Measuring socioeconomic position in New Zealand

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ABSTRACT

INTRODUCTION: Measures of socioeconomic position (SEP) are widely used in health research.

AIM: To provide future researchers with empirically based guidance about the relative utility of five measures of SEP in predicting health outcomes.

METHODS: Data from 12 488 adults were obtained from the 2006 New Zealand Health Survey. Seven health-related outcome measures with expected variations by SEP are modelled using five measures of SEP: a census-based small-area index of relative socioeconomic deprivation, NZDep2006; a questionnaire-based individual-level index of socioeconomic deprivation, NZiDep; an index of living standards, ELSI; education, measured by highest qualification; and equivalised household income.

RESULTS: After including the individual measure of deprivation, the area-based measure of deprivation adds useful explanatory power, and, separately, the broader spectrum provided by the living standards index adds only a small amount of extra explanatory power. The education and household income variables add little extra explanatory power.

DISCUSSION: Both NZiDep and ELSI are useful health-outcome predictors. NZiDep is the cheapest data to obtain and less prone to missing data. The area index, NZDep, is a useful addition to the arsenal of individual SEP indicators, and is a reasonable alternative to them where the use of individual measures is impracticable. Education and household income, using commonly used measurement tools, may be of limited use in research if more proximal indicators of SEP are available. NZDep and NZiDep are cost-effective measures of SEP in health research. Other or additional measures may be useful if costs allow and/or for topic-related hypothesis testing.

KEYWORDS: Deprivation; inequalities; living standards; New Zealand; socioeconomic position

Introduction

Variables measuring socioeconomic position are used in health research both as variables of interest and as important potential confounders in relationships between exposure variables and health outcomes.

'Socioeconomic position' (SEP) is a term indicating 'the social and economic factors that influence what position(s) individuals and groups hold within the structure of society'.[1] The measures with the longest history of use in New Zealand are those based on income, education, and occupation.[2–5] No single measure captures the complete nature of SEP.[6] For example, income measures on their own do not always discern the different living conditions experienced by households—some poor families are more asset rich than others; some have better networks and community supports; some have existed on a low income for longer than others.

To gain an accurate measurement of SEP for a person or household, a range of measures is required. This paper examines and compares the five measures of SEP available from the 2006 National Health Survey:[7] three recent NZ-specific

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indices and two long-established single-variable measures. We did not include an occupation-based measure of socioeconomic position in the analyses because (a) no suitable occupation-based index was available in the survey dataset, and (b) such indices do not include people who are not economically active, such as children, students, homemakers, the unemployed, and the retired, and hence cannot be applied directly to a significant proportion of survey respondents for many of whom imputation would be unreliable.

1. A deprivation index for small areas

The latest census-based index of relative socioeconomic deprivation for small areas, NZDep2006, was created from the proportions of people in each small area with each of nine characteristics related to deprivation. It is fully described elsewhere.[8–11] While designed originally for use in resource allocation, health research and advocacy, NZDep has become a widely used social research tool. It is included in funding formulae for groups of people,[12,13] which is appropriate because aggregates are the unit of analysis and the targets of funding. However, NZDep should not be used to target funding to individuals, since the inherent measurement error would result in discrimination for some people, such as individuals or households where wealthy people live in poorer areas or poorer people live in richer areas.[10,11] Such a mix of households is very common, even at meshblock level. It is for this reason that a robust individual deprivation measure, NZiDep, was developed, primarily for use in research and surveys and potentially as a tool to aid targeting of resources.

The NZDep2006 index is an ordinal scale from 1 to 10 where 1 indicates a small area in the 10% least-deprived small areas in the country at the time of the 2006 census, and 10 indicates a small area in the 10% most-deprived small areas.

2. A deprivation index for individuals

The NZiDep index was derived using the same theoretical basis as the four national census-based small-area indices of relative socioeconomic deprivation: NZDep<year>. NZiDep is fully described elsewhere.[14,15] As an individual measure of SEP, NZiDep, like the living standards index discussed below, is relevant to everyone, not just the economically active.

NZiDep identifies a person on a socioeconomic continuum by reference to the directly measured constraints upon their income, their capacity to consume essential market goods, and their dependence upon non-market support. However, by emphasising the deprivation end of the continuum, this index does not differentiate among those people who possess none of the deprivation characteristics upon which the index is based but who may have variations in access to items of luxury consumption.

The ordinal 5-point NZiDep scale codes the number of deprivation characteristics exhibited by an individual out of eight, as 0 (estimated 66.3% of the population from the Health Survey); 1; 2; 3 or 4; and 5 or more (category estimated at 2.9%).

3. A living standards index

The Ministry of Social Development's Economic Living Standards Index (ELSI) is derived from 25 living standards–related items associated with personal and household consumption, recreation, social participation, and household facilities.[16-18] Conceptually, the living standards approach is very close to the deprivation approach: both emphasise conditions experienced and outcomes.

The ordinal 7-point ELSI scale varies from severe hardship (estimated 1.5% of the population from the Health Survey) and hardship (2.2%) to a very good standard of living (19.0%).

4. Education

Education is a measure of SEP with a long history of use.[19] Education is measured by five categories of the highest qualification obtained, and is not fully ordinal: no qualifications; any school qualification; a trade qualification or technical certificate; an undergraduate diploma; and a graduate degree or professional qualification.

5. Income

Current household income was adjusted for household size and composition (equivalised) us-

ing the Jensen scale,[20] and is analysed as quintiles of the survey distribution.

Aim of paper

Since SEP is strongly associated with, and causally (or reverse-causally) related to, health outcomes,[14] there is frequent debate about the relative usefulness of different measures in their ability to predict health outcomes.[21] This paper compares five measures of SEP in order to provide future researchers with empirically based guidance about their relative utility in predicting health outcomes when there are no pre-determined needs for specific measures.

WHAT GAP THIS FILLS

What we already know: Measures of socioeconomic position have been, and continue to be, widely used in health research and include single variables such as occupation, education, and income, and indices such as those for deprivation. Some of these measures are easier and cheaper to collect than others, but no single measure captures a complete picture of socioeconomic position.

What this study adds: Five measures of socioeconomic position are compared for their ability to predict health outcomes in a nationally representative health survey. The results led to some suggested guidelines concerning which measures to use in what circumstances, given no pre-determined needs for particular measures, and should be of help to researchers contemplating both small and large surveys in primary care research.

Methods

Confidentialised data on health and SEP for 12 488 non-institutionalised adults aged 15 years and over were obtained from the 2006 National Health Survey.[7] The stratified and clustered survey design resulted in unequal selection probabilities for the respondents. Probability-based sample selection weights are used in the current analyses to facilitate hypothesis testing beyond calculation of confidence intervals.

All respondents had an NZDep2006 value ascribed from their geocoded addresses. Seventeen of the 12 488 respondents (0.14%) refused, or did not know the answer to one or more of the eight questions relating to NZiDep. More respondents, 167 (1.34%), did not complete all 25 questions for the ELSI scale. Education was not available for a further 17 respondents (0.27% in total) with otherwise complete NZDiDep and ELSI data. Values in the dataset for the 13.2% of respondents who did not provide household income information had been imputed from respondents with otherwise similar characteristics.[7] All analyses were repeated without these imputed data.

Health-related outcomes

Seven health-related outcome measures with expected variations by SEP are modelled: current tobacco smoking; four health status scales (self-rated, general health, mental health, and psychological distress), and two measures of body mass (the standard body mass index, and obesity).

In overview, the binary current-smoking variable has 18.3% smokers. The self-rated health variable has five categories: excellent (19.1%) to poor (1.9%) but is analysed as a binary variable; categories 4 and 5 ('fair' and 'poor', 10.7%) are combined as a 'self-rated poorer health' group and compared to the remainder. The SF36 general health scale and the SF36 mental health scale each have a range of 0 to 100, from poorest health to best health;[22] the general health scores have a mean of 74.2 while the mental health scores have a mean of 82.3. The Kessler Psychological Distress Scale,[7,23] with values 0–40, is used in three categories, with 78.6% in the generally considered low-risk group (0–5) and 1.8% in the generally considered high-risk (20+) group. The body mass index has a mean of 27.6. In addition, using standard international definitions, the obese group (26.2%) is compared to the remaining three groups.[7]

Statistical methods

All analyses used the survey procedures in SAS which take into account the stratified and clustered properties of the sample.[24] Age, sex, and ethnic group are well-known potential confounders in analyses of health outcomes.[25–27] To control for probable confounding, whether extensive or minimal, and to compare like with like, three categorical variables are always included: age (seven groups each of length 10 years till 75+, thus avoiding any assumptions of linear relationships); sex; and prioritised ethnic group (four groups:

*Table 1. Explanatory power of various measures of socioeconomic position in models of poor health-related outcomes**

Socioeconomic position (SEP) variable(s)	Pseudo R^2 (percent)				Adjusted R^2 (percent)		
	Smoking	Obese	Poorer self-rated health	Kessler Distress scale	General health (SF36)	Mental health (SF36)	Body mass index
None	7.1	8.5	2.0	2.0	2.2	2.8	15.5
Individual: NZiDep	9.6	8.7	6.5	8.1	7.5	8.7	15.9
ELSI	9.9	8.9	7.9	8.9	9.4	11.0	16.2
Education	9.7	9.1	2.7	2.3	2.4	(2.9)	16.1
Household: Income†	8.6	8.7	3.6	3.0	3.4	3.9	15.7
Area: NZDep2006	9.5	9.4	3.5	2.8	3.3	3.2	16.8
NZDep2006 and NZiDep‡	11.1	9.5	7.2	8.3	7.9	8.8	17.0
All significant SEP variables§	13.1	10.0	9.2	10.0	10.2	11.9	17.4

* Models included potential confounders (age group, sex, and ethnic group). The *F*-statistic for the socioeconomic position variable where the adjusted R^2 value in parentheses is not significant ($p>0.05$).

† Quintiles of household income equivalised for household composition.

‡ Both SEP variables are significant in all models, with $p<0.001$ for both variables except the individual index for body mass index ($p=0.001$) and its related variable, obese ($p=0.012$).

§ The variables are identified in Tables 2 and 3.

Maori; Pacific and not Maori; Asian and neither Maori nor Pacific; and the remainder, mostly 'European').

'Best' models were developed by forward selection with the data set restricted at the beginning of each analysis to those respondents having complete data on all potential explanatory variables. For the multiple regression models, hypothesis testing followed the usual processes: *F*-tests for the overall model, *t*-tests for individual terms, and R^2, adjusted for the number of parameters in the model, to assess goodness-of-fit. Socioeconomic variables were added one at a time to a base model of probable confounders provided they (a) increased the explanatory power of the model significantly, and (b) had the biggest improvement of all potential socioeconomic variables not yet in the model.

In the logistic models, socioeconomic variables were added one at a time to a base model of probable confounders provided they (a) increased the explanatory power of the model significantly, assessed by the change in the pseudo-likelihood ratio statistic, and (b) had the largest difference in the Akaike information criterion, which adjusts the pseudo-likelihood ratio for the number of parameters fitted, among all potential socioeconomic variables not yet in the model. The significance of each socioeconomic variable in any model was also assessed by the Wald statistic. Pseudo-R^2 statistics summarise the goodness-of-fit of a model.

The three outcome variables with an ordinal response and few categories—categorised body mass, psychological distress, and self-rated health—were originally modelled by ordinal logistic regression, which assumes proportional odds for the outcomes. However, this assumption was not plausible for two of the variables, which led to the construction of the binary 'poorer self-rated health' and 'obese' variables.

No interactions or further explanatory variables were considered for these models since the purpose was to directly compare different socioeconomic variables, not to fully model variations in the outcome variables.

Results

Effectiveness of each socioeconomic position measure

The proportion of variance in an outcome variable accounted for by the explanatory variables is measured by an appropriate R^2 statistic (Table 1). Apart from the relationship between education and mental health, each measure of SEP was significantly associated with each outcome after adjusting for confounding. The models for the individual indices NZiDep and ELSI show little to moderate substantive differences, although ELSI is always somewhat better than NZiDep. This is not surprising because ELSI contains three times as many questions. In contrast, although the percent of variance explained was similar for education, household income, and NZDep2006 for each health outcome, the percent of variance explained by NZDep2006 differed across the outcomes, and the two single variables did not always explain as much variation as did the indices.

Table 1 shows that the single best indicator (largest R^2) for the outcomes studied is the area index for body mass index and obesity, but it is the living standards index, ELSI, for all the other outcomes, although there was often not much difference between the best and the second best indicators.

The relevant estimated odds ratios or regression coefficients (Tables 2 and 3, part A) all show the expected increasing values as the SEPs become poorer (or poorest, for education, which is not strictly ordinal). The negative signs for the SF36 scales (Table 3) reflect their lowest values equating to poorest health in contrast to the SEP scales or comparisons.

Area deprivation versus individual deprivation

The area and individual measures of deprivation are only moderately correlated (Spearman rank coefficient 0.28) and since the area index of deprivation is readily available, it is appropriate to investigate whether the individual index of deprivation adds significantly to the explanatory power of the area index (Table 1, rows 6 and 7). It does, for all seven outcome variables. However, since the sample sizes are in excess of 11 500—they vary slightly due to missing outcome data—'significance', while necessary, becomes of secondary importance to the extent of the improvement, described by changes in the adjusted-R^2 and pseudo-R^2 values. In themselves, the R^2 values are not large, partly due to the large sample, but also to the possibility of many other possible explanatory variables.

Unsurprisingly, body mass index, its obesity category, and smoking are all heavily influenced by age, sex, and ethnicity (row 1). For the body mass outcomes, controlling for this potential confounding, the area index is clearly a good surrogate for the individual index, and it is not a bad surrogate for the smoking outcome. The area index is not such a good surrogate in the other four analyses, where the R^2 values suggest that if future analyses used the area index alone the conclusion could well be that SEP did not influence these outcomes. However, introducing the comparable individual index would likely reverse this conclusion.

The odds ratios for the deprivation categories calculated from the regression coefficients in the logistic models are shown in Table 2, part B. Apart from the weak association with obesity, the patterns are consistent: increasing deprivation is associated with increasing odds of poor outcomes, and the effect is generally marked when the deprivation is high.

Table 3 provides the regression coefficients for the multiple regression models. For general health (columns 1 and 4), there is a reasonably clear stepped pattern of increasingly poorer health (lower scores) with increasing deprivation (higher scores) for the area index, with or without the addition of the individual index. However, the effect of the individual index is more substantial. For mental health it is quite clear that the area index adds nothing of value to the information contained in the individual index. For the body mass index, neither the area nor the individual index add much to the model after age, sex, and ethnic group have been taken into account.

Table 2. Estimated odds ratios of poor binary or ordinal outcomes in models using five measures of socioeconomic position

	Estimated odds ratios*											
	A: Separate models for each socioeconomic measure				B: Models including both deprivation indices				C: Best models: all significant socioeconomic measures			
Effect	S†	O	P	K	S	O	P	K	S	O	P	K
NZiDep: low (1) to high (5) individual deprivation												
2 vs 1	1.4	(1.1)	1.9	2.0	1.3	(1.0)	1.8	2.0	(1.1)		1.4	1.5
3 vs 1	1.9	(1.1)	3.3	3.5	1.7	(1.0)	3.0	3.4	1.3		1.7	2.0
4 vs 1	3.0	1.5	4.3	5.2	2.5	1.3	3.8	5.0	1.7		1.7	2.4
5 vs 1	4.3	1.7	7.3	12.6	3.4	1.4	6.3	11.8	1.9		2.3	4.6
NZDep2006: least (1) to most (10) deprived areas												
2 vs 1	(1.3)	1.5	(1.2)	(0.9)	(1.3)	1.5	(1.2)	(0.9)	(1.2)	1.4	(1.1)	
3 vs 1	1.8	(1.0)	(1.5)	(1.2)	1.8	(1.0)	(1.4)	(1.1)	1.6	(0.9)	(1.3)	
4 vs 1	1.9	1.3	1.5	(1.1)	1.8	1.3	(1.4)	(1.0)	1.5	(1.2)	(1.2)	
5 vs 1	1.9	1.4	1.6	(1.2)	1.8	1.4	1.5	(1.1)	1.5	1.3	(1.3)	
6 vs 1	2.3	1.4	2.0	1.4	2.2	1.4	1.8	(1.2)	1.8	1.3	1.5	
7 vs 1	2.8	1.6	2.4	1.7	2.5	1.6	2.0	1.3	2.1	1.5	1.7	
8 vs 1	3.0	1.8	2.5	1.8	2.6	1.8	2.0	1.4	2.0	1.6	1.6	
9 vs 1	3.5	2.1	2.7	1.7	2.9	2.0	2.1	(1.2)	2.3	1.8	1.8	
10 vs 1	4.8	2.4	3.2	2.0	3.8	2.3	2.2	(1.3)	2.8	2.0	1.7	
ELSI: very good (7) to poorest (1) living standards												
6 vs 7	1.5	1.2	1.9	1.5					1.2	(1.1)	1.7	1.5
5 vs 7	2.1	1.4	2.9	3.3					1.5	1.2	2.2	2.7
4 vs 7	3.0	1.5	5.7	5.0					1.8	(1.2)	3.7	3.3
3 vs 7	3.4	1.7	7.4	7.6					1.7	1.4	4.2	4.0
2 vs 7	4.7	1.9	10.4	12.3					2.1	1.5	5.2	5.2
1 vs 7	8.8	2.2	19.6	26.1					3.1	1.6	8.4	8.5
Education: graduate or professional (4) to no qualifications (0)												
3 vs 4	1.7	(1.2)	(1.2)	(1.2)					1.5	(1.1)	(1.0)	
2 vs 4	2.8	1.5	1.5	1.4					2.3	1.4	(1.1)	
1 vs 4	1.9	1.3	(1.0)	1.2					1.7	(1.2)	0.8	
0 vs 4	3.6	1.8	1.7	1.6					2.6	1.5	(1.1)	
Income: highest (5) to lowest (1) quintile												
4 vs 5	1.3	(1.1)	1.4	1.3								
3 vs 5	1.6	(1.1)	1.8	1.4								
2 vs 5	2.0	1.3	2.1	1.7								
1 vs 5	2.7	1.4	3.0	2.3								

* Adjusted for the potential confounders age, sex, and ethnic group; values in parentheses are not significant with $p>0.05$.

† The binary outcomes are smoking, obese and poorer self-rated health; the Kessler distress scale has 3 ordered categories.

Table 3. Parameter estimates of poor interval-level outcomes in models using five measures of socioeconomic position

Effect	Parameter estimates *								
	A: Separate models for each socioeconomic measure			B: Models including both deprivation indices			C: Best models: all significant socioeconomic measures		
	G†	M	B	G	M	B	G	M	B
NZiDep: low (1) to high (5) individual deprivation									
2 vs 1	-4.2	-3.4	0.4	-4.0	-3.4	(0.3)	-1.7	-1.8	
3 vs 1	-9.8	-6.2	0.6	-9.3	-6.2	(0.4)	-4.7	-2.7	
4 vs 1	-12.8	-8.6	1.1	-12.1	-8.6	0.7	-5.3	-3.3	
5 vs 1	-19.7	-14.5	1.9	-19.0	-14.5	1.4	-9.6	-6.5	
NZDep2006: least (1) to most (10) deprived areas									
2 vs 1	(-1.3)	(-1.0)	(0.6)	(-1.1)	(1.1)	(0.6)	(-0.5)		(0.4)
3 vs 1	(-2.0)	(-0.2)	(0.1)	(-1.5)	(0.1)	(0.1)	(-0.8)		(-0.1)
4 vs 1	(-1.6)	(-0.1)	(0.5)	(-0.9)	(0.4)	(0.5)	(-0.0)		(0.3)
5 vs 1	-3.7	(-0.5)	0.7	-3.1	(-0.1)	0.7	-1.9		(0.5)
6 vs 1	-2.9	(0.0)	0.9	-2.0	(0.7)	0.9	(-0.5)		0.6
7 vs 1	-5.6	(-1.0)	0.9	-4.2	(0.0)	0.8	-2.7		0.6
8 vs 1	-5.9	-2.2	1.3	-4.1	(-0.9)	1.2	-2.6		0.9
9 vs 1	-6.6	(-1.1)	1.8	-4.3	(0.5)	1.7	-2.9		1.4
10 vs 1	-6.7	-1.9	2.5	-3.4	(0.5)	2.3	(-1.5)		2.0
ELSI: very good (7) to poorest (1) living standards									
6 vs 7	-4.3	-1.8	0.5				-3.9	-1.8	0.3
5 vs 7	-8.9	-5.5	1.0				-7.5	-4.9	0.6
4 vs 7	-13.5	-8.4	1.3				-10.5	-7.0	0.8
3 vs 7	-17.2	-10.9	1.3				-12.7	-8.6	0.7
2 vs 7	-20.5	-13.6	1.8				-14.3	-10.3	1.2
1 vs 7	-27.5	-21.4	3.0				-19.5	-17.0	2.1
Education: graduate or professional (4) to no qualifications (0)									
3 vs 4	(0.4)	(0.2)	0.7					(1.0)	0.6
2 vs 4	-1.4	(-0.3)	1.1					1.0	0.8
1 vs 4	(-0.2)	(0.4)	0.7					1.3	0.5
0 vs 4	-2.8	(-0.5)	1.3					1.4	0.9
Income: highest (5) to lowest (1) quintile									
4 vs 5	-1.9	-0.8	(0.1)						
3 vs 5	-2.7	-0.9	(0.1)						
2 vs 5	-4.2	-1.9	(0.4)						
1 vs 5	-7.2	-4.3	0.8						

* Adjusted for the potential confounders age, sex, and ethnic group; values in parentheses are not significant with $p>0.05$.

† The interval-level outcomes are SF36 general health, SF36 mental health, and body mass index.

A 'best' set of socioeconomic position indicators

Parts C in Tables 2 and 3 provide the estimated coefficients for models using a best set of SEP measures.

In the analyses of smoking, obesity, and poorer self-rated health (Table 2) and of general health and mental health (Table 3), area deprivation adds information beyond individual circumstances. Area deprivation, on its own, underestimates the individual-level relationships, but if used as a surrogate for an individual index it would be unlikely to mislead except, possibly, in the case of mental health as measured by the SF36 questions.

The individual indices NZiDep and ELSI differ primarily in the extra information provided by ELSI at the relatively small 'severe' end of the scale. For smoking, poorer self-rated health status, and psychological distress (Table 2), and for both general and mental health (Table 3), both individual indices provide significant and independent explanations for some of the variations in outcome status.

An important question is whether the full spectrum of living standards, as measured by ELSI, impacts upon health status variations or whether it is the lack of resources, as measured by the NZiDep deprivation index, that has the more apparent effect on health status.

Education provides inconsistent and mostly very weak *additional* help in explaining variations in any of the outcomes. This may be due, in part, to the blunt nature of the four 'highest qualification' categories. Equivalised household income does not feature when other socioeconomic variables can be used, with one small exception. For the SF36 mental health scale income enters the model as the third significant SEP variable, but the signs of the small coefficients change as a result of an unsurprising and un-meaningful interaction with the living standards index, ELSI, making the SF36 relationship unreliable in a simple model. Given the level of household income imputation in this dataset, further analyses were restricted to non-imputed data, but this made no difference to the conclusions.

Discussion

No single measure captures a complete picture of SEP. Five measures are compared above in analyses of seven easily measured outcomes, reflecting four health-related behaviours/states—smoking, body mass, general health, and mental health. Overall, the results suggest that there is likely to be an area-deprivation influence on many such health-related outcomes beyond the influences of personal deprivation. That is, the neighbourhood characteristics encapsulated by the area deprivation index, which is derived from aggregate individual information, adds something useful to individualised information. This is easily understood in relation to smoking, for example, where the chance of an individual smoking is likely to be increased if smoking is commonplace in the local neighbourhood.

Smoking and body mass index (however measured) give the greatest consistency across the measures; for these two health-related outcomes the area index would not be a bad substitute for an individual index if one was not available. The same cannot be said of the various outcome scales of general or mental health, although the area index is still a significant predictor. One possible explanation for this difference might be that smoking (yes/no) and body mass index (weight/height^2) are possibly more reliable measures than those for the other outcomes for which respondents answer a series of questions with an ordered opinion response such as excellent/very good/good/fair/poor.

An important question is whether the full spectrum of living standards, as measured by ELSI, impacts upon health status variations or whether it is the lack of resources, as measured by the NZiDep deprivation index, that has the more apparent effect on health status. It is clear

from Table 1 that ELSI always explains slightly more of the outcome variations than NZiDep. Part of this apparent advantage may be due to the two extra categories in the former index. In Tables 2 and 3 the coefficients for ELSI are larger than those for NZiDep. This is at least partly due to the different base categories—the moderately sized 'very good living standards' category in one index versus the very large 'no deprivation' category in the other. In short, it is difficult to suggest that one index is clearly preferable to the other; rather, both indices help to explain the outcome variations. It is likely that the variation in the moderate-to-good 'living standards' groups adds explanatory information for the two-thirds of the sample in the 'least deprived' category, while the deprivation index enhances the information about those with poorer living standards.

The results of this study compare education and income, as established indicators, with three newer indices of SEP. In this large and representative sample, income does not predict health, probably because current household income, even though adjusted for current household size and composition, is a relatively poor measure of long-term income resources. Apart from smoking, education is also a poor and inconsistent performer when added to other SEP indicators in the models. This may reflect the years, often decades, between educational achievements and the current time. Although 'low' equivalised income and 'no qualifications' are two of the nine variables in NZDep, this is unlikely to account for more than a marginal reduction in the statistical effects of the somewhat more extensive education and income variables used here. Therefore it seems that the various indices of SEP, which utilise current experiences in several variables, improve upon single variables as useful SEP variables explaining outcome variations.

Strengths and limitations of the study

The 2006 Health Survey was nationally representative of the non-institutionalised adult population. It had a relatively large sample size and thus good power to assess the effects of the various measures of SEP, with major likely confounding controlled analytically.

The overall response rate to the survey was 69.7%, so there was a potential for some bias in the results.[3] Corrections for any response bias in the sample were incorporated into the final sampling weights, which were the selection weights adjusted post-survey to national demographic distributions. While the analyses presented in this paper use the selection weights to enable hypothesis-testing beyond calculation of confidence intervals for point estimates using empirical methods, the 'best' models repeated using the final weights were close to those using the selection weights (not shown). Thus the selection-weight analyses are unlikely to be an artefact due to a biased sample.

As noted above, we did not include an occupation-based measure of socioeconomic position in the study because no suitable occupation-based index was available in the survey dataset and, had one been available, it would not have been applicable for a significant proportion of survey respondents (e.g. students, the retired) for many of whom imputation would be unreliable.

Seven outcomes were analysed in this study, all of which were expected to have some association with SEP. Extrapolating to other health-related outcomes is possible only in so far as they would be expected to have a similar relationship. Extrapolating to other measures of SEP, such as occupation, is not possible from this study.

Conclusion

Based on this study, the area index is not a full surrogate for any individual measure of SEP, or even for a group of them. Therefore the area index is a useful addition to the arsenal of individual SEP indicators, but an index which, if used on its own, would probably underestimate the extent of any relationship between a health outcome and individual SEP.

Assuming no pre-determined need either for the living standards measure or the deprivation measure, the latter may be thought preferable since NZiDep has eight questions, compared to 25 for ELSI, and it will likely have less missing data. Either would be better candidates for inclusion than either education or household

income, particularly as income might be fraught with considerable missing data (which could be imputed, if desired, only if there is appropriate data elsewhere in the survey).

In short, assuming no predetermined preferences relating to prior knowledge, specific study subjects, or policy implications, and a need to be parsimonious, if a new survey is small (say, a few hundred respondents) and cost is an issue, the area index, NZDep, could be used to measure SEP. With a little more time and money, and a moderately sized survey (say, up to 1000), and with a minimum of two usable records expected in the smallest NZiDep category and its important cross-tabulated cells (to provide some estimate of variability), consider using both deprivation indices, NZiDep and NZDep. Circumstances permitting, consider using ELSI instead of NZiDep, again checking for adequate expected numbers in the smallest categories.

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COMPETING INTERESTS
None declared.

References

1. Lynch J, Kaplan G. Socioeconomic position. In: Berkman L, Kawachi I, editors. Social epidemiology. Oxford: Oxford University Press; 2000.
2. Elley WB, Irving JC. A socio-economic index for New Zealand based on levels of education and income from the 1966 census. NZ Educ Stud. 1972;7:153–67.
3. Elley WB, Irving JC. Revised socio-economic index for New Zealand. NZ J Educ Stud. 1976;11:25–30.
4. Davis P, McLeod K, Ransom M, Ongley P, Pearce N, Howden-Chapman P. The New Zealand Socioeconomic Index: developing and validating an occupationally-derived inidicator of socioeconomic status. Aust NZ J Public Health. 1999;23:27–33.
5. Davis P, Jenkin G, Coope P, Blakely T, Sporle A, Kiro C. The New Zealand socio-economic index of occupational status: methodological revision and imputation for missing data. Aust NZ J Public Health. 2004;28:113–19.
6. Galobardes B, Shaw M, Lawlor D, Lynch J, Davey Smith G. Indicators of socioeconomic position (part 1). Epidemiol Community Health. 2006;60:7–12.
7. Ministry of Health. A portrait of health: key results of the 2006/2007 New Zealand Health Survey. Wellington: Ministry of Health; 2008.
8. Salmond C, Crampton P, Atkinson J. NZDep2006 Index of Deprivation. Wellington: Department of Public Health, University of Otago Wellington; 2007.
9. Salmond C, Crampton P, Sutton F. NZDep91: a New Zealand index of deprivation. Aust NZ J Public Health. 1998;22:835–7.
10. Salmond C, Crampton P. NZDep96—What does it measure? Social Policy Journal of New Zealand. 2001;17:82–100.
11. Salmond C, Crampton P. Heterogeneity of deprivation within very small areas. Epidemiol Community Health. 2002;56:669–70.
12. Crampton P, Sutton F, Foley J. Capitation funding of primary care services: principles and prospects. NZ Med J. 2002;115:271–4.
13. Hefford M, Crampton P, Foley J. Reducing health disparities through primary care reform: the New Zealand experiment. Health Policy. 2005;72:9–23.
14. Salmond C, King P, Crampton P, Waldegrave C. NZiDep, a New Zealand index of deprivation for individuals. Wellington: Department of Public Health Wellington School of Medicine and Health Sciences and The Family Centre Social Policy Research Unit, Lower Hutt; 2005.
15. Salmond C, King P, Crampton P, Waldegrave C. NZiDep: a New Zealand index of socioeconomic deprivation for individuals. Soc Sci Med. 2006;62:1474–85.
16. Krishnan V, Jensen J, Ballantyne S. New Zealand living standards 2000. Wellington: Ministry of Social Development; 2002.
17. Jensen J, Spittal M, Crichton S, Sathiyandra S, Krishnan V. Direct measurement of living standards: the New Zealand ELSI scale. Wellington: Ministry of Social Development; 2002.
18. Jensen J, Spittal M, Krishnan V. ELSI Short Form: user manual for a direct measure of living standards. Wellington: Ministry of Social Development; 2005.
19. Berkman L, Kawachi I, editors. Social Epidemiology. New York: Oxford University Press; 2000.
20. Blakely T, Fawcett J, Atkinson J, Tobias M, Cheung J. Decades of disparity II: socioeconomic mortality trends in New Zealand 1981–1999. Wellington: Ministry of Health; 2005.
21. Blakely T, Pearce N. Socio-economic position is more than just NZDep. NZ Med J. 2002;115:109–11.
22. Ware J, Kosinski M, Gandek B. SF-36 Health Survey: manual and interpretation guide. Lincoln RI: Quality Metric Incorporated; 2005.
23. Kessler R, Barker P, Colpe L, Epstein J, Gfroerer J, Hiripi E, et al. Screening for serious mental illness in the general population. Arch Gen Psychiatry. 2003;60(2):184–9.
24. SAS System (Version 9). Cary, NC, USA: SAS Institute Inc.
25. Blakely T, Ajwani S, Robson B, Tobias M, Bonne M. Decades of disparity: widening ethnic mortality gaps from 1980 to 1999. NZ Med J. 2004;117: U995.
26. Blakely T, Kiro C, Woodward A. Unlocking the numerator-denominator bias. II: Adjustments to mortality rates by ethnicity and deprivation during 1991–94. NZ Med J. 2002;115:43–8.
27. Blakely T, Tobias M, Robson B, Ajwani S, Bonne M, Woodward A. Widening ethnic mortality disparities in New Zealand 1981–99. Soc Sci Med. 2005;61:2233–51.