy.⁴ The tool was rapidly taken up by health researchers and also by local government planners, who were the first to explore its mapping potential. They overlaid grey-scale transparencies of small-area variations

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for each variable in the index to illustrate how the index identified increasing prevalence of one or more forms of deprivation. Atlases of socio-economic deprivation have been produced from the last three indexes, NZDep96, NZDep2001 and NZDep2006. The first two were soft-bound books, but the latest atlas exists as both a free on-line resource and a ring-bound book for easy desk-top use,⁵ as is done regularly, for example, in the Ministry of Health and in local district health boards. The index itself is free.⁶

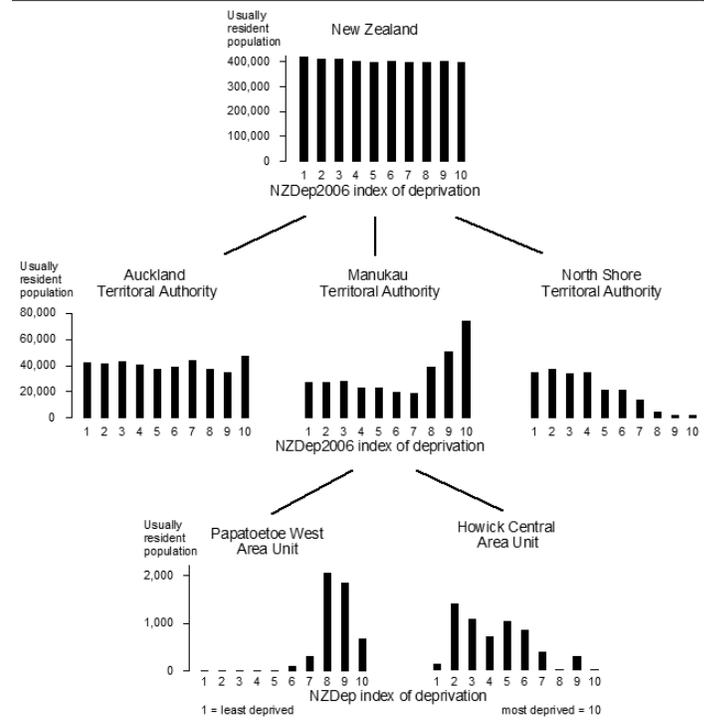
The first index, NZDep91, was released in 1997, by which time data from the 1996 census were becoming available. This enabled lessons learned from developing the first index to be quickly applied to the updated version. Two of the original ten variables in the index, capturing separation and divorce among those of working age and those older, were dropped given concerns about their lack of face-value validity, their potential as risk factors for deprivation rather than direct markers of it and the capture of the economic consequences by the already included income variable. A new variable in the 1996 census (access to a telephone) was included. A further improvement was made to the index created from the 2001 census by using the Canadian National Occupancy formula for crowding, instead of the OECD (Organisation for Economic Cooperation and Development) formula used earlier. The latter used counts of adults and children, and the number of bedrooms, but the former also includes information about the household composition, allowing, for example, for couples sharing a bedroom.⁷ The Canadian measure was more closely related to other measures in the index than the former had been. The 2006 index is similar to the 2001 version, though all versions have some unavoidable differences dictated by legislative and geographic changes. For simplicity, the latest version is used as the exemplar.

METHODS

Each small-area index was created as the first principal component of the deprivation variables: the weighted sum that describes the greatest proportion of the overall variation of the variables. It is the best single indicator of deprivation, given those variables. Specifically, the NZDep indices are weighted sums of proportions of people of an appropriate age in a small area having specific deprivation characteristics. Potential deprivation characteristics available from the census data were included on the basis of theoretical considerations, reliability (there were few missing data) and correlation (their weights in the first principal component indicated a reasonable correlation with the other deprivation variables). The distribution of scores on the first principal component was divided into tenths, so that the usual NZDep index runs from 1 (an area in the least deprived 10% of small areas) to 10 (in the 10% most deprived small areas). Distributions in quintiles are also commonly used.⁸ The indices have all been extensively construct and criterion validated,^{9,10} the latest being criterion validated against individual smoking data in the 2006 census (extensive previous research has shown smoking to be strongly patterned by socio-economic position).⁶

The variables in each index are age- and sex-standardized proportions of people in each small area with certain deprivation characteristics. For NZDep2006, there were nine such characteristics. They related to people who were aged 18-64 years and receiving a means-tested benefit; were living in households with equivalized income below an income threshold; were not living in their own

Figure 1. An example of variation in NZDep2006 profiles by standard administrative boundaries

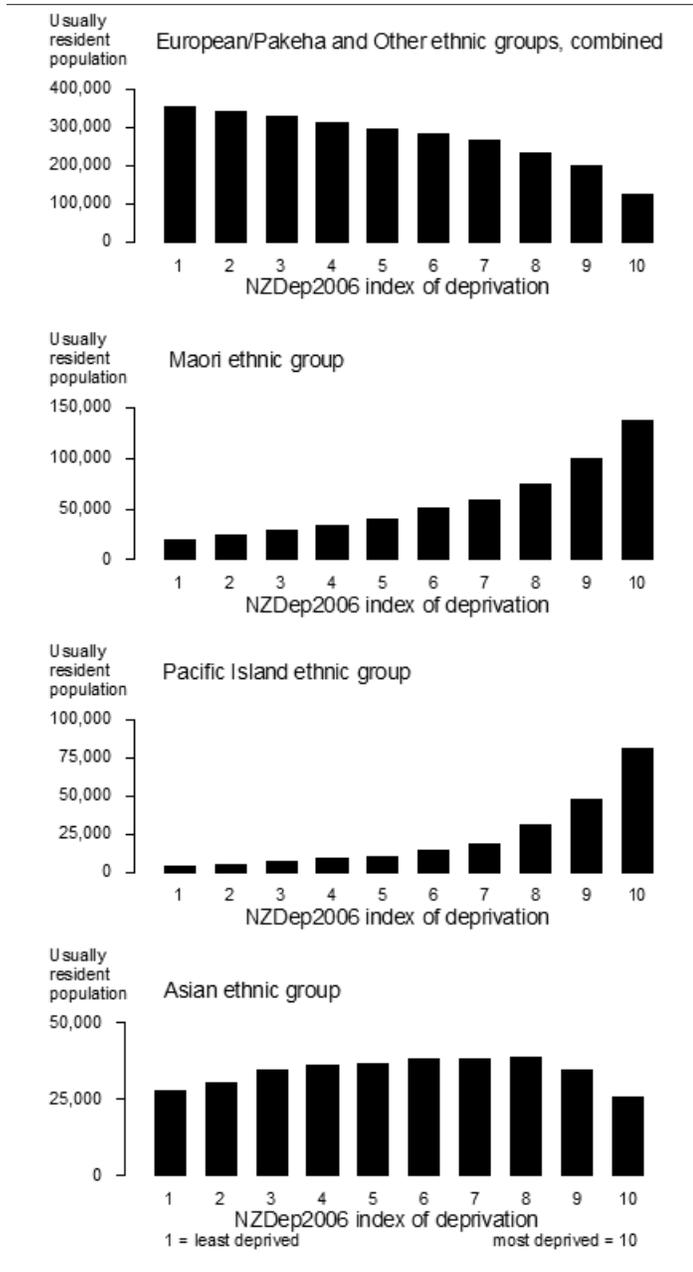


home; were aged under 65 years living in a single-parent family; were aged 18-64 years and unemployed; were aged 18-64 years and without any qualifications; were living in households below an equivalized bedroom occupancy threshold; were without access to a telephone; and were without access to a car.

Users wanted an index that changed little from one census to the next, but some changes are desirable and others are inescapable. A recent change in the age of retirement entitlements, from 60 to 65 years, gave rise to the (evaluated) use of 64 years as the upper age limit of generally working-aged people for NZDep2006. Both income variables have always necessitated some tweaking. First, the income-tested benefits have not been constant across the censuses; and second, the threshold for low equivalized household income is dependent on the income-band distribution at each census time. The threshold is taken to be the nearest possible to 15% of the population on the basis that the proportion of the population identified as being socio-economically deprived by the threshold should be broadly consistent both with the other variables in the index and with other measures of income poverty.⁶

A key feature of the index is the smallness of the areas used. The smallest standard area that Statistics New Zealand uses is the meshblock, a realistic responsibility of a single enumerator at census time. Meshblock populations vary spatially and numerically. Their median population size is approximately 90 persons but can be as few as a handful or as many as 300. Clearly, in order to use proportions the denominator should be large enough to produce robust values. Thus, where necessary, meshblocks were agglomerated to create NZDep2006-specific small areas with a population of at least 100 persons usually resident, where possible. Agglomeration occurred only within the boundaries of Statistic New Zealand's internal primary sampling units, so that the resulting small areas were geographically connected. In general, the NZDep2006 small areas consist of one or two meshblocks. The index value for any

Figure 2. Ethnic disparities in relative socio-economic deprivation as measured by NZDep2006



small area was assigned to each of its component meshblocks. In any application of the index the meshblock value is ascribed to an individual living there by means of their geocoded address. Addresses are readily available in many administrative and survey datasets. Further details concerning the construction of the index are available elsewhere.^{4,6}

RESULTS

Social variation in the 10-point scale is easily graphed whether the source is sample survey data or census data and whether geographic or health/social associations are being explored, as shown in the examples that illustrate extremes of deprivation within larger, apparently undifferentiated areas (Figure 1) and variations by ethnicity (Figure 2, discussed later). In Figure 1, the top graph shows that there are approximately equal numbers of people in each

NZDep (area-based) category at the highest level of geographic aggregation. The middle graphs drill down to smaller geographic areas and demonstrate that three territorial authorities in the Auckland area show marked differences. The bottom graphs show two smaller area units in one of these territorial authorities, identifying stark differences in their socio-economic deprivation.

Uses of NZDep

NZDep has been widely used as a variable of interest or as a confounding variable in numerous health research studies focusing on areas as diverse as mortality,¹¹ hospitalizations,¹¹ cancer,¹² asthma,¹³ immunization,⁴ pertussis,¹⁴ cot death,¹⁵ smoking,¹⁶ nicotine replacement therapy,¹⁷ nutritional status,¹⁸ primary health care utilization,¹⁹ antibiotics use,²⁰ contaminated wastes sites²¹ and health status.²²

An early example of the use of NZDep for needs assessment was the directive from the Ministry of Health, in 2000, to the country's district health boards to include NZDep96 as a measure of deprivation as part of the demographic data required for its Health Needs Assessment for New Zealand.²³

NZDep is widely used by social service planners in central and local government as a tool for planning and resource allocation. A central government example is the population-based health funding formula, which uses NZDep as a weighting factor in order to direct health service funding to areas of high need.²⁴ The formula allocates public funds to the 20 district health boards based largely on the number of people within each board's region. These per-head allowances are then adjusted so that young people and older people receive a greater per-capita allowance (consistent with their greater need for health services), as do those living in socio-economically deprived areas, and Maori and Pacific populations.

In another central government example, the press release of the latest Drinking Water Subsidy Scheme announced by the New Zealand government in 2010 noted: "Only those communities with a deprivation index higher than 7 are eligible (deprivation index of 10 is the least socially and materially well off)."²⁵ There are, however, potential problems with this community-level NZDep usage in areas such as very rural farmland, where the administrative area upon which NZDep is calculated has a sparse population in a large geographic locality, since it could hide tiny pockets of deprivation (of lack of it) as measured by the NZDep variables. A better alternative in these circumstances might be a small local survey measuring individual deprivation, for example by the New Zealand index of socio-economic deprivation for individuals, NZiDep.²⁶ This example is cautionary: like any other tool, NZDep is not the best tool in all circumstances.

In local government circles, town planners around the country consider the broad local deprivation landscape in their planning strategy – see Auckland, for example²⁷ – and at the community level NZDep is used as a tool for advocacy related to issues as diverse as gambling venues and fast food outlets.

One of the ongoing key areas highlighted by NZDep is ethnic disparities, whether they be disparities in health outcomes²⁸ or disparities in the deprivation of the areas in which people from different ethnic groups live (Figure 2). New Zealand has four major ethnic divisions: indigenous Maori; Pacific Islanders; Asians; and the rest, who are mostly European (often referred to as Pakeha) and who comprise approximately three quarters of the total popula-

tion. The NZDep profiles of the Maori and Pacific ethnic groups are very different from the profiles of the other two ethnic groups (Figure 2). This highly unequal distribution of material and social resources across different ethnic groups has roots in both New Zealand's colonial history and its contemporary social stratification.

DISCUSSION

Although NZDep is a very useful tool for highlighting disparities to aid resource allocation and policy making, the meshblock boundaries suggest rigid dividing lines that will be fuzzy in reality, and the colour coding of areas in maps can lead to pejorative labeling by vested interests (such as real estate agents) or through careless use in the news media. These technical and stigmatizing problems have to be balanced against the benefits of identifying small communities that need assistance, be it with health, housing or other social services.⁵

Cautions

A number of other potential problems arise in using area-based measures of socio-economic position. They include reification, interpretation, simplicity, relativity and longitudinal misapplications.

Reification occurs when abstract concepts are treated as concrete, for example, when users forget that an index is only a partial or proxy measure of the complex underlying phenomenon it purports to measure. Thus, users of NZDep indices are urged to refer to "areas that have the most deprived NZDep scores" rather than "the most deprived areas".⁵ NZDep is a small-area measure, so caution is advised when applying it to individuals to approximate their personal level of deprivation – for example, when detailed individual information is not available but their address is – because deprived individuals can live in relatively non-deprived neighbourhoods, and vice versa.^{29,30} Thus, for allocation of resources to individuals the area index is to be avoided and individual information, such as occupation or income, should be used, if appropriate, or else an individual index, such as NZiDep.²⁶

The NZDep scales (from 1 to 10) have been constructed so that they can be used in a variety of contexts and are easily presented graphically. However, this simplicity should not be allowed to obscure the underlying complexity of construction, the limitation to components available from the census and the underlying theoretical assumptions. It should also be remembered, in reference to the different NZDep indices, that 10% of areas will always fall into the most deprived decile of NZDep scores, since the index measures socio-economic deprivation relative to the population at the time of the relevant census, not to some absolute measure of socio-economic deprivation. Comparison of the NZDep values across different indices is not straightforward to interpret because of changes in the census-specific definitions of the small areas as a result of changes in administrative boundaries; changes in the precise definitions of the variables included; and small statistical changes in the distribution of the resulting first principal components. However, cross-sectional comparisons and relations with other variables are completely valid, as the assumption of an underlying deprivation continuum is maintained, as is the computational method.

The future

The need for policy-relevant measures of socio-economic position is not likely to diminish over the coming decades. NZDep will be updated and recreated following each planned 5-yearly census until it is superseded by other policy-relevant tools.

NZDep is dependent on census data and thus on a census actually taking place. The devastating earthquake in Christchurch in February 2011 has resulted in the postponement of the next New Zealand census, which was due to be held in March 2011; it is now to be held in 2013. Although such phenomena are rare, this illustrates the need to think of alternative sources of information on which to base a cost-effective national index. Unfortunately, no such alternative in New Zealand is obvious.

The primary uses of NZDep – resource allocation, research and advocacy – are as relevant now as when the index was first developed, and NZDep remains a widely used tool in policy, funding, research and community action.

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