



Chronic Diseases in Canada

A Comparison of Methods for Measuring Socio-economic Status by Occupation or Postal Area



Raywat Deonandan, Karen Campbell, Truls Ostbye, Ian Tummon and James Robertson

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Abstract

Seven methods of estimating socio-economic status (SES) were compared, including four based on data specific to individuals (Blishen, Pineo-Porter, British Registrar General, Hollingshead) and three based on the average characteristics of the postal code area in which people live (income alone, education alone, income and education combined). Data from the files of 151 patients undergoing in vitro fertilization were used. The four individual scales were highly correlated among themselves (Spearman s correlation coefficient between 0.6 and 0.9) but only moderately correlated with the measures based on postal code (Spearman s correlation coefficient between 0.2 and 0.3).

Key words: *in vitro fertilization; Ontario; postal codes; socio-economic status*

Introduction

Socio-economic status (SES) has long been a prime predictive variable in epidemiologic studies. People of lower socio-economic status have lower life expectancy and higher mortality rates from almost all causes of death,¹ and a variety of morbidities are variably associated with SES. As an explanatory variable in health studies, SES has been used to derive health policy recommendations² and to infer public health implications of dietary needs in different social strata.³ In addition, SES has long been an important factor in many studies in the social sciences.

In a lengthy review of the use of SES in epidemiology, Liberatos et al.¹ pointed out that most measures are based upon three related dimensions: occupation, education and income. A ranking of occupational classes is often employed because occupation is considered to be a reliable indicator of relative standing in industrial societies. It is not surprising, then, that many scales and indices for assessing SES, such as that described by Pineo et al.,⁴ rely on the social prestige of subjects' occupations as a major indicator.

For studies in which detailed personal questionnaires are not available for all subjects, the accurate measurement of SES is problematic. Educational level and income are particularly difficult to ascertain in administrative or medical data sets, since such data are rarely collected. For population or administrative data in which occupation, education and income are unknown, census surveys are sometimes used, estimating the income and education of individuals on the basis of their neighbourhood average. The existence of a variety of occupational scales and other proxy measures is an indication of the extent of this problem.

Although occupation can be considered an important sole estimator of social class and status for several types of investigations, for other studies it is desirable to estimate SES comprehensively by including measures of education and

income. Occupation or neighbourhood-indexed census data, then, must often suffice to estimate education and income. The use of data imputed by assuming individual information from ecologic census data linked to postal codes is a common method of estimating SES in the absence of more specific and detailed records. Collins et al.⁵ were one group who used this method of extracting income and other demographic information from Canadian postal codes. The impressive levels of documentation, digitization and accessibility of the Statistics Canada data retrieval and compilation systems make the use of census data for SES estimation an attractive technique.

In order to validate the application of any one method of SES estimation for larger studies using a similarly specialized population, we conducted this study to measure the extent of agreement between seven measures of socio-economic status, using, as did Collins et al.,⁵ a population of clinically infertile individuals undergoing in vitro fertilization (IVF) treatment.

Methods

Data from the administrative files and patient charts of the IVF clinic at the London Health Sciences Centre in London, Ontario, were extracted for 200 randomly selected patients (out of a possible total of 3,373 patient files). This set was to be used as part of a quality control study for a larger study of IVF, which includes postal codes as a proxy measure for SES. Therefore, this smaller study was undertaken to assess the validity of that method with respect to other SES measures available in the literature.

The data extracted included the self-reported occupations of both the patients and their spouses as well as their home postal codes. Only patients with complete records of postal codes and occupations were included; 151 had complete information.

SES Estimation

Seven methods of SES estimation were selected from the medical and anthropological literature for their popularity in infertility studies or in larger Canadian public health studies. Four are direct measures from individual-level data (referred to here as Blishen, Pineo-Porter, Hollingshead and British), and three other methods use postal code information. Unfortunately, the coding of self-reported occupations to refer to established categories of these SES methods was subjective, relying on the investigators' discretion as to how best to categorize patients' occupations. This subjectivity was partially addressed through trichotomization of all scales (discussed in greater depth later) to more generously allow for potential concordances.

A scale for ranking occupations developed by Blishen et al.⁶ has been popular in Canadian public health studies. The Blishen scale assigns SES codes to the occupations listed in the *1981 Canadian Classification and Dictionary of Occupations*. The scale's developers derived indicators of prevailing education and income levels for each occupational category. Income indicators were based upon the pooled median employment income for all paid labour force participants in each occupation; education level was based upon the proportion of people with higher education in that occupational category. The original authors pointed out that the validity of assuming concordance between occupational prestige and socio-economic prestige is questionable, given that the latter is, in fact, a composite measure of the three dimensions of education, income and occupational prestige. Instead they offered an SES score derived from a linear regression involving the Pineo-Porter prestige scores described below, thus, in their words, making minimal use of occupational prestige. A list of many common occupations and their corresponding SES scores is available in the original reference.

The Pineo-Porter method⁴ attaches prestige scores to 16 occupational categories and is the basis for the Blishen method. The Pineo-Porter method was intended, in part, to be an evaluative test of the 1971 census codes.

What is referred to here as the British method is similar to the Wilson-Barona method⁷ and uses the British Registrar General's levels of social class. These levels are summarized in the research of Benzeval et al.² There are obvious concerns resulting from cultural differences between British and Canadian societies. It is nevertheless assumed that a profession benefiting from a degree of prestige in one culture will experience a comparable degree in the other.

The Hollingshead method,⁸ used by Newton et al.,⁹ defines each occupation as being in one of nine categories, the ninth being at the highest SES level.

The last three SES estimation methods all use information on education, income and the product of education with income,

derived from characteristics associated with postal code area. For the data in this study, Statistics Canada was able to provide such information by enumeration area, which subtends a smaller area than the postal code. However, only the postal codes of subjects were available in the data set, so a best match enumeration area was chosen for each postal code. The best match is defined by Statistics Canada as the enumeration area with the highest number of surveyed addresses within that postal code or, for rural areas, the enumeration area in which the main post office resides. Street addresses were not employed.

The first of the postal code methods used education data obtained from the 1996 census, which consisted of the number of individuals surveyed within an enumeration area who had completed each of six educational levels, in ascending order of prestige: less than grade nine education, at least some high school, a trade certificate or other diploma, other non-university education, some university or the completion of a university degree. An integral SES score was computed using a weighted sum of these variables (with weights equal to the number of people reporting each level of highest education obtained), divided by the total number of families surveyed in each enumeration area.

Income data from the census the average family income for each enumeration area was the second postal code method. Cases in which average income was reported as zero were assumed to represent unco-operative jurisdictions and were therefore excluded from this study. In order to make statistical comparisons with the other methods of SES measurement, which are referenced against national averages, the income data were similarly trichotomized: the national 1996 Canadian census data for average family income were divided into three levels, each containing somewhat equal numbers of surveyed individuals. The divisions are imprecise because the Statistics Canada data used were themselves pre-divided into income ranges.

Since the Blishen method assumes, with justification, an estimation of SES as a linear combination of the two variables of education and income, it is useful to test another simple combination of the two: their product. This was the third postal code method used. A weighted average with coefficients matching those of the Blishen linear equation would garner a response similar to that described by the Blishen method, as would a power series expansion. However, since the data are reduced to an ordinal discrete type, a simple multiplicative product serves as an approximation.

Statistical Methods

Contingency tables were constructed to compare the results from each of the seven measurements with each other. The data were reduced to ranked integral SES scores, and Spearman coefficients were computed to determine the extent of correlation between the seven methods. Each method generates scales of differing ranges, but they were all trichotomized to low, medium and high SES for one of the two analyses of this study. When the data were so categorized, kappa statistics were computed to evaluate the degree of agreement between the various methods. This trichotomization was performed to assuage any concerns that might arise about subjectivity in coding along strict categorical parameters.

For the Blishen method, the cut-offs that determined the medium SES range were defined as the mean Blishen score for the general population plus or minus 1.5 standard deviations. The trichotomization of the Pineo-Porter scores was accomplished by grouping similar prestige categories. Since, in all cases, the dollar value of farms or businesses was not available in the patients' files, small business owners and farmers were universally assumed to belong to the medium SES category when the Hollingshead method was applied. Given that the original Hollingshead reference is more than 20 years old, the subjective coding procedure was modified to represent the modern monetary values of comparable businesses.

The primary analysis assumes that household status reflects the SES of the highest occupation in that household, thus benefiting from the highest income and education of the two spouses. This allows a traditional homemaker, whose score is low on some scales, to be more accurately recorded as of the same SES (prestige, standard of living, social opportunities, etc.) as his or her, presumably better employed, spouse.

Two secondary analyses were conducted on an exploratory level. For each SES measurement type, an arithmetic mean was computed of the patient's score and the spouse's score. That mean was then considered to be the SES estimation for the household. As well, to test the possibility that the various methods may agree on the scoring of one sex's traditional occupations more than on the other's, data from each sex were separated and tested independently.

Results

The kappa scores for agreement are given in [Table 1](#) and the Spearman coefficients for ranked correlations in [Table 2](#). No kappa scores appeared in comparisons with the Blishen method due to a dearth of low SES measures according to that method.

TABLE 1
Agreement between methods of estimating socio-economic status (SES)^a according to kappa score and 95% confidence interval (CI)

SES method	Pineo-Porter		British			Hollingshead	
	K	95% CI	K	95% CI		K	95% CI
British	-0.553	-0.439 0.668					
Hollingshead	-0.065	-0.029 0.159	-0.233	-0.118	0.349		
Postal code income	-0.012	-0.091 0.066	-0.11	-0.008	0.212	-0.06	-0.083 0.203
Postal code education	-0.096	-0.034 0.226	-0.026	-0.143	0.091	-0.051	-0.123 0.022

^a SES based on highest occupational score between two spouses

TABLE 2
Correlation between methods of estimating socio-economic status (SES)^a according to Spearman's correlation coefficient (r_s) and p values

SES method	Blishen		Pineo-Porter		British		Hollingshead	
	r_s	p value	r_s	p value	r_s	p value	r_s	p value
Pineo-Porter	0.60742	0.0001						
British	0.61494	0.0001	0.88977	0.0001				
Hollingshead	0.70132	0.0001	0.61745	0.0001	0.59927	0.0001		
Postal code income	0.19259	0.0178	0.26621	0.001	0.30312	0.0002	0.19336	0.0174
Postal code education	0.21914	0.0069	0.19142	0.0186	0.22038	0.0065	0.23214	0.0041
Product of income X education	0.22477	0.0055	0.26539	0.001	0.29967	0.0002	0.23930	0.0031

^a SES based on highest occupational score between two spouses

In general, the kappa scores were of moderate size. The greatest scores were predictably given by comparisons between the British and Pineo-Porter methods. This is not surprising since the Pineo-Porter method was derived in part from the British Registrar's prestige scale.

Of greater interest is the relation between the postal code methods and the others. Both the kappa and correlation scores were low for these comparisons.

Findings from the secondary analyses were generally consistent with those of the primary analyses. The highest degree of agreement overall was demonstrated in the comparison of men only with men. The results of the secondary analyses are not included here.

Discussion

The postal code methods did not estimate SES in the same way as did other occupation-based methods. The highest scores for this comparison, in terms of both agreement and correlation, were observed when men were compared only with men. This implies that household SES, ostensibly measured by the postal code methods, is more closely approximated by men's occupations than by women's, at least in this data sample. If the finding is not artefactual, the reasons for it may have to do with issues of sex relations, religion or affluence. It is marginally related to the finding of Collins et al.⁵ that the male's profession in their Canadian sample was statistically more likely than the female's to influence a couple's decisions regarding reproductive services and technologies. According to their data, among couples seeking infertility services, only

1.7% of the men were unemployed as compared with 15.9% of the women. Sauer et al.¹⁰ found an almost identical rate of unemployment among Californian IVF women, supporting the supposition that the financial status of IVF households is best estimated by the male spouse's income.

The composite method involving the product of census-based income and education, reflective of Liberatos' insistence that SES embody both financial and pedagogical wealth,¹ is encouraging in that all its correlation scores were greater than those computed for census education alone, and greater than most of those for census income. However, a superior method of combining the two measures may be desirable. A linear combination of the two, as in the Blishen method, would be possible if the given census data were not categorically presented but were, in fact, representative of individual households rather than averages of enumeration areas.

Krieger et al.'s very thorough analysis¹¹ of the general limitations of most kinds of SES estimation methodologies identifies a poignant facet of this particular population: SES will vary over time. Krieger's suggestion that SES measures be performed at different points in time would be well applied in this case, since an IVF couple's preparations for impending pregnancy may include alterations to their lifestyle, such as employment status.

A further important consideration when evaluating these results is that the IVF population examined may be characterized by much less SES variability than the populations from which the tested measures were derived. This is borne out by the lack of low SES scores for men obtained by the Blishen method. How this difference would skew the results is uncertain, but it may imply that many of the SES methods are quite inapplicable to such a specialized population. Under such an assumption and with the limitations of the given data in mind, the neighbourhood-averaging approach implicit in the various postal code methods may indeed be the most heuristically valid method of the seven investigated in this study.

The dearth of low SES scores for men may have broad implications. Since IVF for certain common etiologies of infertility is paid for by the provincial health insurance program in Ontario, one might not expect income to be a factor that distinguishes IVF men from men in the general provincial population. This is a simplistic view, since SES purports to measure, in addition to income, factors associated with prestige and education. These latter factors may indeed significantly influence a couple's decision to seek IVF services, perhaps even more so than income alone. This polarization in IVF men's SES levels, at least according to the Blishen method, also may be simply indicative of the need of those who seek IVF for a higher degree of household wealth, implying that selective funding policies of the provincial health insurance program are putting a large financial burden on individual patients, thus inadvertently altering the demographic profile of IVF consumers.

A further consideration when examining these results is the lack of completely comparable definitions of low, medium and high SES. For the postal code income method, for example, these delineations were defined on the basis of the national income distribution; no such externally referenced delineation is possible for the education method. This would perhaps underestimate the kappa scores, but would not affect the Spearman correlation coefficients.

Conclusion

In general, the degree of agreement between the methods of SES measurement was moderate, though there was high correlation among all methods except the postal code ones. The specialized nature of the IVF patient community may, in fact, invalidate the application of popular SES methods to comparable infertility studies. Indeed, all occupation-based SES methods may be more limited, by virtue of their respective degrees of sensitivity, when applied to such a homogeneous group. The use of census data via the postal code methods may therefore still be a viable method of SES estimation for internal comparisons only, but not necessarily for comparisons with larger reference populations, whose greater variability makes traditional approaches more appropriate. However, depending on the comparisons being made, the use of postal code estimations may be useful to demonstrate the impact of SES on access to specialized medical procedures such as IVF, provided that there is more heterogeneity in the sample population.

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Author References

Raywat Deonandan, Karen Campbell and James Robertson, Department of Epidemiology and Biostatistics, Faculty of Medicine, University of Western Ontario, London, Ontario

Truls Ostbye, Department of Community and Family Medicine, Duke University, Durham, North Carolina, USA

Ian Tummon, Department of Obstetrics and Gynaecology, London Health Sciences Centre, London, Ontario

Correspondence: Ray Deonandan, Department of Epidemiology and Biostatistics, Faculty of Medicine, University of Western Ontario, London, Ontario N6A 5C1; E-mail: ray@deonandan.com

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