

The Health Utility Index: Measuring Health Differences in Ontario by Socioeconomic Status

Roger Roberge, Jean-Marie Berthelot and Michael Wolfson*

Abstract

The positive relationship between socioeconomic status (SES) and longevity has long been established. Comparable evidence exists for SES and morbidity, but observations of this relationship tend to be limited to specific health indicators. In this article, a comprehensive quantitative measure of health status, the Health Utility Index (HUI), is applied to an analysis of the relationship between SES and the health status of people aged 25 and over in Ontario. The HUI, based on a set of questions included in the 1990 Ontario Health Survey (OHS), provides a summary index of the health of each respondent. The OHS data show that lower levels of education, income, and occupation are associated with lower HUI values. Health status differences across SES groups are greater in late middle-age than at younger or older ages, a pattern consistent with the findings of other studies. The development of summary indicators like the HUI is part of a larger effort to construct measures for monitoring the health of Canadians.

Keywords: socioeconomic status, socioeconomic health differences, Health Utility Index, utility weights, Ontario Health Survey

Introduction

The positive relationship between socioeconomic status (SES) and longevity has long been established. Numerous studies have shown that factors such as income, occupation, and education have a fairly strong correlation with mortality.¹⁻⁴ Comparable evidence shows a relationship between SES and specific indicators of health, morbidity, and functional limitation.⁵⁻⁷ Lower SES has been linked with poor health, as measured by indicators such as perceived general health, prevalence of disability, birth weight, body height, and prevalence of health complaints.⁸

The Health Utility Index (HUI) is a generic health status index that is able to synthesize both quantitative and qualitative aspects of health. The HUI provides a quantitative measure of a population's overall health status, as opposed to focusing on narrowly defined health indicators, risk factors, or diseases. Such a measure is an analytic tool, which can be used for health policy evaluation and for the assessment of health care interventions at a population and a clinical level. The HUI is an important component in the development of a Population Health Index, which will monitor the health of the Canadian population on an ongoing basis. This article applies the HUI to Ontario Health Survey (OHS) data to show health differences by socioeconomic status (see *The 1990 Ontario Health Survey*).

The 1990 Ontario Health Survey

The data in this article are from the 1990 Ontario Health Survey (OHS), which was sponsored by the Ontario Ministry of Health. The survey used both interviewer-completed and self-completed questionnaires to obtain data from the household population (excluding people in institutions). It contained questions on physical and mental health, use of health care services, and lifestyle risk factors.

The OHS had a cross-sectional sample of over 64,000 individuals. Only those aged 25 and over (38,050 individuals) are included in this analysis.

The survey was conducted between January and December 1990, with responses evenly distributed throughout the year.⁹ The survey design of the OHS is taken into account in the statistics presented here (particularly the effect of clustering on estimated confidence intervals). Significant differences are reported at a 95% confidence level.

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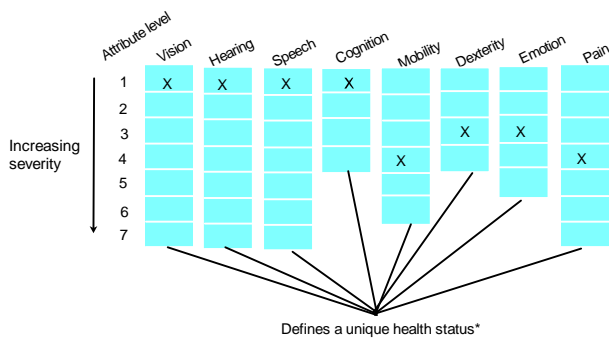
Constructing a Health Utility Index

The first step in the construction of a health utility index is specification of a set of health status attributes.

These are chosen to reflect a wide range of functional capacities and to capture what most people consider the most serious health-related problems they might encounter. The Comprehensive Health Status Measurement System (CHSMS), developed at McMaster University's Centre for Health Economics and Policy Analysis, describes an individual's overall functional health, based on eight attributes: vision, hearing, speech, mobility (ability to get around), dexterity (use of hands and fingers), cognition (memory and thinking), emotion (feelings), and pain and discomfort.¹⁰ An individual's health status is the vector of the observed levels of functional ability for each attribute (Chart 1). For example, "vision" ranges from perfect vision to blindness, while "pain" ranges from no pain to completely disabling pain.

Chart 1

Attributes comprising the Comprehensive Health Status Measurement System



Source: Centre for Health Economics and Policy Analysis, McMaster University, 1992

* The vector of the rated attributes qualitatively defines an individual's health status.

The CHSMS is the basis for a provisional health utility index. The HUI is a single numerical value for any possible combination of levels of these eight self-reported health attributes.¹¹⁻¹³ The HUI maps any one of the vectors of eight health attribute levels into a summary health value between 0 and 1. For instance, an individual who is near-sighted, yet fully healthy on the other seven attributes, receives a score of 0.95 or 95% of full health.

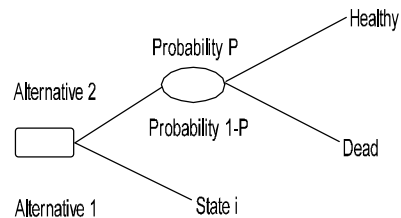
The HUI value also embodies the views of society concerning health status (see *Eliciting societal preferences embodied in the Health Utility Index*).

Eliciting societal preferences embodied in the Health Utility Index

The HUI embodies societal preferences for alternative health states. These health states are represented as various combinations of levels of functioning on each of eight health status attributes. Societal preferences are defined as an average of the preferences of individuals, insofar as they form a representative sample of the population. Each person's preferences are represented as a numerical value (typically between 0 and 1) for a given health state. (Some of the worst states of health are often given values less than 0, indicating that the individual considers them to be worse than death.)

The technique used to elicit and quantify individuals' preferences is the Standard Gamble (SG),^{11,12} which is based on the axioms of consumer utility theory developed by von Neumann and Morgenstern.¹⁴ The SG presents an individual with a choice between two health status alternatives (see below). The first is to live in some clearly specified intermediate health state for the remaining life expectancy: for example, partial blindness on the vision attribute and perfect health on each of the other seven attributes. The second alternative is a gamble, involving a treatment with two possible outcomes:¹³ a probability P of becoming fully healthy (perfect eyesight), and a probability 1-P of grave failure (immediate death). The probability of becoming fully healthy (P) is varied by an interviewer until the individual expresses indifference with respect to the alternatives: to live with the health status or to accept treatment with probability P of "success." The probability P at that indifference point is defined as the individual's utility for that health state. Systematically collecting data on these utilities for a wide range of possible health states (defined on the eight health status attributes) from a representative sample of the population yields a measure of societal preferences.

Standard Gamble decision diagram¹⁰



The HUI preferences used in this analysis are from the Childhood Cancer Study (CCS) conducted by the Centre for Health Economics and Policy Analysis of McMaster University.¹⁵ The study elicited preferences from approximately 200 parents of school-age children from the municipality of Hamilton. These preferences were originally compiled for an earlier (Mark II) version of the CHSMS. Since the OHS contains a revised and expanded (Mark III) version of the CHSMS, the CCS preferences were adapted for Mark III use. Preferences specifically designed for the 1990 OHS CHSMS (Mark III) are currently being developed and will be available in 1996. While the CCS preferences are appropriate for initial analysis, health status preferences from a fully representative sample of the population are essential for analyses to reflect Canadian society.

The specific HUI calculated here is provisional, as the societal preferences were derived from the small-scale Childhood Cancer Study¹⁵ using a precursor of the CHSMS and were adapted for use with the Ontario Health Survey. This version of the CHSMS, however, was tested for consistency and was deemed to provide a realistic appraisal of individual health status. (For a detailed explanation of the calculation of the HUI, refer to Berthelot et al.¹⁶)

Results

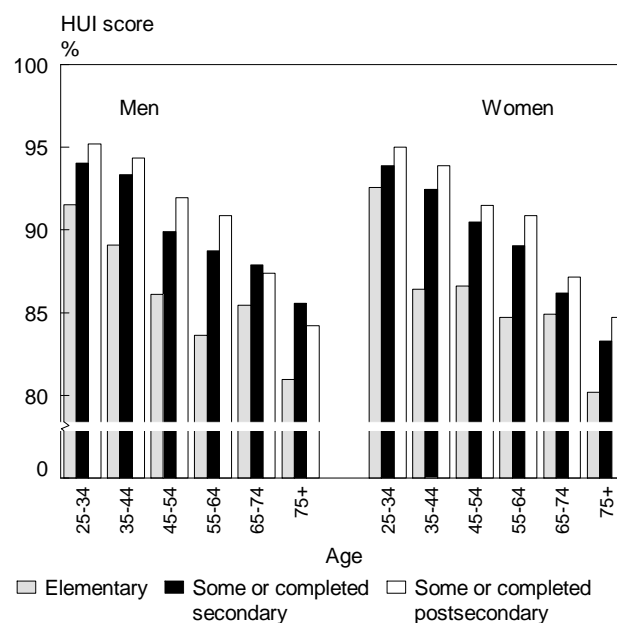
The majority of Ontario's population aged 25 and over have a fairly high level of health. On the HUI scale, the proportion considered to be fully healthy (a score of 100%) was approximately 35% for men and 30% for women. The difference between men and women overall for age-adjusted HUI was not significant. In fact, over 70% of both men and women had health status scores of 90% or more. Vision-related impairments (including wearing glasses or contact lenses) accounted for most of the values less than fully healthy (100%), but greater than 90%.

Education and income

Educational attainment is a strong correlate of health status, as measured by the HUI (Chart 2). This is consistent with Winkleby et al.,¹⁷ who noted that of all the SES variables, education was the strongest marker of individual health status. At most ages, the health status of the least educated group (elementary) of both men and women in Ontario was significantly lower than that of groups with more formal education. At older ages, there was a convergence in health status, with the gap between attainment categories narrowing. This may be due, in part, to the long-term trend toward more education (a secondary diploma represents a relatively high level of attainment for older people, but not for younger individuals).

Chart 2

Mean Health Utility Index scores, by educational attainment, age group and sex, Ontario,* 1990



Source: Ontario Health Survey, 1990

* Based on a cross-sectional sample of 17,297 men and 17,156 women aged 25 and over.

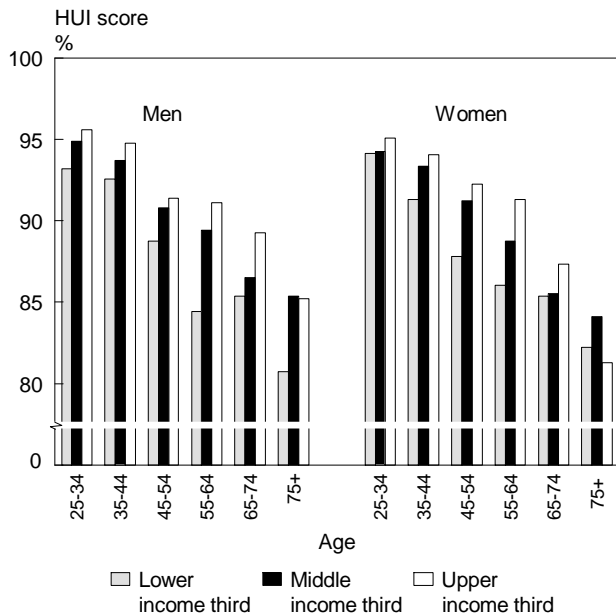
Household income is also correlated with health status. An analysis of income, however, must take account of typical patterns throughout the life cycle. The incomes of the youngest and oldest age groups tend to be lower and concentrated within a relatively narrow range, while middle-age groups' incomes are generally higher and cover a wider range. At older ages, household income is affected by retirement, whereas the comparatively low income of young age groups may reflect the transition from school to work. To account for these age effects, household income is displayed by tercile (three equal-sized income groups) for each age group (Chart 3). Income levels are thus compared only within age groups. As well, the income used in these calculations was first adjusted for household size and composition.¹⁸

There was a significant difference in the HUI scores of the lower and upper income terciles across all ages and for both sexes, except for women aged 75 and over. In addition, for both men and women aged 55 to 64, mean HUI scores of each income tercile were significantly different. Women's HUI scores converged at older ages, but not men's. Between ages 55 to 64 and 65 to 74, the mean HUI score of men in the low

income tercile rose slightly. This may not represent an improvement in health, but rather, a change in the composition of the population as healthy men retired and replaced employment income with lower pension income.

Chart 3

Mean Health Utility Index scores, by household income terciles,* age group and sex, Ontario,† 1990



Source: Ontario Health Survey, 1990
 * Adjusted for family size and composition.
 † Based on a cross-sectional sample of 17,578 men and 20,480 women aged 25 and over.

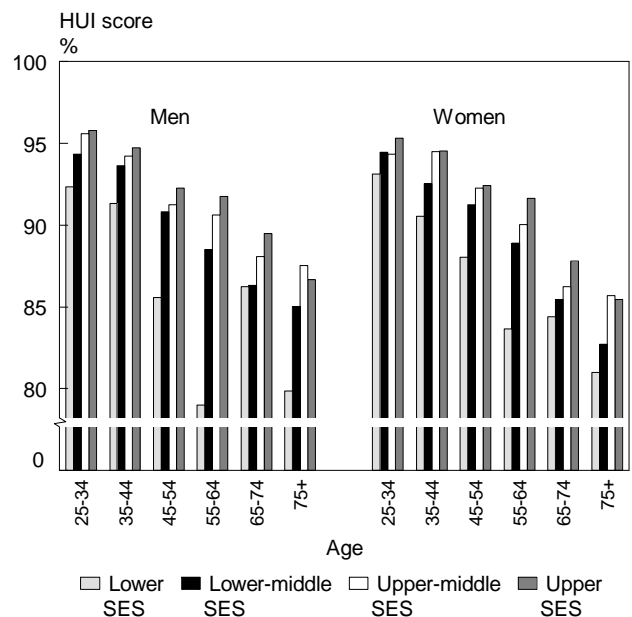
Separately, education and income are associated with significant health differences, as measured by the HUI. A composite education and income indicator, as suggested by House et al,¹⁹ was derived using the income terciles within each 10-year age group. For people under age 55, educational attainment was divided into two categories: high (some postsecondary and postsecondary completion) and low (secondary completion or less). For individuals aged 55 and over, those who had completed secondary school were included in the high-education category to compensate for changes in educational attainment over time. A matrix consisting of education and income categories was constructed, and one of four SES classes was assigned to each cell (see Appendix).

Within each age and sex group, health status diminishes with decreasing SES. The differences between the health status of the lowest and the three upper SES groups for both sexes in Ontario were statistically significant up to ages 65 to 74 (Chart 4). The differences were greatest in the middle-age groups.

The combined variable makes the upturn in health status for low SES men between ages 55 to 64 and 65 to 74 much more pronounced than when each variable is examined separately. As noted earlier, this shift may reflect changes in the major source of income (employment to pension) and in labour force status (employed to retired). To some extent, it may also be an effect of the change in the criteria used to designate high education among older age groups.

Chart 4

Mean Health Utility Index scores, by SES,* age group and sex, Ontario,† 1990



Source: Ontario Health Survey, 1990
 * Composite SES (income and education).
 † Based on a cross-sectional sample of 17,042 men and 17,107 women aged 25 and over.

Main activity and occupation

Main activity S working, looking for work, attending school, keeping house, or retired S is also associated with health status. At all ages, Ontario residents who

were working for pay had better health than those who were not employed.

As well, men and women aged 25 and over who were attending school had a lower than average health status. It was not clear, however, whether a substantial number of them were mature students or people who had left the workforce temporarily and were pursuing education until they could find employment.

Men who retired early (ages 45 to 54) also had a relatively low health status, below that of individuals looking for work. Decomposition of early retirees' HUI scores by health attributes suggests that many people who retire early do so because of health problems. These men had more pain and discomfort than did men in the other main activity categories, which was reflected in lower HUI scores among the former for that attribute.

Women whose main activity was keeping house had lower levels of health than women employed in the paid labour force. Even at older ages, when keeping house tends to be more prevalent as a main activity for women, this difference in health status was evident.

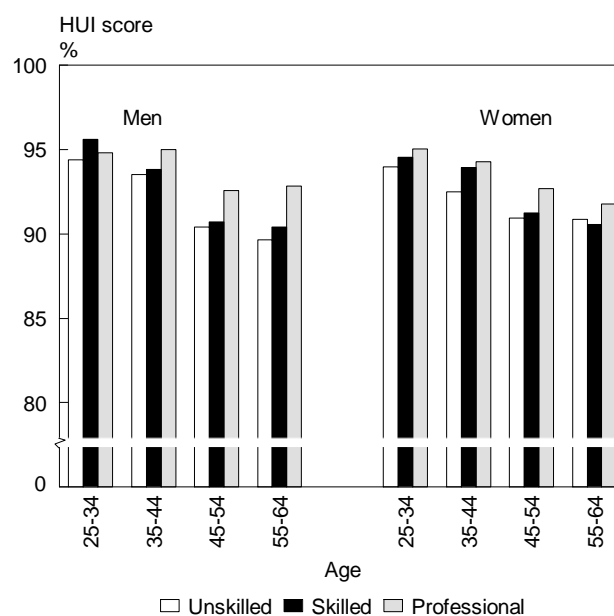
Occupation is another SES variable that is associated with health status.⁵ It is also clearly associated with both education and income. The Pineo-Porter-McRoberts scale, which groups occupations into categories that have common attributes across the entire labour force, is used for this analysis (Chart 5).²⁰ At most ages, Ontario men and women in the professional category had a significantly higher HUI scores than did those in the unskilled or skilled categories. Men in the last two categories were similar in health status. At younger ages, women in the skilled category had a significantly higher HUI score than did those in the unskilled category; at older ages, there was no significant difference.

Marital status

Married people tend to have longer life expectancies than those who are single, divorced/separated, or widowed.^{21,22} At age 50, married men have a life expectancy 3.7 years longer, and married women, 1.0 years longer, than that of their single counterparts.²³

Chart 5

Mean Health Utility Index scores, by occupation,* age group and sex, Ontario,† 1990



Source: Ontario Health Survey, 1990

* Pineo-Porter-McRoberts classification of occupations.

† Based on a cross-sectional sample of 13,704 men and 12,191 women.

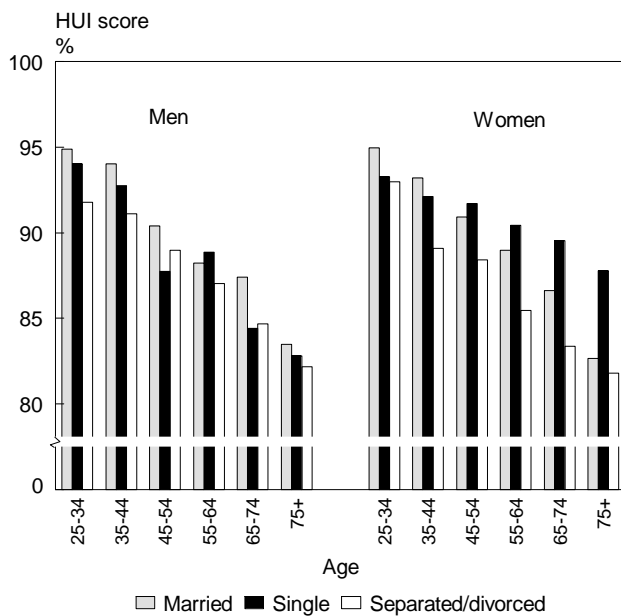
Among Ontario men, the HUI also tended to adhere to this pattern. Except at ages 55 to 64, married men had higher HUI scores than did those who were single (Chart 6). This was also true for women aged 25 to 44. But at older ages, the situation was reversed — single women had significantly higher HUI scores than did their married counterparts.

These patterns for men and women may reflect SES. For example, older single women in the OHS tended to have more education than married or separated/divorced women, and were less likely to be in a low-income category. By contrast, single men in the same age groups tended to have SES equal to or lower than married men.

In most age groups, the HUI score of separated/divorced people was lower than that of people in other marital categories, with women showing the largest difference. This phenomenon is in line with observations made for mortality.

Chart 6

Mean Health Utility Index scores, by marital status,* age group and sex, Ontario,† 1990



Source: Ontario Health Survey, 1990

* Widow/widower is not shown because of small counts.

† Based on a cross-sectional sample of 17,422 men and 20,278 women aged 25 years and over.

Discussion

In general, application of the HUI to data from the Ontario Health Survey supports well-known findings of significant variations in health by socioeconomic status. For men and women throughout the age spectrum, health status declines with decreasing SES. Health differences between higher and lower SES groups are relatively small at younger ages, greater among middle-age groups, and then diminish at older ages. Variations in health status by SES are larger among men.

While these results are generally consistent with the research literature, there are some differences. Unlike mortality, health service utilization, or other health status indicators, the HUI shows observable, but not statistically significant differences between Ontario men and women.^{23,24} Another difference from findings based on mortality data is that health status was higher among single than married women, particularly at older ages. These results may be confounded by SES or influenced by the lack of data for the institutionalized population. Specifically, a selection effect may be

present, since only older women still in the household population, who are likely to be relatively healthy, have been included in these calculations. Of further note is the fact that across all age groups, women who classified themselves as keeping house consistently had lower health status than women employed in the paid labour force.

Some caveats are in order with respect to the HUI itself. The version used in this analysis is based on a provisional weighting system originally developed for a similar but more limited set of health status attributes. Weights designed specifically for the set of eight health status attributes included in the OHS, as well as the new National Population Health Survey,²⁵ are planned to be available in 1996. In addition, the current HUI weights are based on a sample of 200 persons from the municipality of Hamilton. The weights for the planned HUI will be based on a sample of 500 persons, also from the municipality of Hamilton. To be truly representative of societal preferences, the weights must be derived from a national sample with more participants.

Another caveat concerns non-coverage of the population living in institutions. The HUI scores are likely biased upward, particularly for older age groups, because residents of institutions, who are generally assumed to have poorer health than the non-institutionalized population, are not included.

Finally, the OHS data are cross-sectional, representing the population at a point in time. Even though much of the analysis discussed patterns over age groups, this should not be construed to refer to the dynamics of health status over time. In future, data from the National Population Health Survey will enable researchers to conduct longitudinal analysis.²⁶

The HUI synthesizes into a single number both qualitative and quantitative information about a range of aspects of an individual's health. Regular estimation of the average HUI score for the population, or better yet, the value in terms of years of life expectancy adjusted for average health status at each age (Health-Adjusted Life Expectancy), can provide a summary health status measure analogous to the Consumer Price Index (CPI) as a measure of inflation, or to Gross Domestic Product (GDP) per capita as an overall measure of economic well-being. Such a measure is planned, based on data from the National Population Health Survey.

Appendix

Frequency distributions of Ontario population aged 25 and over, by age group, sex and SES, 1990

	Total	Lower SES	Lower-middle SES	Upper-middle SES	Upper SES
			%		
Men					
25-34	100.0	15.4	41.2	14.3	29.1
35-44	100.0	17.0	39.0	16.2	27.9
45-54	100.0	21.3	47.2	11.3	20.2
55-64	100.0	16.6	38.0	12.8	32.5
65-74	100.0	20.1	40.2	10.4	29.4
75+	100.0	16.1	47.1	15.2	21.6
Women					
25-34	100.0	17.4	38.6	15.3	28.6
35-44	100.0	20.9	42.3	13.3	23.5
45-54	100.0	26.4	45.7	11.1	16.9
55-64	100.0	22.4	36.5	15.6	25.6
65-74	100.0	23.7	38.9	10.1	27.4
75+	100.0	23.1	42.0	12.7	22.2

References

- Hirdes JP, Forbes WF. The importance of social relationships, socioeconomic status and health practices with respect to mortality among healthy Ontario males. *Journal of Clinical Epidemiology* 1992; 45(2): 175-82.
- Marmot MG, Kogevinas M, Elston MA. Social-economic status and disease. *Annual Review of Public Health* 1987; 8: 111-35.
- Wilkins R, Adam OB. Health expectancy in Canada, late 1970's: demographic, regional and social dimensions. *American Journal of Public Health* 1983; 73: 1073-80.
- Rogot E, Sorlie PD, Johnson NJ. Life Expectancy by Employment Status, Income, and Education in the National Longitudinal Mortality Study. *Public Health Reports* 1992; 107(4): 457-61.
- Black D, Morris JN, Smith C, et al. The Black Report. In: Townsend P, Davidson N, editors. *Inequalities in Health*. Suffolk: The Chaucer Press, 1988: 33-209.
- Hay DI. Socioeconomic status and health-status: a study of males in the Canada health survey. *Social Science and Medicine* 1988; 27(12): 1317-25.
- Lemkow L. Socioeconomic-status differences in health. *Social Science and Medicine* 1986; 22(11): 1257-62.
- Mackenbach JP. Socioeconomic health differences in the Netherlands: a review of recent empirical findings. *Social Science and Medicine* 1992; 34: 213-26.
- Ontario Ministry of Health. *The 1990 Ontario Health Survey - Documentation Report*. Toronto (Ontario): The Ministry: 1992.
- Torrance GW, Furlong W, Feeny D, et al. *Provisional health index for the Ontario Health Survey*. Hamilton (Ontario): McMaster University Centre for Health Economics and Policy Analysis: 1992. Project No.: 44400900187.
- Feeny D, Furlong W, Boyle M, et al. Multi-attribute health status classification systems: Health utilities index. *Pharmaco-economics* 1995, In press.
- Torrance GW, Furlong W, Feeny D, et al. Multi-attribute preference functions: Health utilities index. *Pharmacoeconomics*, 1995, In press.
- Torrance GW. Measurement of health state utilities for economic appraisal: A review. *Journal of Health Economics* 1986; 5: 1-30.
- von Neumann J, Morgenstern O. *Theory of games and economic behavior*. Princeton: Princeton University Press, 1947.
- Feeny D, Barr RD, Furlong W, et al. Quality of life of the treatment process in pediatric oncology: An approach to measurement. In: Osoba D, editor. *Effect of cancer on quality of life*. Boca Raton: CRC Press, 1991: 73-88.
- Berthelot J, Roberge R, Wolfson MC. The calculation of health-adjusted life expectancy for a Canadian province using a multi-attribute utility function: A first attempt. In: Robine JM, Mather CD, Bone M, Romieu I, editors. *Calculation of health expectancies: Harmonization, consensus achieved and future perspectives*. Colloque INSERM: 1992 Oct; Montpellier (France): John Libbey Eurotext. 1993: 161-72.
- Winkleby MA, Jatulis DE, Frank E, et al. Socioeconomic status and health: How education, income, and occupation contribute to risk factors for cardiovascular disease. *American Journal of Public Health* 1992; 82(6): 816-20.
- Wolfson MC, Evans JM. *Statistics Canada's Low Income Cut-Offs: Methodological concerns and possibilities*. Analytical Studies Branch, Statistics Canada, Unpublished.
- House JS, Kessler RC, Herzog AR, et al. Age, socioeconomic status, and health. *Milbank Memorial Fund Quarterly* 1990; 68(3): 383-411.

20. Pineo PC, Porter J, McRoberts HA. The 1971 Census and the socioeconomic classification of occupations. *Canadian Review of Sociology and Anthropology* 1977; 14(1): 91-102.
21. Wyke S, Ford G. Competing explanations for associations between marital status and health. *Social Science and Medicine* 1992; 34(5): 523-32.
22. Trovato F, Lauris G. Marital status and mortality in Canada. *Journal of Marriage and the Family* 1989; 121: 907-22.
23. Adams OB, Nagnur DN. *Marriage, divorce and mortality: A life table analysis for Canada and regions* (Statistics Canada, Cat. No. 84-536E) Ottawa: Supply and Services Canada, 1988.
24. Badley EH, Yoshida K, Webster G, et al. *Disablement and chronic health problems in Ontario*. Toronto (Ontario): Ontario Ministry of Health: 1993. Ontario Health Survey 1990: Working Paper No. 5.
25. Catlin G, Will BP. The National Population Health Survey: Highlights of initial developments. *Health Reports* 1992; 4(3): 313-19.
26. Wolfson MC, Rowe G, Gentleman JF, et al. Career earning and death: a longitudinal analysis of older Canadian men. *Journal of Gerontology* 1993; 48(4): 5167-79.