Socioeconomic Determinants of Prescription Drug Use By the Elderly in British Columbia

by

Indra R. Pulcins

A thesis submitted in conformity with the requirements for the degree of Doctor of Philosophy
Graduate Department of Health Administration
University of Toronto

0-612-49911-1

Socioeconomic Determinants of Prescription Drug Use By the Elderly in British Columbia

Indra R. Pulcins

Doctor of Philosophy, 2000
Graduate Department of Health Administration
University of Toronto

Abstract

This dissertation examines the socioeconomic determinants of prescription drug use by the elderly in British Columbia between 1989 and 1995. The objectives of this research are to describe drug utilization by the elderly in British Columbia as it varies by socioeconomic status, and to determine whether there exists a socioeconomic gradient in rates of drug use after controlling for demographic factors and other health care utilization. These relationships are explored in detailed for gastrointestinal, central nervous system and cardiovascular medications.

Data sources include the British Columbia Linked Health Database and Canadian Census data. All individuals 65 years of age and over who subscribed to Plan A of Pharmacare, the provincial drug plan, are included in this analysis. Socioeconomic status is measured in terms of income quintiles, an area-based measure of average household income. Bivariate descriptive analytic techniques and multiple regression analysis were employed.

The results of this study confirm the presence of an inverse, monotonic relationship between income and patterns of prescription drug use. Per capita utilization of gastrointestinal, central nervous system and cardiovascular drugs increases as income decreases. An examination of utilization rates per user, which consider only those individuals receiving at least one drug in each therapeutic drug group, reveals similar gradients, with the exception of cardiovascular drugs. Although the quantity of drugs dispensed and number prescriptions for cardiovascular drugs

increase monotonically as income decreases, income level has no effect on drug costs. There is some evidence that the type of cardiovascular medications prescribed varies by income level. Multiple regression analysis demonstrates that despite the significant effect of physician, hospital and home care use on the amount of prescription drugs dispensed, income still emerges as a significant predictor of drug utilization.

These results point to the existence of systematic differences in the utilization of prescription drugs. The extent to which these are due to socially determined differences in treatment, or to differences in the health status, is not known. Further research in this area would refine our knowledge of the relationships between drug utilization, socioeconomic status and need.

Acknowledgments

The completion of a dissertation depends very much on one's thesis committee, and I am thankful for having one of the best. I sincerely thank my thesis supervisor, Dr. Rhonda Cockerill at the University of Toronto for her assistance, unbounded patience and encouragement. I also thank Dr. Marsha Cohen at the University of Toronto, who was instrumental in preparing the groundwork for this research, and Dr. Victor Marshall, at the University of North Carolina Institute on Aging, for their perceptive comments on the research proposal and many drafts of the thesis that followed. I extend sincere appreciation to Dr. Morris Barer, at The University of British Columbia, for his enviable insight into the data and issues that he shared through many thorough readings of this thesis. I would also like to offer my gratitude to Dr. Robyn Tamblyn at McGill University, and to Dr. Jan Hux and Dr. Jan Barnsley at the University of Toronto, for the very helpful comments they provided as external examiners.

This study could not have been completed without the assistance of several individuals at the Centre for Health Services Policy and Research at the University of British Columbia. Dr. Morris Barer generously provided the resources for this research, which was completed as part of a National Health Research and Development Program (NHRDP) project (6610-2117-602). I gratefully acknowledge the Ministry of Health for granting access to data required for this project. Brian McCashin was a constant source of assistance with the technical aspects of this research. Both Patrick Wong Fung and Kerry Kerluke provided programming assistance and database management. Kimberlyn McGrail was invaluable in facilitating data transfer and numerous other tasks. Dr. Clyde Hertzman and Dr. Bob Evans provided useful commentary in the early stages of data analysis. I would also like to extend a special thank you Clyde Hertzman for providing the original suggestion to investigate this topic.

Most of all, a very special and heartfelt thank you to my wonderful husband Eriks, my family and friends who supported, and to no small extent, endured with me in this endeavour.

This research was made possible in part by Health Canada through a National Health Research and Development Program (NHRDP) Research Training Award.

Table of Contents

List of Tables

List of Figures

List of Appendices

Chapter One

Socioeconomic Determinants of Prescription Drug Use in the Elderly in British Columbia

Introduction

This dissertation examines the socioeconomic determinants of prescription drug use by the elderly in British Columbia. While there is an extensive body of literature linking socioeconomic factors with health outcomes, there has been comparatively little investigation of the relationship between socioeconomic status and the processes of care. This study extends our knowledge of patterns of care in the elderly, and in doing so provides evidence to enhance our broader understanding of the role of socioeconomic status in the provision of health care.

Examination of the socioeconomic determinants of prescription drug use is one attempt to look at patterns of care in a health care system that provides comprehensive coverage of pharmaceuticals to the elderly population. In British Columbia, the site of this study, all residents over the age of 65 years are eligible for enrolment in Plan A of Pharmacare, the provincial drug benefits program, and all residents are covered under the provincial medical services plan. Yet we know that universal access to health care in Canada has not alleviated systematic differences in health outcomes according to socioeconomic status. In fact, mortality and morbidity have been shown to increase as socioeconomic status decreases (Mustard et al., 1997; Wilkins, Adams and Brancker, 1989; Wolfson et al., 1993). It is also known that the utilization of health services is inversely related to socioeconomic status, perhaps independently of health status (e.g. Roos and Mustard, 1997). The manner in which the use of prescription drugs varies by socioeconomic status in Canada is not well known.

This thesis focuses on the elderly. The elderly are of special interest to us; increasing life spans, improved medical interventions and increasing frailty among the elderly may contribute to growing care costs. As a group they contribute more to overall health costs than any other (Barer, Evans and

Hertzman, 1994), including prescription drug costs covered by provincial health insurance plans. And they continue to increase. For example, the average cost of a Pharmacare prescription for individuals over 65 years of age has increased over 136 percent between 1985 and 1996, or 9 percent per year, which means that pharmaceuticals represent the fastest growing component of health care costs in British Columbia (British Columbia Ministry of Health, 1998).

The focus on prescription drug use in the elderly is a particularly important area of inquiry. Care of the elderly over the last decades has been typified by changes in treatment and diagnostic patterns as well as by an expanding array of pharmaceutical treatment alternatives. These shifts have also been responsible for most of the increase in expenditures in this group (Barer et al, 1994). Data from British Columbia (Anderson et al., 1993) and Ontario (Lexchin, 1992), for example, indicate that mounting costs for pharmaceuticals dispensed to the elderly are driven by the significant costs of new and more expensive drugs, more intensive prescribing, and increased prices for old drugs. While there is ample documentation of an increase in pharmaceutical expenditures, there are also Canadian studies which suggest that many widely used prescription drugs may not produce any clear benefits for their users (McIsaac et al., 1994; Rapoport, 1994; Tamblyn et al., 1994), and often produce adverse effects (Grymonpre et al., 1991). Adverse drug effects stemming from polypharmacy, or the use of several medications concurrently, has been linked to increased hospital and physician use (e.g. Cooper, 1999; Hanlon, et al., 1997; Parks and Josef, 1997; Satish et al., 1996).

Yet the sole focus of our investigation of drug utilization should not be on clinical factors alone, since they represent just one facet of a larger picture. It is important to evaluate prescription drug use in a broader context, since it represents just one component of a complex system. The document *Nurturing Health: A Framework on the Determinants of Health* (Premier's Council, 1991) is just one publication to challenge conventional wisdom that health status is determined predominantly by medical care. This population health perspective and the departure from conceptualizing health and illness within a purely medical model is now widely recognized. Here, the socioeconomic factors that may be significantly related to the utilization of prescription drugs are emphasized.

This study also makes a contribution to the growing body of research demonstrating the power of using of linked databases for population based studies. It will demonstrate how linked databases can be used in order to gain a fuller understanding of prescription drug use than is afforded by conventional administrative databases. The relatively new British Columbia Linked Health Database, which is the main data source for this study, was created to maximize the potential for research using administrative data already available in the province (Chamberlayne, et al., 1998). This database links statistics from various program areas as well as Vital Statistics in order to create a comprehensive account of an individual's health services utilization over a specified period and thereby represents a powerful tool with which to examine several concurrent aspects of health care utilization. The data in this study are also linked to area-based measures of socioeconomic status from Canadian Census data, thereby further strengthening the capabilities of this already robust database.

The Links Between Socioeconomic Status, Health Status and Utilization

There is a fundamental difference in the determinants of health, *per se*, and the determinants of health care utilization patterns that may or may not reflect differences in health status. The triad between health, health care utilization and socioeconomic position, therefore, represents a more complex relationship than that between socioeconomic status and health, or socioeconomic status and health care utilization alone. Drug utilization represents an additional facet of health care utilization.

While studies have examined the links between socioeconomic status and health, and socioeconomic status and health care utilization, there has been comparatively less emphasis on the analysis of prescription drug use, socioeconomic status and health care utilization in tandem. Therefore it is the objective of this study to determine whether there is a relationship between prescription drug use in the elderly in British Columbia and socioeconomic status when other health care utilization is controlled for.

Several factors must be considered at a conceptual level in order to understand the dynamic driving prescription drug utilization. These are presented in Figure 1.1. Although only the basic components are presented here, this process is, in fact, quite complex, as the presentation of the literature in the following chapter will attest. The interrelationships between socioeconomic status, health status and health care utilization may involve a myriad of factors, including the social environment, physical environment and genetic endowment (Evans and Stoddart, 1990).

At the top of this figure, socioeconomic status figures prominently, and is linked to all the other components considered here. One's social position is seen to be a key determinant of health status, whether this implies physical and mental wellness, acute illness, chronic conditions or injuries and accidents.

As also indicated in this model, socioeconomic status may have an independent effect on health care utilization. But there also exists an important interplay between health care utilization and health status. Accessing the health care system may lead to curative or ameliorative effects on ill health. At the same time, it is possible, that due to side effects of treatment, labeling or other iatrogenic processes, health status is negatively affected, thereby possibly further increasing the utilization of hospital or physician services.

Socioeconomic status exerts other mediating effects on the propensity to effectively access the health care system. It is posited that one's educational level, occupation, income, and differential power, prestige or health beliefs, for example, have a profound effect on one's ability to navigate the health care system. These qualities may influence the decision of when to seek medical help, from whom to seek it, when to medicate, which treatments to seek, compliance and demands for specific treatments or medications.

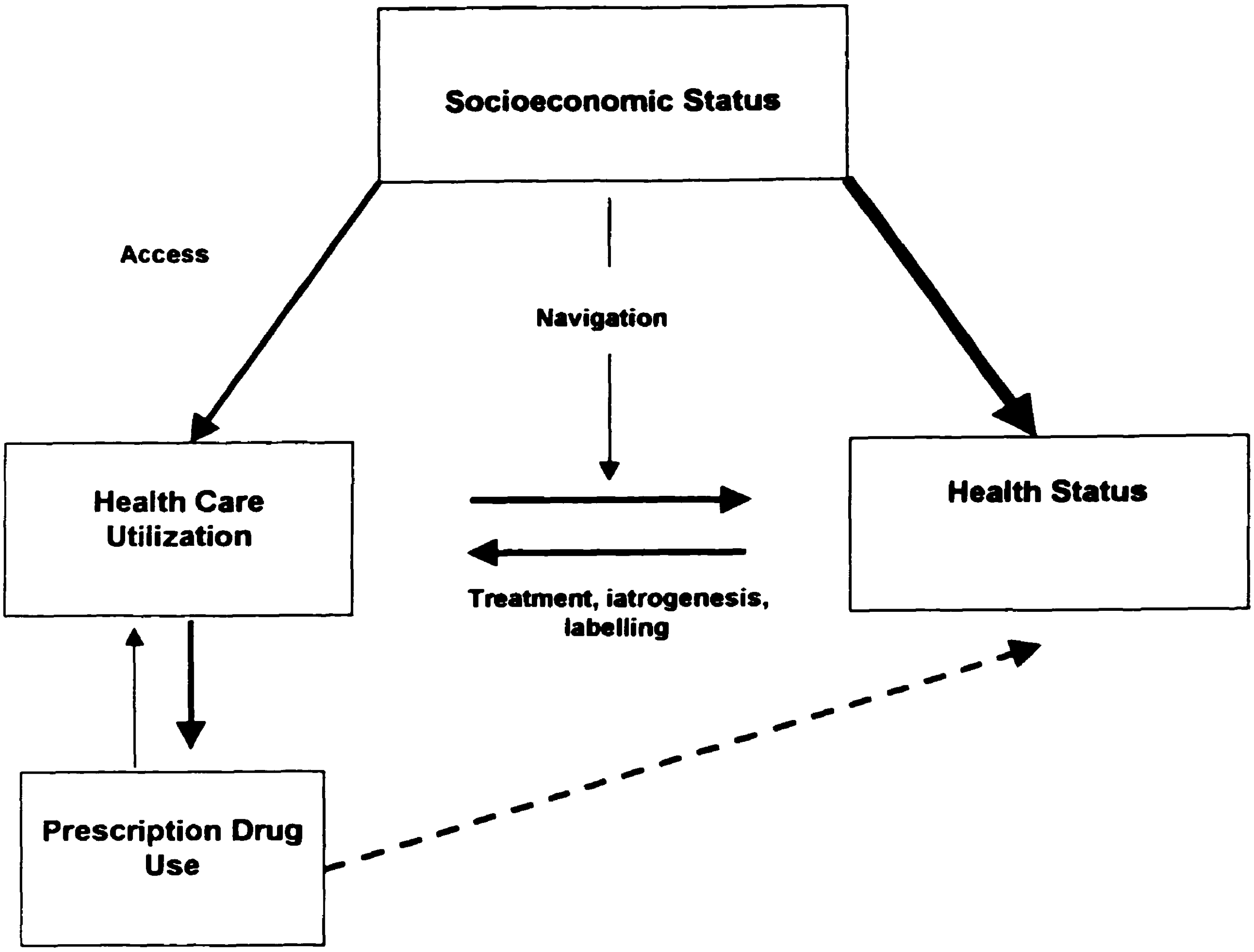


Figure 1.1

Determinants of Prescription Drug Utilization

Prescription drug utilization, of course, cannot occur until there has been contact with a physician (or dentist, midwife or podiatrist), the only professionals licensed in British Columbia to prescribe medications. This too, has a dual effect. While physician contacts lead to prescription drug utilization, further contacts with the health care system may then be required to update, monitor or refill prescriptions. For this reason, health care utilization may not be a primary determinant of health, but it certainly plays a central role in the prescribing of medications.

Thus the importance of considering the total picture, and the inclusion of the factors discussed above is underscored. To some extent the degree of drug utilization will mirror the presence or absence of clinically defined disease states (which as stated have been shown to vary with social position). At the same time, drug utilization is determined by overall health care utilization, which, as will be demonstrated in the following chapter, is also related to socioeconomic status. In other words, while health status is important in determining the use of health care services, including pharmaceutical preparations, socioeconomic status exerts a pronounced and independent effect on both health and utilization. Thus the literature on drugs is interesting precisely because of its complexity, and research in this area should address at least two questions: what is the extent and direction of patterns, or gradients in drug utilization by socio-economic indicators, and second, why are they there?

In this study, the first of these issues will be addressed. The specific research objectives are:

1. To describe prescription drug utilization by the elderly in British Columbia as it varies by socioeconomic status, for all drugs and for the three major therapeutic drug categories (gastrointestinal, central nervous system and cardiovascular drugs);

2. To determine whether there exists a socioeconomic gradient in rates of drug use and costs after controlling for age, sex and health care utilization, for overall drug utilization and for the utilization of gastrointestinal, central nervous system and cardiovascular drugs;

3. To examine the trends in any relationship between socioeconomic status and overall drug utilization over time.

A better understanding of the non-clinical as well as clinical determinants of drug utilization would clarify the effect of socioeconomic factors on the processes of care. This study extends our knowledge of the use of prescription drugs by the elderly as well as the role socioeconomic status plays in this process. Such insight should not only shed light on prescribing behaviour in one Canadian province, but should also elucidate some more generalizable principles on the socioeconomic determinants of utilization patterns.

In the following two chapters, the literature describing the relationships between the components specified above, as well as on the various approaches to the measurement of socioeconomic status, is presented. Chapter Four provides an overview of the methods and data sources used in this study. The overall results of the data analysis are provided in Chapter Five, while the results for gastrointestinal, central nervous system and cardiovascular drugs are presented in Chapters Six, Seven and Eight, respectively. In the final chapter, these results are discussed in light of other existing evidence, their limitations, and the implications for further study.

Chapter Two

Literature Review:

Socioeconomic Status, Health Outcomes and the Use of Health Services and Prescription Drugs

The literature on socioeconomic status as one of the broad determinants of health lends credence to the supposition that higher social position is associated with better health. Health status, expressed in terms of morbidity or life expectancy, for example, has been shown to vary with income, occupational class, education and other composite measures of socioeconomic status. The evidence on use of health care services by social position, however, tends to be equivocal. Compared to the interest in the relationship between socioeconomic status and health status or health care utilization, links between socioeconomic status and drug use have received relatively less attention in the literature.

In the introductory chapter, the pathways between socioeconomic status, health status, the utilization of health care services and ultimately, the use of prescription drugs, were discussed. The current literature on the social determinants of mortality as well as morbidity forms the foundation of our understanding of the relationships between social position and health care utilization. The relationships between prescription drug use and socioeconomic status cannot be adequately understood without knowledge of the socioeconomic determinants of mortality, morbidity or health care utilization in general. In this chapter, the evidence concerning the known relationships between each of these three components is presented. The evidence on the socioeconomic determinants of mortality and morbidity, as well as a number of the hypothesized underlying mechanisms in which socioeconomic differences are manifested, is reviewed. Next, the utilization of health care services, including medication use, is discussed in relation to social position.

The Context

Socioeconomic differences in mortality are not a uniquely modern phenomenon. In fact, there is no dearth of data illustrating socioeconomic differences in mortality among all age groups throughout this century, especially in the U.K. (Adler et al., 1993; Barker and Osmond, 1987; Macintyre, 1997). In recognition of these inequalities in health the National Health Service in Britain was established in 1948, intended to equalize health status by eliminating socioeconomic barriers to health care. This did little to ameliorate social class differences in health status, which, in fact, have widened since the 1970's (Frank and Mustard, 1994; Marmot et al., 1978; Pincus, Ester and Dewalt et al., 1998). The widening of the gap in social and economic disparities in health is not unique to Britain. To the contrary, it is characteristic of many developed countries, including Canada (Badgley, 1991; Davey Smith, Bartley and Blane, 1990).

In 1980, the controversial Black Report produced by the Research Working Group on Inequalities in Health in Britain reported large social class differentials in morbidity and mortality. The report not only detailed the pattern in which the higher social classes in this very class-stratified society were healthier, but that the availability of a national health service had done little to redress this basic health issue (Department of Health and Social Security, 1980). This report is, in many ways, one of the cornerstones of the population health perspective. Clearly, the Black Report influenced contemporary thinking on the relationship between socio-economic status and health, and has spawned many new investigations in this area since its publication (Frank and Mustard, 1994).

Despite some methodological and theoretical criticisms that have been raised with respect to the Black Report (see, for example, Strong, 1990), the ensuing body of knowledge that has been generated since its publication builds a strong and convincing case for the importance of considering socioeconomic influences in health. Since the Black report, new evidence on not only life expectancy and mortality, but also quality of life, in terms of morbidity or disability has emerged. Moreover, a major contribution of this report lies in the variety of potential, possibly complimentary explanations for the socioeconomic differences in health suggested therein. The Black Report may have set the stage for this discussion, but our understanding is still far from complete. Still, better research designs, the availability of linked data and extensive research since then has furthered our understanding of this complex phenomenon (Davey Smith, Bartley and Blane, 1990; Macintyre, 1997). The existing evidence is presented in the following sections.

Mortality and Socioeconomic Status

Perhaps the most compelling evidence on mortality and socio-economic status has been provided by the methodologically rigorous Whitehall Studies. The wide range of statistical data collected on a remarkably large sample not usually available from vital statistics or administrative databases and ten year follow-up further strengthens these studies. In the first phase of this study, or "Whitehall I", 18,403 men in the British civil service were classified by employment grade and followed over a 10 year period (Marmot, 1989; Marmot 1994; Marmot et al., 1978; Marmot, Shipley and Rose, 1984; Rose and Marmot, 1981). The primary finding of this study was that there exists an inverse monotonic gradient in all cause and cardiovascular mortality according to employment grade, as well as with respect to lung cancer, other respiratory diseases, gastrointestinal disease and some cancers. In other words, the higher the employment grade, the lower the mortality rates. In fact, all-cause mortality was approximately three and one half times higher in the lowest employment grade compared to the highest, or administrative employment grade. Cardiovascular mortality witnessed a similar socioeconomic gradient. Only about 25 percent of the differences in CHD mortality could be explained by differences in smoking, blood pressure or serum cholesterol, and access to health care services is not a factor under universal access to the National Health Service. Although it is perhaps not surprising, given what was already known, that those in the lowest occupational status experienced the highest mortality rates, the emergence of this very systematic stepwise gradient across *all* groups was a key, new and important finding.

These findings refute the notion of a threshold effect in mortality. Rather, higher mortality is not just a result of abject poverty nor is lower mortality the effect of extreme wealth. The monotonic nature of the gradients, in fact, is one of the key findings in this study. It is extremely important to note that the men included in this study were all employed, and therefore of working age, predominantly worked in office environments not susceptible to the effects of industrial toxins or hazards, and earned salaries that were, on average, higher than the mean salaries in the society at large (Evans, 1994). Although these results cannot be necessarily generalized to both genders, recent data suggest that the overall patterns between occupationally based gradients and mortality for men and women may be very similar (Emslie, Hunt and Macintyre, 1999).

The Whitehall data, supplemented by the OPCS Longitudinal survey and the Registrar General's Dicennial Supplement, were used to determine the socioeconomic gradient of cancer related deaths. An inverse socioeconomic gradient was observed overall, although the pattern varied for specific cancers. While a distinct inverse gradient was seen for cancer of the oesophagus, stomach, pancreas and lung, a relatively flat distribution between occupational grades was found for colon cancer, rectal cancer or haematopoetic cancer. Conversely, age-adjusted mortality from brain cancer was highest in the administrative class, and decreased with lower occupational grade (Davey Smith, et al., 1991). The fact that a variety of data sources were used to explore this phenomenon suggests that it is highly unlikely that the observed relationships were artefactual.

Since the Whitehall study, many other studies have examined the relationships between social position, measured in terms of occupational class, and mortality. In a comparison of British and Swedish mortality data the existence of socioeconomic differences in health status in both countries was revealed. These disparities were, however, somewhat lower in Sweden. The ratio of death rates between the two lowest social classes and the two highest social classes in the 1960's and 1970's was documented as 1.27 in Sweden, while it was comparatively higher, 1.48 in Britain (Vägerö and Lundberg, 1989). In Sweden, social inequities between occupational groups continue to exist despite policy directed toward minimizing social and material disparities

(Diderichsen, 1990). Finnish data also closely mimic these patterns, but like the results of the Whitehall studies, indicate that not all causes of death parallel this pattern exactly (Koskinen, Martelin and Valkonen, 1996). Similar results have been reported in New Zealand, France, Norway and the United States (Marmot, 1989), the Netherlands (Otten and Bosma, 1997) and Australia (Burnley, 1998).

In the United States, a clear inverse gradient between mortality from heart disease and an occupationally based socioeconomic classification has been observed. The mortality rate from heart disease for individuals in the lower middle classes in Ohio was almost two times that of those in the upper classes; the working poor were more than four times as likely to die from heart disease, than the upper middle classes (Logue and Jarjoura, 1990). This occupationally based gradient was also observed for all-cause mortality in a study based on the National Longitudinal Mortality study, a very large American cohort, regardless of which of four occupationally-based measures of socioeconomic status was used (Gregario, Walsh and Paturzo, 1997)[1]. Survey data from North Carolina also demonstrated excess mortality in males in the lowest occupational groups, over a ten year study period (Barnett, Armstrong and Casper, 1997).

As a measure of socioeconomic status, income also produces strong associations with mortality. Very strong evidence in the Canadian context may be found in a study of over 500,000 retired males between the ages of 65 and 74 (Wolfson et al., 1993). The data showed that the probability of survival up to age 74 increased with higher incomes in the twelve years prior to retirement, with a very steep gradient between income quintiles. Also, marital status, early retirement, disability and marked changes in earnings prior to retirement were also significantly related to survival past retirement.

---

[1] The four measures tested in this study included the US Census, Nam-Powers, Duncan and Siegal occupationally-based measures of social position. Only the US Census measure did not yield a linear gradient between six income groups, although the lowest mortality rates were observed for the highest status group, and the highest mortality rates were observed with the lowest status group. The remaining three measures of social position produced inverse gradients of mortality (Gregario, Walsh and Paturzo, 1997).

Wilkins and Adams (1978) analysed the relationship between morbidity and mortality and socioeconomic status in the Canadian population. Although this analysis was performed at the relatively large census tract level, which may be less sensitive to differences than smaller geographical units, the findings are impressive. A decade later, very similar findings relating to mortality differentials by income in urban areas were uncovered in a comprehensive study by Wilkins, Adams and Brancker (1989). In 1971 and 1986, life expectancy at birth displayed a clear inverse income gradient. The magnitude of inequalities between the five income quintiles decreased slightly over this period. Similarly, rates of infant mortality in the poorest income quintile were approximately double those in the most affluent quintile in both 1971 and 1986 despite significant decreases in infant mortality in all income groups over this fifteen year period. Disparities in mortality were shown to be greatest in infancy and adulthood (ages 25 to 64), then declining in the oldest age groups. When analyzed by cause of death, Wilkins and his colleagues found that while the income-related differences in death rates for some diagnoses decreased over the study period (e.g. infectious diseases, diabetes, motor vehicle accidents), this disparity increased for others (e.g. lung cancer, suicide, ill-defined conditions). Virtually all diagnostic groups, with the exception of breast and uterine cancer, leukemia and skin diseases showed excess mortality in the poorest income quintile compared to the most affluent. The robustness of these results was verified through several alternative methods of analysis.

In this decade, research in Canada has revealed similar patterns (Roos and Mustard, 1997). Age-standardized mortality rates were shown to follow a clear, and statistically significant inverse gradient, for males and females. Also, life expectancy increased as the relative affluence of the neighbourhood increased. In this study, which included the population of Winnipeg, Manitoba, the ratios for deaths from specific diseases (lowest income quintile compared to the highest income quintile) were 1.7 for deaths attributed to ischemic heart disease, 5.5 for hypertension, 1.5 for vascular complications, 2.2 for diabetes and 2.5 for lung cancer. Most importantly, a monotonic gradient, rather than a threshold effect, emerged between all quintiles. Furthermore, life expectancy was considerably lower for those in the lower income areas. Whereas average life expectancy equalled 65.3 years for men in the lowest income quintile, it reached 76.6 years for those in the highest income quintile. Life expectancy for women was calculated as 74.6 years and 82.1 years in the lowest and highest income quintiles respectively.

In a similar study in Manitoba, an inverse relationship between mortality and both education and income quartiles emerged (Mustard et al., 1995; 1997). Unlike the study cited above, however, a strict linear gradient did not emerge. Rather, mortality decreased with increasing income, then increased slightly in the highest income quartile. The authors posit that this departure from the usual linear gradient may have been due to higher mortality at earlier ages in those in the lower socioeconomic quartiles. Also, this study considered all ages in the calculation of mortality rates, whereas Roos and Mustard (1997), cited above, considered only those deaths occurring to individuals up to 74 years of age. The use of income quartiles versus income quintiles constitutes another difference between these two studies.

These trends have been uncovered in a recent study in another Canadian province. Data from British Columbia demonstrated that mortality from all causes increases as income, as well as occupational status and education decrease. As well, potentially avoidable deaths, or those that could have been prevented if appropriate medical interventions were available, clearly follow this inverse gradient. The relative risk between the lowest and highest occupationally based social class scale was particularly high, i.e. over 2.0 for several causes of death including hypertensive disease, tuberculosis, bacterial infections and pneumonia and bronchitis (Wood et al., 1999). Low income was also proven to be the most significant socioeconomic predictor of premature mortality among men in Ontario (Jerrett, Eyles and Cole, 1998).

In the United States the relationship between income and mortality has been found in a number of studies. Two studies examining socioeconomic inequalities in mortality in white and black men, respectively, confirmed the important role of social position, measured by area income, for mortality from different causes. An inverse gradient was uncovered for all-cause mortality in both studies over 16 years of follow-up, regardless of smoking status or race (Davey Smith et al., 1996a; 1996b). Further studies on a very large multi-centre cohort of 361,662 men revealed that higher mortality in black men in the United States could be predominantly explained by socioeconomic position (Davey Smith et al. 1998). Pappas and colleagues (1993) reported similar results among both white and black men and women.

Thus whether individual or area-based measures of social position are used, a strong association between socioeconomic status and mortality has emerged[2]. Few studies have attempted to use both individual and area-based measurements of socioeconomic status. Ecob and Jones (1998), however, in response to a call in the literature for the use of both levels of measurement concurrently, have explored the relationship between area-based measures and individual-based socioeconomic classification and mortality. Their findings indicate that differences in mortality rates by socioeconomic area exist even after adjusting for individual socioeconomic variations. As expected, areas typified by higher concentrations of people employed in the professional classes were also at the lowest risk of dying. However, these social differences are amplified for those who were, at an individual level, in the higher-class occupations. This indicates that there may be both area-based and individual influences of socioeconomic status on mortality.

Residents of defined "poverty areas" in the US were shown to exhibit higher than average mortality rates in a well-designed study that controlled for individual life-style variables, such as smoking, physical activity, sleep patterns as well as race, employment status, income, access to medical care, marital status and other factors. After 18 years of follow-up in the Alameda County Study, low income earners were shown to experience higher age-, race- and sex-adjusted mortality. When individual income was entered into the model, the risk of mortality from living in a poverty area did not change, suggesting the importance of area characteristics on health outcomes (Haan, Kaplan and Camacho, 1987; Kaplan, 1985). In another American study, mortality rates in low income census tract areas compared to high income areas were reported to

---

[2] The relative strengths of area-based measures are discussed in greater detail in Chapter Three.

be higher for both black and white men and women (e.g. RR=2.10 in low income areas, RR=1.49 in high income areas for black men), an effect which occurred independently of personal income (Anderson et al., 1997). In fact, the results of this study indicated that low income areas had 30 to 40 percent greater mortality rates than higher income areas, after adjustment for individual income levels. Similar area-based results were reported in the US (Pappas et al., 1993), in Britain (Charlton et al., 1983), and in Canada, in British Columbia (Thomson, 1990), although in the latter study no adjustments were made for other risk factors.

The effects of income on mortality may be independent of the manner in which income is measured or conceptualized. McDonough et al., (1997), demonstrate that while current income is an important predictor of mortality, persistent low income, income instability, and single-year versus multiyear income estimates were all sensitive predictors of mortality. For example, the adjusted odds ratio for those aged between 45 and 64 years was 3.54 for those individuals with persistently low incomes. When income stability was considered instead of absolute income, very similar results emerged. In both cases, a clear monotonic inverse gradient was produced.

Education is less frequently used as a sole measure of socioeconomic status in studies of mortality, and is usually used in tandem with either occupational or income based measures of social position (e.g. Mustard et al., 1997; Pappas et al., 1993). However, in some contexts education may be the more relevant measure of socioeconomic standing feasible. For example, income or occupation in Russia or other former Warsaw Pact nations may not fully reflect status or material standing. One recent Russian study confirms that the inverse relationship between education and mortality is at least as large as those observed in western countries. This relationship declines with age, and is particularly pronounced with some causes of death, especially injuries and accidents, where age-adjusted mortality with only a primary education is twice that of university-educated individuals (Shkolnikov et al., 1998).

Morbidity and Socioeconomic Status

The Whitehall II study analysed an entirely new cohort of 10,314 men and women. This study demonstrated that morbidity exhibited the classic socioeconomic gradient associated with mortality in the British Civil Service, despite the passage of two decades between the two Whitehall studies. A wide variety of disorders, including ischemia or angina, regular cough (with phlegm) during winter months, hypertension requiring drug therapy or premenstrual symptoms produced a statistically significant inverse social gradient (Marmot et al., 1991). For example, age adjusted prevalence of diabetes for males in the lowest employment rank was over five times that of the highest employment rank. The prevalence of drug treated hypertension in the lowest employment rank was approximately two and a half times that of the highest employment rank. In women the relationship between occupational class and morbidity was less apparent.

Other British studies utilizing different occupational measures than those used in the Whitehall studies did uncover inverse gradients of ill-health among women (Bartley et al., 1999). Although patterns of ill-health between men and women may be very similar overall, there may be differences in more specific predictors of health outcomes, such as job security, between the two genders (Matthews, Manor and Power, 1999).

One aspect of the Whitehall II study explored the relationship between socioeconomic status and health functioning. Over 8000 working aged men and women were administered the SF-36, an internationally validated instrument designed to measure health status. Significant differences between occupational groups were found on all scales of the SF-36 for men, and for the physical functioning, pain and social functioning scales for women; in all cases low socioeconomic status was related to poorer health status. Again, this was a methodologically rigorous study, controlling for variables such as access to health care, age and sex (Hemingway et al., 1997). Other measures of self-reported health status showed that the number of health problems in the previous year as well as self-rated health followed the same pattern (Marmot et al., 1991). A comparison of the British Whitehall data with data from two large American samples that were methodologically similar to the former revealed similar social gradients in all three studies (Marmot, Ryff, Bumpass et al., 1997).

Data from the Whitehall II study were also used to evaluate the relationship between socio-economic status and cancer prevalence (Davey Smith et al., 1991), as well as long and short term sickness absences due to psychiatric disorders (Stansfeld, et al., 1995). Both displayed the usual pattern of higher disease rates in the lower socioeconomic strata.

Closer to home, a multivariate analysis of the Canada Health Survey revealed significant associations between health status (disability days, reported health problems, mental health status, psychological well-being, skinfold test, oxygen consumption) and socioeconomic status, especially when measured in terms of income. Oddly, fitness levels did not conform to this pattern; higher socioeconomic status was related to lower overall levels of fitness (Hay, 1988). The British Health and Lifestyle Survey data produced similar monotonic gradients in socioeconomic status and health status, including disease prevalence, psychosocial health and subjective health *and* physical fitness (Blaxter, 1987).

Canadian data from a five percent sample of residents of Manitoba revealed that morbidity, measured by treatment prevalence, increased monotonically as socioeconomic status decreased. The odds of having experienced three or more disorders decreased with both increasing income and education in this study. However, socioeconomic status was not related to treatment prevalence for most of the diagnostic groupings tested. When it was, however, treatment prevalence was higher in individuals in the lower socioeconomic strata, as expected. It is also important to note that these relationships emerged most frequently in adults between 30 and 64 years of age rather than for the very young or older segments of the population (Mustard et al., 1997). When data from the same Canadian province were analysed according to regional socioeconomic scores, represented by a summary socioeconomic risk index, significant differences in health status emerged (Frohlich and Mustard, 1996; Mustard and Frohlich, 1995).

At the regional level, the socioeconomic risk index was able to explain *at least* 87 percent of the variance in the health status index. In turn, the regions with the worst health outcomes displayed the highest rates of utilization.

Studies have also documented socioeconomic variation or income differences in the prevalence of specific conditions, such as psychiatric disorders (Meeks and Murrell, 1997; Muntaner et al., 1998; Stansfeld and Marmot, 1992; Stansfeld et al., 1995; Timms, 1988), ischemic stroke (Chambless et al., 1996; Wolinsky et al., 1998), heart disease (Morrison et al., 1997; Otten and Bosma, 1997), diabetes (Gulliford et al., 1997; James et al., 1997), hypertension in men (Bunker et al., 1996), obesity and metabolic syndrome (Brunner et al., 1997) and cataracts (Meddings et al., 1998). Other more generally defined chronic health problems (Weinreb, Goldberg and Perloff, 1998), asthma (Erzen et al., 1997), AIDS (Diaz et al., 1994) and back pain (Hemingway et al., 1997b) have also been shown to be inversely related to socioeconomic status.

On a more general level, activity limiting long standing illnesses were more common among those with a basic education compared to those with a higher education, in Finland, Norway and Sweden; for men the ratio between lowest and highest educational levels was 2.2 in Finland, 2.7 in Norway, and 2.4 in Sweden. The ratios for women are somewhat lower, but are starting to resemble those demonstrated for men, according to the most recently available data (Lahelma et al., 1994; Lahelma, Rahkonen and Huuhka 1997). Similar results for limiting long standing illness, as well as self-assessed health and other health outcomes are indicated from recent British (Arber, 1997; Ecob and Davey Smith, 1999; Marmot et al., 1991) and Norwegian (Dahl, 1994) data. In the same vein, life expectancy with ill health, a comprehensive measure incorporating both morbidity and mortality, has been shown to be inversely related to education in Finland and Norway, while health expectancy was found to be directly related to education (Sihvonen et al., 1998; Valkonen, Sihvonen and Lahelma, 1997).

In addition to documenting the relationship between socioeconomic status and the incidence or prevalence of disease, the literature also reports that the progression of disease may also vary by social position. One carefully designed nested case-control study of HIV patients, compared non-progressors (those who had been HIV positive for 5 years, but with limited progression of disease) with progressors (those who had developed AIDS or Kaposi's sarcoma within 6 years of seroconversion, or within 5 years of enrolment in the study if already seropositive). The results show that non-progressors were significantly more likely to have higher incomes, be better educated, be employed in management and professional positions, and be assigned a higher occupationally based socioeconomic index. The analysis included controls for certain clinical indicators, such as baseline CD4 count and symptoms. All participants in the study received a standardized pattern of care in a Canadian health care system that provides access to health care without direct cost (Schechter et al., 1994).

The probability of surviving various types of cancers (breast, cervix, and rectum) has been shown to increase with higher occupational status and housing tenure. Morbidity associated with other cancers, such as those of the lung or stomach, were not related to socioeconomic status, probably due to the poor prognosis associated with them (Gordon et al., 1992; Karjalainen and Pukkala, 1990; Kogevinas, et al., 1991; Vagero and Persson, 1987). The socioeconomic gradient in cancer survival could be due to earlier detection of cancers in higher socioeconomic groups, differential treatment by social class or differences in the host response combined with the biological properties of the tumours themselves, although none of these factors alone could explain the systematic variations in survival by social position. The decreased rates of survival in the lower social strata following myocardial infarction may be most affected by events preceding, and in reaching, hospitalization (Morrison et al., 1997).

Recovery is also hypothesized to be influenced by socioeconomic status. Individuals of higher social position are significantly more likely to have improved functional status following myocardial infarction than individuals of lower social status. This effect was observed independently of other clinical, demographic or psychosocial factors that were also considered in the analysis (Ickovics, Viscoli and Horwitz, 1997).

Functional status represents another facet of health that has been shown to exhibit this inverse socioeconomic gradient. (Maddox and Clark, 1992; Smith and Kington, 1997; Kington and Smith, 1997). The relationship between lower income and worsened functional status associated with chronic disease, but not the prevalence of chronic disease *per se*, has also been documented. However, this relationship was strongest in the lowest income groups, with relatively little variation between the most affluent income quintiles (Kington and Smith, 1997).

Morbidity in newborns has also been shown to vary by socioeconomic status. Mustard and Roos (1994) uncovered an inverse gradient between mothers' income level and birthweight in a study using administrative data and area-based measures of socioeconomic status. The difference in birthweight between the lowest and highest quintiles was, on average, 140 grams. This difference was largely attributed to complications, smoking, marital status, as well as lower levels of prenatal care. A similar finding was reported in the United States. Using data and a variety of socioeconomic measures derived from a national survey, low birth weight, but not preterm delivery or incidence of births which were small in relation to gestational age, was associated with low social position among black and white mothers (Parker, Schoendorg and Kiely, 1994). Thus similar relationships between socioeconomic status and birth outcomes have been documented across health care systems, and despite a variety of research methods used.

Socioeconomic differences have been demonstrated to manifest in early childhood and in the perinatal period. Recent data from an outstanding database, the 1987 Finnish birth cohort, mimic the patterns of poor health, intellectual disabilities and hospitalizations that have repeatedly been demonstrated for adults; i.e. lower socioeconomic status translates into poorer health status after adjusting for confounders (Gissler et al., 1998). Children living in poverty areas were reported to be nine times, on average, more likely to be admitted to hospital in Glasgow than those in more affluent neighbourhoods (Maclure and Stewart, 1984).

Injury- and accident-based morbidity exhibits an income gradient as well. As described by Dougherty, Pless and Wilkins (1990), a significant income gradient was evidenced in traffic injuries to children aged up to 14 years of age in Montreal, where the injury rate to children in the poorest areas surpassed that of children residing in the most affluent neighbourhood by a magnitude of four. A study of medically attended injuries to adolescents in Scotland did not provide any evidence of a socioeconomic gradient, but did note socioeconomic differences in the circumstances in which injuries occurred and the type and extent of risk factors exhibited (Williams, et al., 1996).

Socioeconomic Gradients in Health: Possible Explanations

The mechanisms underlying socioeconomic differences in mortality and health status are not clearly understood. It has been suggested that the internationally documented socioeconomic gradients in mortality, for example, might be explained by biologic, behavioural or psychosocial pathways (Lynch, et al., 1996). These complementary, rather than competing, explanations have been explored in the literature in some detail. In the following section, potential explanations that may underlie socioeconomic disparities in mortality and morbidity are discussed. These include the involvement of behavioural risk factors, psychosocial variables, social cohesion theory and lifecourse explanations.

Behavioural determinants of socioeconomic inequalities in mortality and morbidity

Although the early Whitehall studies showed that individual risk behaviours played some part in socioeconomic differentials in mortality between occupational grades in the British Civil Service, the role of individual behaviours on the relationship between health and social position continues to be debated. In the Whitehall studies, there was a clear association between smoking, for example, and occupational class (Marmot, Shipley and Rose, 1984). The role of smoking in higher rates of mortality from lung cancer or other respiratory diseases, for example, is not disputed. But the socioeconomic gradient remains regardless of smoking status, and persists across non-smoking related diseases. Individual risk behaviours may vary with socioeconomic status, and this may be reflected in social inequalities in mortality rates (Brännstrom et al., 1993; Connolly and Kesson, 1996; Droomers et al., 1998; Holme, et al., 1977; Marmot, Shipley and Rose, 1984; Wickrama et al., 1997; Winkleby et al., 1992). Certainly, differences in risk factors and individual behaviours have been able to explain differences in cardiovascular mortality (e.g. Pekkanen et al., 1992), or disability-free years (e.g. Vita et al., 1998) when socioeconomic status is *not* taken into account.

However, poorer health outcomes in lower socioeconomic groups would persist regardless of individual risk behaviours. The effect of smoking, alcohol consumption, sedentary lifestyle and relative body weight on mortality from all causes was investigated utilizing the Americans' Changing Lives survey, and the National Death Index (Lantz et al., 1998). Indeed, smoking, body mass index and physical activity all varied by both education and income, and in the expected direction. The effects of these behaviours did attenuate the inverse gradient of mortality by income group, but did not significantly reduce it when controlling for base-line health status. Similarly, another study in which the focus was *not* on the contribution of socioeconomic factors to disease, still found that lower incomes were significant in explaining variation in mortality from cardiovascular disease in men and women 65 years of age and older (Fried et al., 1998). Controlling for many factors, including age, education, income, sex, weight, lifestyle factors, blood pressure factors, serum lipid levels, diabetes and serum measures, disease, physiologic measures and consequences of disease, income still emerged as a significant and substantial explanatory factor. Although physical activity and smoking were significant predictors of mortality, the effect of income could not be "explained away" by these variables.

Individual physiologic risk factors, such as hypertension, on the other hand, may be related to, but not exclusively determined by, individual behaviours. Data from three American studies confirmed the socioeconomic gradient, measured by educational attainment, with respect to blood pressure, smoking, weight, and ECG abnormalities, but not serum cholesterol. An inverse gradient for mortality from coronary heart disease was evidenced, even with controlling for these life-style related risk factors, thereby indicating that risk factors explain only part of this equation (Liu et al., 1982). This does not imply that the notion that health behaviours are partially responsible for ill health has been abandoned. Conversely, they still constitute one focus in the redressing of social inequities in health. The gap in knowledge about health behaviours in relation to cardiovascular risk factors between poorly and highly educated individuals has prompted some observers to urge policy makers to target cardiovascular educational programs among those in the lower socioeconomic strata (e.g. Davis, Winkleby and Farquhar, 1995).

Whereas some health behaviours that vary with socioeconomic status might exacerbate or cause certain pathological conditions, other behaviours may ameliorate the effects of pre-existing conditions. Katz (1998) argues that the associations between morbidity and socioeconomic status might, in part, be explained by the application of self-care activities. Katz's data show that level of education was positively associated with the performance of self-care activities such as using a heated pool or special diet. However, the magnitude of the *effect* of these behaviours on morbidity or functional impairment was not considered in this study; therefore it is not possible to determine to what extent socioeconomic differences in health would diminish if physician- or self-induced self-care behaviours were held constant between educational groups.

Psychosocial explanations

In terms of sheer volume, explorations of the psychosocial pathways leading to ill-health and shorter life spans dominate the current literature. The interactions between socioeconomic and psychosocial status have been postulated as one of the mechanisms underlying the manifestations of social stratification in differential health outcomes.

Excess cardiovascular mortality among those in lower social positions reported in the Whitehall studies could not be entirely explained by physiological or behavioural coronary risk factors; in fact most of the variation remained unexplained. Psychosocial factors related to job strain were postulated as one area in need of further exploration (e.g. Marmot and Theorell, 1988; Rose and Marmot, 1981). Since then, a major focus of the Whitehall II studies has been on the psychosocial aspects of work, which have been shown to systematically vary between occupational grades. Lower status jobs were associated with less frequent social contacts, fewer hobbies, lower degrees of support, financial difficulties, the reporting of more negative reactions from their friends and associates, and the occurrence of at least two stressful life events in the previous year. These differences were postulated to underlie mortality differences between occupational grades (Marmot et al., 1991).

Work characteristics, then, may constitute one key to understanding social inequities in cardiovascular health. The job strain model, which considers both high demands and low control in occupational groups, developed by Karasek and Theorell (1990), formed the theoretical underpinnings of studies examining job characteristics and health outcomes. The Whitehall study demonstrated that individuals in positions characterized by low job control had increased odds ratios for both newly reported and subsequent coronary events that outweighed the effects of employment grade or coronary risk factors (Bosma et al., 1997; Marmot, Bosma, Hemingway et al., 1997). Other authors have reported similar results (Everson et al., 1997; Hallqvist et al., 1998; Theorell et al., 1998). Coronary morbidity may be induced through heightened blood pressure responses related to lower socioeconomic status or high workplace demands (Everson et al., 1997; Lynch and Everson et al., 1998). A more recent phase of the Whitehall II study assessed the applicability of a second job stress model, the effort-reward model, and found that increased personal efforts in the presence of reduced rewards resulted in new coronary heart disease that was over twice that in individuals in whom the opposite was true (Bosma et al., 1998). It should be noted, however, that new evidence suggests occupational scales other than the Registrar General's Social Classification[3] used in the Whitehall studies may not produce any association

[3] It has been argued that the British Registrar General's Social Classification scheme lacks a clear theoretical basis, despite the strong linear gradients that it produces with respect to mortality (Chandola, 1998).

between job stresses and mortality (Chandola, 1998)[4].

Unemployment rates were shown to be related to increased death rates in unemployed men in Denmark (Iversen, et al., 1987). While the unemployed suffered mortality rates higher than the employed individuals from all causes, but especially accidents and suicides, this effect was stronger in areas where the employment rate was relatively low. Similarly, the anticipatory anxiety related to uncertainty in the work force and potential unemployment has also been identified as a source of psychosocial stress that effects health outcomes (Ferrie et al., 1995; Ferrie et al., 1998; Knutsson and Goine, 1998). Although the directionality of this relationship may be debated, there seems to be limited support for the hypothesis that excess mortality related to employment is the result of job loss due to ill-health. Ill health seems to stem from unemployment rather than *vice versa* (Moser, Fox and Jones, 1984).

In general, the link between social relationships on the one hand, and health on the other, has been long established (e.g. House, 1988). Studies exploring the relationship between social relationships, socioeconomic status and health elucidate this issue. One Canadian study demonstrated the interaction between income levels and social relationships, measured by marital status, children, family contact and participation in voluntary organizations. High income, together with high social relationship scores and the absence of smoking, contributed to an 18-fold reduction in mortality over twenty years (Hirdies and Forbes, 1992). Self-efficacy has also been shown to vary with socioeconomic status; moreover, it may partially explain the relationship between health status and socioeconomic status (Grembowski et al., 1993).

Self-efficacy may be affected by a number of factors, including the stresses caused by sustained economic hardship. This aspect of psychosocial stress would not have been captured by studies such as Whitehall, in which all subjects were employed in fairly stable and relatively well-paying

---

[4] It should also be noted that variables representing job demands or decision latitude were not presented by Chandola, although health behaviours were included in the analysis.

positions. Long episodes of economic hardships, measured over a period of almost twenty years, have been associated with decreased physical, psychological as well as cognitive functioning (Lynch, Kaplan and Shema, 1997).

Recent research on the east-west health divide has provided considerable insight into the possible role that psychosocial factors play in health and mortality. Differences in health status between western Europe and most of the former Warsaw Pact countries, as well as marked changes in life expectancy and mortality rates in the latter in recent years, demonstrate how profound changes in the social, economic and political fabric of a nation manifest in terms of psychosocial factors and ultimately, health (Bobak and Marmot, 1996). The rapidity with which these changes occurred is striking (but is matched by the mushrooming of the literature on this topic since). Between 1989 and 1994, marked decreases in life expectancy were witnessed in these countries. Cockeram (1997) cites a decrease in life expectancy of approximately six years for men in five years, but in Moscow life expectancy dropped by almost 8 years between 1990 and 1994 (Leon and Schkolnikov, 1998). Cardiovascular disease and injuries accounted for approximately two thirds of the decrease in life expectancy (Notzon et al., 1998). Mean birthweights in the Czech Republic decreased for all levels of mother's education, especially the less educated women, up to 1991, then started to increase slightly (Koupilova et al., 1998). The circumstances in these nations provide a natural laboratory of sorts in which to assess the health effects of major economic, social and political changes which occurred over a remarkably short time frame.

Psychosocial and lifestyle factors have been cited as potential drivers of these downward trends in health outcomes. Social stress is clearly targeted as a primary determinant of the marked increases in mortality over a relatively short time frame (Kaasik, Andersson and Horte, 1998; Kristenson, Orth-Gomer and Kuchinskiene, 1996; Leon and Shkolnikov, 1998). This is not inconsistent with the literature on health and socioeconomic status in general. Social stress may either be experienced differently according to one's social position, or may be encountered to different degrees depending on one's social position (Adler et al., 1994). The health effects of stressful life events may leave their imprint many years after they occur (Rosengren et al., 1993).

An individual's sense of life control has been identified as a significant contributor to these extraordinary mortality shifts in Eastern Europe, where life control and economic satisfaction have been shown to be considerably lower than in the west (Bobak et al., 1998; Bosma and Appels, 1996; Carlson, 1998; Watson 1996). Similarly, demoralization may reflect another facet of this phenomenon (Wilkinson, 1996).

Some observers have linked the changes in Eastern Europe to lifestyle factors, which may have been affected by the additional stresses that the vast changes have generated (Cockerham, 1997; Pajak, 1996). However, it is questionable whether they have changed sufficiently, in a short period of time, to affect life expectancy and morbidity (Bobak, 1996).

The effects of stress have been posited to manifest through one of various biophysiological processes, perhaps through the immune or endocrine systems[5]. These may be the same types of biological pathways evidenced in human cardiovascular response which act as precursors to carotid atherosclerosis. Workplace demands were strongly associated with stress-induced cardiovascular reactivity, especially in those men in whom there was already evidence of atherosclerotic plaque. The etiology of cardiovascular disease in humans is therefore informed by studying exposure to stressful environments in conjunction with biophysiological responses (Everson et al., 1997; Lynch, Everson, Kaplan et al., 1998). As previously noted, these are stresses that have been shown to vary systematically by social position.

The social cohesion and social capital theories

Psychosocial factors that are rooted in community, rather than individuals, which are referred to

---

[5] Animal models provide much of the evidence in this area, and demonstrate how social stressors may manifest as physiological reactivity (Evans, Hodge and Pless, 1994; Manuck et al., 1988; Sapolsky, 1993; Suomi, 1994; 1996).

as social cohesion or social capital, have recently received increasing attention in the literature. Even so, this is an area that has been underemphasized. It has been claimed that individual psychosocial factors have been emphasized at the expense of an enhanced understanding of the social functioning of entire communities, possibly because of the perceived political neutrality associated with an individually-centred analysis as well as the dominant paradigms that stress the individual over the collective (Lomas, 1998).

Social cohesion has been shown to be a protective factor in health and mortality. When measured in terms of the social quality of communities, it has been positively associated with perceived health status for women (Molinari, Ahern and Hendryx, 1998). A lack of social cohesion, as reflected in racial segregation, for example, may be related to mortality independently of the socioeconomic characteristics of the area (Fang et al, 1998).

Social cohesion may be associated with income inequality. Wilkinson (1997a; 1997b) postulates that income inequality reduces contact between social groups and increases social divisions that supersede the positive effects of individual social networks. Kawachi and colleagues (1997) provided the first solid evidence of the relationship between income inequality and social cohesion *within* the United States. A comparison of social capital in 39 states, measured by per capita membership in voluntary groups and level of trust according to the questions included in the primary data source, the General Social Survey, revealed that infant mortality and total mortality from all causes as well as coronary heart disease and neoplasm, were strongly correlated with both social cohesion and income inequality. Other American data also lend credence to this thesis (Kennedy, Kawachi and Prothrow-Stith, 1996; Lynch, Kaplan, Pamuk et al., 1998), and indicate that the greatest effect of income inequality appeared to manifest in the non-elderly adult population, rather than more vulnerable children or the elderly (Kaplan et al., 1996).

The relationship between income inequality and various aspects of *quality* of health has been explored. In a comparison of areas in the United States, strong correlations between income inequality and homicide, violent crime, per capita health care expenditures and low birth weights were reported (Kaplan et al., 1996).

Income inequality may stem from an underinvestment in social capital, either through insufficient resources in education or medical care (Davey Smith, 1996), although high levels investment in social capital alone cannot guarantee low levels of income inequality. Areas in the United States with the highest indices of income inequality also had the highest unemployment, incarceration and social assistance rates, lower rates of medical insurance, the lowest proportional spending on education and poorest educational outcomes (Kaplan et al., 1996). In other words, greater income inequality may pose not only psychosocial stressors on individuals in the lower socioeconomic strata, but to those individuals in the higher income strata as well. This research from the United States provides important data, because unlike international studies, is not prone to the confounding effects of inter-country variations.

The literature on income inequality and the relative deprivation thesis is more abundant. Wilkinson's (1992) seminal paper on differences in income distribution between various countries and its effect on life expectancy demonstrated that a greater degree of income inequality, rather than absolute levels of relative social and economic position, may exert the more influential effect on mortality. In this study, Sweden and Norway, which had the lowest concentration of income of the countries considered, also exhibited the highest life expectancy. This is in stark contrast to the United States and West Germany, in which the situation was reversed. This effect was constant over time and produced significant associations, providing strong evidence of the relationship between income inequality and life expectancy.

The effects of income inequality on mortality have been supported in other international comparisons (Ben-Shlomo et al., 1996; Davey Smith and Matthias, 1996; Kunst et al., 1998; Rodgers, 1979). However, Judge and colleagues (1998a; 1998b) recently maintained that the methodological problems inherent in the currently published studies in this area render their results questionable, and are cautious about attributing the health and life expectancy of an entire nation solely to income inequality in light of other social, economic and cultural factors.

Lifecourse

Socioeconomic variations in health, health behaviours, psychosocial characteristics, life expectancy, as well as mortality, may have as much, or more, to do with childhood socioeconomic status than current social position (Dahl and Birkelund, 1997; Forsdahl, 1977; Gliksman et al., 1995; Hertmzan and Wiens, 1996; Lundberg, 1993; Lundberg, 1997;Lynch, Kaplan and Salonen, 1997; Rahkonen, Lahelma and Huuhka, 1997; Wadsworth, 1997), and may be mediated by adult socioeconomic position[6], although the reported strength of this association varies. The effects of childhood socioeconomic conditions may still manifest later, in fact, into old age as evidenced by a study of survival to 85 years of age (Preston, Hill and Drevenstedt, 1998). The results of the Kuopio Study suggest that this may partially be due to the health behaviours and psychosocial characteristics that are imprinted or learned in early life, and carry over into adulthood and old age (Lynch, Kaplan and Salonen, 1997). Overall, other data from a prospective study with 21 years follow-up of adult males suggest that the cumulative effects of socioeconomic status over the life course, rather than social mobility, are important determinants of life expectancy, and the relative importance of social position at each stage of life may vary by cause of death (Davey Smith, Hart, Blane et al., 1997; Hart, Davey Smith and Blane, 1998a; Power, Matthews and Orly, 1996). It has been hypothesized that economic hardship, as well as other conditions, present in childhood, affect both adult social status and a sense of coherence later in life, both of which affect health and illness in adulthood (Lundberg, 1997).

---

[6] Interestingly, in adolescence and early adulthood, socioeconomic differences at origin in health outcomes tend to disappear, but potentially reemerge later in early adulthood (Arber, Rahkonen and Lahelma, 1995; Macintyre and West, 1991; Power et al., 1997;West, 1997). However, socioeconomic gradients in health risk behaviours may persist in adolescence, albeit in a diminished manner (Östberg and Vågerö, 1991; Tuinstra et al., 1998; Vågerö and Östberg, 1989). There is evidence that throughout childhood, inverse social gradients of physical and intellectual health according to parent's socioeconomic position are quite pronounced (Gissler et al., 1998).

These results lend further credence to the hypothesis that it is not social mobility that is most important. Changes in social position in adulthood may not override the effects of social class at origin in determining health inequalities (Power, Matthews and Orly, 1996). The evidence suggests that in later life, as well as in middle age, social mobility has little effect on mortality; rather, lifetime socioeconomic characteristics may outweigh short-term fluctuations in social status (Faresjöm, Svärdsudd and Tibblin, 1994; Fox, Goldblatt and Jones, 1985; Hart, Davey Smith and Blane, 1998b).

What is not clear, is whether a "latency model", which presupposes that certain events occurring in childhood have an independent effect upon health outcomes later in life, or the pathways model, which considers that factors operating at many stages in the cycle produce a cumulative effect on lifetime health, is the correct interpretation of the scientific results produced to date (Hertzman, 1994; Hertzman and Wiens, 1996;Wadsworth, 1997). Yet the contribution of socioeconomic conditions throughout the lifecourse is recognized as an important determinant of health outcomes.

Socioeconomic Status and Health Care Utilization

The postulate that medical care in itself has *not* been the most important source of improved longevity has been investigated, and supported, by several authors, including McKeown (1976), who credits general improvements in the quality of life in the general population, rather than health care, for reductions in mortality in the twentieth century (McKeown, 1978). McKinlay and McKinlay (1977) reproduced a similar analysis in the United States, which demonstrated that significant increases in health care were introduced at a time when mortality rates had already dropped relatively close to current levels. This position has been argued by other authors who assert that the contribution of medical care was not negligible (Mackenbach, 1993), or who attribute the public health movement with increases in longevity (Szreter, 1988). In any event, the assumption that medical care has been the *most* influential determinant of improvements in health cannot be accepted. Furthermore, the magnitude of continued spending on health care in developed countries in more recent years has not been shown to be related to health outcomes (Babazono and Hillman, 1994). New schools of thought, supported by scientific evidence, point out that there are other overriding factors, such as socioeconomic status, the environment and genetics, all extricably linked, that may be more important to the health of populations than health care (Evans and Stoddart, 1990).

One recent review of social factors and access to care as determinants of health concludes that social position has unequivocally been shown to exert greater influence on health and ill-health than health care (Pincus, Ester and Dewalt et al., 1998). There is no question about the life-saving capabilities of medical technology; however, the literature does suggest that socioeconomic factors may play an even more important role.

But the differences in the *use of health care services by socioeconomic status* are of interest; they reflect not only underlying morbidity but also intangible barriers, or alternately, enhanced access, associated with social position. Relatively consistent relationships between health services utilization and socioeconomic status have been uncovered in the literature. The study of socioeconomic differences in the use of hospital services, at least, is not a new addition to the scientific literature, as a not very recent review of the literature in this area indicates (Barer et al., 1982). Very early on, and prior to the articulation of the population health framework that is the basis of many of these studies, Barer and his colleagues demonstrated that those in poorer income groups utilize more hospital days, although were not necessarily hospitalized more frequently than those in the more affluent groups in Ontario during the 1970's.

More recently, hospital use, measured in terms of the number of individuals hospitalized, total discharges, or days in hospital, was found to be strongly and significantly associated with relative neighbourhood affluence (Roos and Mustard, 1997). The number of hospital days attributed to the least affluent individuals in Winnipeg was almost two times that of the most affluent (Brownell and Roos, 1995; Roos and Mustard, 1997). Hospital admission rates between the lowest and most affluent income quintiles were statistically significantly dissimilar for all types of admissions (i.e. ambulatory sensitive, avoidable or amenable, for chronic diseases or injuries). When specific diagnoses were considered, a statistically significant difference was noted only for pneumonia, although marked differences between the most and least affluent were documented for other diagnoses such as hypertension, diabetes, vascular complications and lung cancer. Perhaps not surprisingly, the greatest income inequalities were found for those diagnoses which were classified as "high-variation medical" conditions[7], which may entail a high degree of potential physician discretion in terms of treatment options. On the other hand, few statistically significant variations by income group were uncovered for surgical procedures, with the exception of coronary artery bypass surgery and tympanostomy (Roos and Mustard, 1997). Higher hospital use for residents of poorer areas in Ontario has also been documented (Anderson, 1997).

Potentially avoidable hospitalizations, or those hospital admissions which could have been avoided if alternate, ambulatory care had been provided, have been shown to be higher for privately insured persons residing in low income areas, compared to those living in high-income neighbourhoods in the United States, but were only significant for those under the age of 65 (Pappas et al., 1997). Income-related differences seem to exist irrespective of access to care, broadly reflected in the general characteristics of the health care, but are markedly narrower in the Canadian, as opposed to the American, setting (Billings, Anderson and Newman, 1996). This is at least partially due to the absence of the principle of universality in the American health care system, which may undermine equal access to care (Bindman et al., 1995). In the elderly, potentially avoidable hospitalization has been shown to be related to insurance status and education (Culler, Parchman and Przybylski, 1998). In fact, socioeconomic differentials in the case fatality rates from myocardial infarction have also been hypothesized to be due, at least partially, to treatment prior to the acute event and delays in admission, rather than unequal

[7] This term refers to a classification developed by Wennberg and colleagues (Wennberg et al., 1987; Wennberg et al., 1989), and is used to denote those diagnoses that are associated with a greater degree of medical uncertainty regarding treatment options and consequently, a greater degree of geographic variation in admissions.

treatment after the event. These differences in treatment might result in a more favourable case mix among the higher socioeconomic strata, and greater acuity in the lower socioeconomic strata with higher mortality rates (Morrison et al., 1997).

In Canada, a marked social patterning of physician utilization has been documented in Nova Scotia (Kephart, Salazar Thomas and MacLean, 1998) and Manitoba (Roos and Mustard, 1997). The association between increased use and decreasing socioeconomic status appears to hold true for the utilization of general practitioners' services, rather than for specialist services, and has been noted in several countries (Bongers et al., 1997; Roos and Mustard, 1997; van der Meer, van den Bos and Mackenbach, 1996).

The utilization of physician services by children living in the United States has also been shown to with the socioeconomic status of their parents. Characteristics including family income and mother's educational attainment were found to be good predictors of low utilization, but the relationships between socioeconomic status and high utilization of physician services were less clear. Health characteristics as well as maternal utilization patterns were closely related to utilization in both high and low users (Newacheck, 1992).

Attention to socioeconomic differences in the use of various medical and surgical *procedures* is evident in the literature. An inverse social gradient has been documented for hysterectomies (Kuh and Stirling, 1995; Marks and Shinberg, 1997), as well as the risk of repeat cesarean delivery (King and Lahiri, 1994). One studied documented that higher socioeconomic status was related to the type of procedures used for end-stage renal disease starting hemodialysis. Higher socioeconomic status access (based on area incomes, Medicare coverage and education) was related to the use of grafting procedures, while lower socioeconomic status was related to procedures involving fistula for vascular access. Furthermore, morbidity, but not comorbidity, increased as socioeconomic status decreased (Hirth et al., 1996). Transplantation is yet another domain in which socioeconomic inequities have been recorded. Ozminkowski and colleagues

(1998) demonstrated that high income patients were 2.6 times more likely to receive a transplant than middle income patients. In both Canada and the United States, rates of coronary artery bypass surgery for non-elderly population were highest in the lowest income quintiles, whereas for the elderly population, this trend was reversed (Anderson, et al., 1993). However, the authors do not state whether the data were adjusted by age and sex.

More recent data demonstrate that increasing area income is associated with increases in rates of coronary angiography among patients admitted to Ontario hospitals over a three-year period, while waiting times for this procedure decreased with increasing socioeconomic status (Alter et al. 1999). One-year mortality following admission decreased by approximately 10 per cent with each $10,000 increase in area income. Income emerged as a significant predictor of angiography within six months when adjusted for demographic characteristics, predicted 30-day mortality, physician speciality and facility characteristics. These results suggest that despite a universal health insurance program, a socioeconomic bias may exist in treatment decisions, waiting times, and longer-term mortality associated with individuals admitted to Ontario hospital for acute myocardial infarction. The authors do not suggest that access to angiography and longer-term outcomes are causally related, rather they posit that they represent two independent correlates of socioeconomic position.

Studies have indicated that hospital mortality may also be related to socioeconomic status. This was the case in a study of mortality in an intensive care unit. Despite the high level of intensity of medical care required for all the patients studied, an inverse gradient between social class, derived from the British Registrar General's Classification, and mortality was observed. This difference, however, was explained by a higher severity of illness found in the patients with lower occupational status, rather than to any differences in medical care, suggesting that a preselection process may have occurred prior to admission to hospital (Latour et al., 1991).

Socioeconomic differences in the use of preventive measures, including prenatal care have been examined in Manitoba. The authors conclude that although poorer women had a lower utilization of prenatal care, these differences accounted for less than 15 percent of the difference in the incidence of low birthweight relative to infants born to wealthier women. Socio-economic factors unrelated to prenatal care were cited more important to differences in birthweight, and thus the research does not support a relationship between better outcomes and increased access to care (Mustard and Roos, 1994). Other sources confirm that it is not simply prenatal health care that is at issue, especially for low income women, but other mediators including diet, health education and psychosocial factors (Homan and Korenbrot, 1998).

In the same vein, screening for breast and cervical cancer were more apt to be used by more highly educated and higher-income women, both in Canada and the United States despite the difference in the health insurance schemes in these two countries. The significantly higher propensity for cervical cancer to be diagnosed late in low income women further underscores the effects of financial and other direct or indirect barriers to preventive health care (Katz and Hofer, 1994). Yet in Denmark, significant social class differences related to surgical treatment for breast cancer were observed. Women in the highest social class were more likely to receive a lumpectomy rather than a mastectomy, despite no social class differences in the size of the tumour at diagnosis, which would rule out any discrepancies in early diagnosis, at least (Norredam et al., 1998).

There is little doubt that some of the observed patterns in the United States, which are clearly divergent from those documented in Canada or other countries with full or partial national health insurance, stem from socioeconomic differences in health insurance status. This must certainly be considered when interpreting the results of any U.S. study of socioeconomic disparities in the utilization of health care. It should come as no surprise that individuals with no health insurance in the U.S. would have lower hospital utilization rates (see, for example, Fleishman and Mor, 1993). This relationship may be further obfuscated by the myriad of health insurance options in the American context. For example, the inverse income gradient associated with invasive cardiovascular procedures (bypass graft surgery, angioplasty and angiography) was evidenced in both the Medicare population and those enrolled in Health Maintenance Organizations, but not among the uninsured or privately insured (Carlisle and Leake, 1998). Differences in utilization by insurance status have been documented in other countries with a very different type of private/public insurance mix (Bongers et al,. 1997).

Health care utilization is even more poorly understood when considering the complex triad involving health care utilization, socioeconomic characteristics and need. While it has been argued that hospitalization rates are solely determined by need, some recent data suggest that both need and socioeconomic position drive increased hospital utilization in the lower income or educational strata. A methodologically robust statistical analysis has shown that while need is demonstrably an important factor, household income also affects the incidence of hospital use (Newbold, Eyles and Birch, 1995). This is in contrast with previous data which suggested that need, rather than income, is the primary determinant of hospital utilization in Canada (Manga, Broyles and Angus, 1987), as well as more recent data on physician use in Canada which suggest that the use of medical care is reflective of health status. Katz, Hofer and Manning (1996) maintained that whereas in Ontario, utilization was as much as 33 percent higher among low income residents than their counterparts in the United States, the reverse was true for those with higher reported incomes. The latter analysis, however, did not use the two-stage multivariate analysis that characterizes the study designed by Newbold and colleagues. The results may also be affected by the differences in the measurement of health status in these studies. Whereas Newbold and his colleagues defined need in terms of self-assessed health status, Manga and his colleagues measured need by a number of variables, including number of accidents, disability days, number of current health problems, number of previous illnesses and drug use. Certainly, the differential effects between the use of subjective versus objective measures of health status, or the number of health measures used as control variables, have been documented (van den Meer, van den Bos and Mackenbach, 1996).

In the Netherlands and Finland, the relationship between hospital utilization and socioeconomic status became negligible when health status was controlled for (Keskimaki, Salinto and Aro, 1995; van den Meer, van den Bos and Mackenbach, 1996). The socioeconomic gradient in these countries has been reported to be less pronounced than in others (Bongers et al., 1997).

A lively debate has emerged over the role of socio-economic characteristics in geographic variation in use (e.g. McLaughlin et al., 1989)[8]. Socioeconomic status has been shown to be a significant determinant of area-based variations in hospital use (McLaughlin et al., 1989; McMahon et al., 1990), surgical procedures (Carlisle et al., 1995) as well as disability claim rates (Volinn et al., 1988). The absence of any significant effect of income on small-area variations has also been demonstrated (Roos and Roos, 1982; Wennberg, et al., 1987). At least one review found consistent associations between variations in preventable mortality and socioeconomic variables (Mackenbach et al., 1990). Work in Manitoba (Roos and Roos, 1982) examining the determinants of surgical use rates found that "needs" were less likely to explain geographic variations in surgical rates, which instead linked higher utilization to higher education and ethnic differences, but not income. Similarly, Roos et al. (1993) carried out a multivariate analysis of health status and found that 87 percent of all variation could be explained by differences in socio-economic status, rather than availability of hospital beds or services.

Excess use among the lower socioeconomic groups has been deemed not only to reflect need, but according to one study, may also represent excess use unrelated to medical need. One Italian study reported that although those in the lower socioeconomic groups did indeed, demonstrate greater need on the basis of a number of indicators, but that they also received more services per "illness episode" than their counterparts higher on the socioeconomic scale (Mapelli, 1993).

---

[8] The authors do point out that disagreement over the effect of socio-economic status between studies may be largely due to differences in statistical techniques and measurement.

Utilization of Medications by Socioeconomic Status

In contrast to the studies examining the links between social class and mortality and morbidity, and to a lesser extent, health services utilization, there has been relatively little interest in the investigation of systematic socioeconomic differences in the use of pharmaceuticals. The literature discussing the determinants of drug use tends to focus on morbidity, patient compliance, physician factors, as well as health care system factors (Canadian Coalition on Medication Use and the Elderly, Ch. II(A), 1990), rather than socioeconomic factors. This may be because drug use has historically been dealt with from an experimental point of view with a focus on treatment efficacy. Also, utilization studies may have concentrated on determinants of utilization of physician and hospital services rather than drug use due to more easily accessed databases. Since a strong dynamic between utilization and socioeconomic status has been captured in various aspects of health care utilization, it is reasonable to extend this investigation to an exploration of relationships between socioeconomic status and prescription drug use.

Some studies have shown that prescription drug use exhibits the same inverse relationship with socioeconomic status that has generally been demonstrated with respect to mortality or morbidity. In their recent analysis of population-based data from Manitoba, Metge and colleagues (1999) revealed that the use of pharmaceuticals, whether measured in terms of the number of prescriptions dispensed, the number of different drugs dispensed, the number of defined daily doses (DDD's) dispensed or expenditures, increased as area income decreased. A closer inspection of antidiabetic agents, antiinfectives and antidepressants indicated that the number of DDD's increased as area income decreased. The largest differences in the number of DDD's occurred with respect to antidiabetic agents. On average, 11 DDD's were dispensed to individuals in the highest income quintile, whereas 31 DDD's were dispensed to those in the lowest income quintile. Additionally, drug use was noted to be higher in areas where overall health status is poorer, as measured by premature mortality.

Other data from the Netherlands (van der Meer, van den Bos and Mackenbach, 1996), Scotland (Scott, Schieel and King, 1996) and Brazil (Miralles and Kimberlin, 1998) indicate that increased drug utilization is indeed closely associated with lower social position. Likewise, higher levels of education have been reported to be associated with lower use of prescription drugs (e.g. Benson, 1983; Fillenbaum, et al., 1993).

It has been suggested that higher utilization of prescription drugs by individuals with lower socioeconomic status may be due, in part, to different patterns of patient-provider communication and interaction that may also be contingent on one's socioeconomic status. Better communication between physicians and patients (Bain, 1977), information-seeking behaviour (Pendleton and Bochner, 1980; Boulton et al., 1986) and a higher propensity for testing over prescribing (Scott, Shiell and King, 1996), for example, have all been shown to be correlated with higher educational qualifications of individuals seeking health care.

However other evidence contradicts these results. One study of an American PACE (Pharmaceutical Assistance Contract for the Elderly) cohort revealed an income-related gradient of prescription drug costs; the average charge per claim *increased* with income. However, the average costs per month did not exhibit any clear pattern (Stuart et al., 1991). On average, PACE enrolees represent atypical American elderly; they are characterized by higher than average levels of morbidity and have lower average incomes compared to the overall mean. Over the counter drug use, which is usually not reimbursed by any insurance scheme has similarly been reported to increase with income (e.g. van der Meer, van den Boss and Mackenbach, 1996). Alternately, Woo et al. (1995) report no effect of occupational status or educational level on either prescription or nonprescription drug use by the elderly.

In the non-elderly, a greater number of prescriptions have been reported to be dispensed to women of higher socioeconomic status (defined by education and income), and may also be dependent on the number of comorbidities present, race and other factors (Rubin et al., 1993). The earlier literature in this field underscores the confusion about the directionality of the relationship between drug utilization and socioeconomic status (Rabin, 1972).

The reported associations between socioeconomic status and the use of specific types of drugs are no more illuminating than those reported for overall patterns of drug use. Much of the literature on drug use and the elderly focuses on psychoactive medications, which represents a sizeable portion of total drug use in this age group (Baum et al., 1984; Grymonpre et al., 1991; McIsaac et al., 1994; Olfson and Klerman, 1993; Pincus, Tanielian, Marcus et al., 1998; Wessling, 1987). Tranquillizer use, as well as use of hypnotics, sedatives and antidepressants is correlated with both residence in poverty areas as well as mortality and suicide in Sweden (Sundquist, Ekedahl and Johansson, 1996). Significant differences in the use of psychotropics by occupational status have been reported as well; in the total population the highest users were unemployed, and among men, blue-collar workers were reported to be higher users of psychotropics than farmers (Isacson and Haglund, 1988).

Conversely, benzodiazepine use in the community-dwelling elderly has been shown to increase with higher educational status in the United States (Mayer-Oakes et al., 1993), as has the use of other psychotropic medications (Cooperstock and Parnell, 1982; Fejer and Smart, 1973; Mayer-Oakes et al., 1993; Mellinger et al., 1984; Wells et al., 1985). The lack of any association between neuroleptic drug use and either educational status or diagnosis, when adjusted for sex, age, and diagnostic history, has also been reported (Muscettola, Bollini and Pampallona, 1991). Other evidence questioning any relationship between socioeconomic factors and psychoactive drug use exists as well (e.g. Brown, et al., 1995; Muscetolla et al., 1991; Reid et al., 1990),

As with the utilization of health care services, "need" may partially explain socioeconomic differences in drug utilization, although the available evidence is by no means conclusive. It has been suggested that educational differences in psychotropic drug use become insignificant when mental health status is also considered. When only socioeconomic variables were considered, tranquillizer use decreased with higher educational status, but increased with higher incomes (Wells et al., 1985). This is a puzzling observation, given the high correlation that is usually found between education and income. According the authors of this study, the observed differences in the direction of income and education may be due to the potential confounding between education and mental health status. Still, this study employs a rigorous methodology incorporating relatively sophisticated statistical techniques which enables the separation of the effects between correlated indicators of socioeconomic status, and socioeconomic status and health status, as well as their independent effects.

Analgesics represent another sizeable drug group. Jyhla (1994) demonstrated that for Finnish elderly over a ten-year period, an odds ratio of the likelihood of use of over the counter vitamin and analgesic use of 1.8 was reported for all individuals who listed non-white collar jobs as their previous occupation. Analgesic use by occupational grade was reportedly least common among white-collar women, and most common among white-collar men. Occupational status was rather loosely defined in this study only as "white-collar" or "other" past employment status, which may have affected the somewhat inconsistent results between various types of drugs in this analysis. On the other hand, the authors clearly state their study rationale, i.e. that drug use is as reflective of societal and cultural forces as it is of medical indicators. Other research exploring the relationship between socioeconomic status and analgesic use is inconsistent, at best (Eggen, 1993).

Given the evidence on the significant social variations that exist with respect to coronary heart disease presented earlier in this chapter, it is perhaps surprising that socioeconomic differences in cardiovascular medications have not been investigated more thoroughly. At least one study has examined the relationship between antihyperlipidemics and socioeconomic status. When socioeconomic position was measured as type of clinic attended (public cardiology clinics, with a greater proportion of Medicaid patients, versus private cardiology clinics, with fewer Medicaid patients), no discernible difference in prescribing was uncovered (Harnick et al., 1998). This study, however, considered the proportion of patients receiving medication as the main outcome measure, which, like the socioeconomic measures, is perhaps too imprecise to depict any possible true variations accurately.

As with the utilization of health services in general, the results of studies of medication use must be considered in light of national and individual health insurance status. Among elderly Medicare beneficiaries, higher incomes were associated with a greater propensity to consume prescription drugs, and a decreased probability of leaving medical problems unmedicated. These patterns, however, were largely the result of differences in insurance between individuals. Persons with supplemental private or public drug coverage were shown to be more likely to use prescription medicines than those without (Stuart and Grana, 1998). An earlier study by these authors demonstrated that in Pennsylvania, prescriptions drug use by the elderly increases (with concomitant decreases in over-the-counter drug use) with increasing levels of insurance coverage. Generally, increased drug coverage is associated with higher drug use (LaVange and Silverman, 1987; Moeller and Mathiowetz, 1989; Whynes, Baines and Tolley 1996) and the use of more expensive drugs (Mott and Kreling, 1998).

The effect of insurance coverage has also been demonstrated in Ontario. Grootendorst et al. (1997) did not uncover any statistically significant income effect on drug use by the elderly in Ontario, although health status did have a pronounced effect on drug utilization. However, among persons in the lower income groups, the consumption of prescription drugs did increase upon turning 65, and thus becoming eligible for coverage under the provincial prescription drug plan, an effect that was not evidenced among those in the higher socioeconomic brackets.

Persistence of use, after the initial prescription is dispensed, has been shown to have similar differences by insurance status. For example, elderly persons insured under Medicaid were shown to be 58% as likely to renew their antihyperlipidemic medications as their higher-income counterparts enrolled in a PACE program (Avorn et al., 1998). Non-compliance, by not filling prescriptions, did not vary by insurance category in one American study (Saunders, 1987), or by socioeconomic level in the UK (Beardon et al., 1993).

Similarly, user or dispensing charges present a barrier to acquiring prescription medications, especially to those with lower incomes and no insurance coverage. Variations in additional out-of pocket costs affect prescription drug use and may further obfuscate the relationships between socioeconomic status and prescription drug utilization (e.g. Jones and Purdie, 1993; Lundberg et al., 1998; Soumerai et al., 1987; Smith, 1993). The introduction of a drug benefit program for low-income families in Ontario resulted in large out-of-pocket savings for its beneficiaries. But even with this program, the proportion of total household expenditures spent on drugs by low income families continued to exceed those of high-income families (Lexchin, 1996). This suggests that the differential effect of out-of-pocket costs between high or low income households must be considered when evaluating the relationship between socioeconomic status and medication use.

In summary, the evidence concerning the relationship between socioeconomic status and drug use is inconclusive. This is partly due to the confusing nature of intervening variables such as differences in insurance coverage between jurisdictions, socioeconomic status and age groups. Moreover, this review points to the paucity of serious research endeavours that seek to uncover systematic differences in drug use according to socioeconomic status.

Conclusions

The evidence outlined in this chapter clearly demonstrates that health, death and illness are determined, to a large extent, by socioeconomic factors. A veritable mountain of evidence has accumulated over the past two decades that attests to the inverse relationship between socioeconomic status and mortality, morbidity and to a lesser extent, health care utilization. Still, the mechanisms underlying the relationship between socio-economic status and health are not fully understood. While various behavioural, psychosocial or social pathways have been identified to date, we still do not know why "poorer people are more likely to possess the constellation of biologic risk factors, behaviour, and psychosocial characteristics that increase their risk of mortality" (Lynch, et al., 1996, p. 941).

Any relationship between socioeconomic status and the utilization of prescription drugs is even less evident. In the remainder of this dissertation, measurement considerations, the design, results and implications of a study devised to contribute to our understanding of the relationship are reported.

Chapter Three

Measuring Socioeconomic Status:

The Special Case of the Elderly

In Chapter Two the vast literature describing the relationships between social position and mortality, morbidity and various aspects of health care utilization was presented. This diverse body of knowledge delivers a clear message: social position is related to health. Broadly speaking, in most cases this is irrespective of how social position is conceptualized or measured. The direction of the relationship between social position and health and mortality may not be greatly affected by the choice of measure of social position or socioeconomic status. However, the strength of this relationship may vary by the socioeconomic measure used, as well as the population, diagnostic group or outcome measure. Studies use a broad range of indicators, including income, education or occupation. These may be measured at different stages of the life cycle, such as either adult socioeconomic status or parental socioeconomic status at birth. In adult populations, either one's own current socioeconomic position may be measured, or that associated with a parent, spouse or household. The array of socioeconomic indicators becomes even more daunting when one considers that either absolute measures or relative measures of socioeconomic status, such as quintiles, or measures of inequality may be used. Measures of socioeconomic status may be used either singly or as composite indexes comprised of several individual indicators of socioeconomic status. One study even used the variable "perceived social class", obtained by asking respondents directly (Freeborn, et al., 1990), although the criteria on which the respondents' judgements of "social class" were based are unclear.

At the same time, criteria for selecting the most valid, reliable and appropriate indicators of socioeconomic status for health research have not been well articulated in the literature. The need to critically examine measures of socioeconomic status is obvious. Without an understanding of how well certain indicators are able to capture differences in relative or absolute socioeconomic status, differences in health care utilization, mortality or health status across socioeconomic strata cannot be measured with any degree of precision or reliability. This further impedes our ability to understand the mechanisms underlying the relationships between socioeconomic status and health as well as formulate future strategies for the collection of pertinent data, such as in the design of national health surveys or other databases (Marks and Shinbert, 1997). Little has changed since Abramson et al. (1982, p.1746) commented that: "There can be no simple prescription for the measurement of social position in epidemiological studies". While Abramson and collegues were generally referring to income and occupationally based measures of socioeconomic status, developed predominantly for assigning socioeconomic status to employed males, there has been very little development or even study of socioeconomic indicators that would apply to other "special" groups, such as adolescents, women or the elderly. It is this latter group, the elderly, that is of specific interest here. Although the literature contributes very little in addressing this issue directly, existing frameworks for measuring socioeconomic status in a health-related context do serve to shed some light on this complex question. In the following sections, conventional approaches to measuring socioeconomic status will be outlined briefly, their applicability to the elderly will be examined, and in light of these issues the area-based approach is presented as an appropriate measure of socioeconomic status. Finally, some general conclusions regarding measurement of socioeconomic status in the elderly are offered.

Socioeconomic Status versus Social Class

Studies as well as other non-empirical explorations of the social determinants of health refer to a variety of terms to address social status, including socioeconomic status, social position, social inequality and social class. The focus in this study is on socioeconomic status rather than on social class. Although there has been a tendency in the literature to use the terms social class, social position and socioeconomic status interchangeably, more precise definitions of these terms show that they reflect theoretically, and methodologically distinct constructs. Although measures of socioeconomic status have been used to approximate social class, predominantly because these measures, such as income or occupation, are more readily ascertained from available data sources, it is important to distinguish between the two. Social class, on the one hand, is a concept firmly rooted in Marxist and Weberian sociological theory, and reflect one's connection to control over the means of production and land ownership, and furthermore, through consumption and culture (Moss, 1997). Socioeconomic status[1], on the other hand, is a descriptive term that captures characteristics such as income, education or prestige, and is not necessarily rooted in sociological theory. In other words, socioeconomic status "refers to an individual's relative position in the social hierarchy and can be operationalized as level of education, occupation and/or income" (Mackenbach and Kunst, 1997, p.758). Thus while class is based on a model of conflicting relations within social groups, socioeconomic status is a more descriptive term that captures the salient differences between social groups. The manner in which class is captured empirically must differ from the manner in which socioeconomic status is captured empirically; any empirical measure of social class must, by definition, be based on economic position *vis à vis* employment status (self-employed, employed in a cooperative or employed by another person or entity), decision latitude and degree of control in the workplace (Wolfarth, 1997; Wohlfarth and Van den Brink, 1998). For example, while an occupationally based definition of social class might be based on different types of control over production, socioeconomic status would be based on an income or prestige-based occupational measure. Using these two concepts interchangeably, or embarking on research without a clear understanding of which construct is of primary interest can lead to misleading interpretations of research results. Studies have shown that the relationship between social class and certain

[1] Moss (1997) defines socioeconomic position as the composite of all "environmental measures of social and material deprivation as well as the individual measures of income, wealth, education and occupation."

psychological disorders on the one hand, and socioeconomic status and psychological disorders on the other, may be very different, suggesting that the two are conceptually distinct (Wohlfarth, 1997; Wohlfarth and Van den Brink, 1998). It is, however, socioeconomic status that is the focus of this research.

Conventional Approaches to Measuring Socioeconomic Status

A useful point of departure may be to briefly outline the accepted socioeconomic measures used in the general population. Although by and large they have been developed in the context of employed males, no alternative exists specifically for retired (or semi-retired) individuals. As a result it is possible that in many studies examining the role of socioeconomic status in determining health outcomes in the elderly, insufficient attention has been paid to the appropriate selection of a socioeconomic measure.

Socioeconomic indexes have generally been based on some combination of three correlated variables: occupation or occupational prestige, income and education (Nam and Powers, 1983). Rooted in the Weberian tradition of sociology, which bases social position on the dimensions of class, status and power, measures of socioeconomic position are most frequently operationalized in terms of wealth and ownership, and occupational prestige (representing class and status), while power remains an unoperationalized political concept. Education is seen as an indicator which reflects both class (as a proxy for wealth) and status (in terms of the influence of education on lifestyle and social networks). Thus in this conceptualization, socioeconomic status may be related to health through different physical or psychological exposures in the workplace, job security and control (psychosocial factors), access to medical care, values and behaviours, environment and social and physical amenities (Libertos, Link and Kelsey, 1988).

Occupation and prestige based measures of socioeconomic status

Many socioeconomic measures are based on an occupational ranking, and incorporate the element of prestige garnered from occupation as well as the monetary remuneration associated with it. Traditionally they have tended to be stable (i.e. they reflect a career or occupation that may have spanned several years, not subject to abrupt short-term changes), but are subject to the biases of the judgements made by raters who may be more or less familiar with the occupation or hold various stereotypes (Libertos, Link and Kelsey, 1988). Widely used occupational measures of socioeconomic status include the British Registrar General's Scale favoured by British researchers (used in the Whitehall studies, e.g. Marmot et al., 1978), the socio-economic groups schema (Rose, 1995), the Nam-Powers' Occupational Status Scores and Siegel's Prestige Scale. The relative strengths and weaknesses of these are discussed in depth elsewhere (Libertos, Link and Kelsey, 1988). In Canada, the now somewhat dated Pineo and Porter (1967) Occupational Prestige Index, which ranks occupations spanning professional to unskilled jobs, has been used predominantly by sociologists.

Comparative analyses of occupational scales show that they tend to be strongly correlated, and highly correlated with health status measures. Therefore in general terms, different occupation-based measures may be used interchangeably, at least in studies of mortality (Abramson et al., 1982; Gregorio, Walsh and Paturzo, 1997). However, they are limited since they are most useful in working aged adults, are not viable indicators in children and youth or those unable to work, and may neglect the powerful effects of income and education[2]. Furthermore, they may not be able to reflect gender-sensitive differences in occupational structure (Gregorio, Walsh and Paturzo, 1997). Nor are they able to capture the transformation of the labour market if used to compare occupations over time. Occupation is not a static phenomenon. The individuals

[2] It must be noted, however, that parental or household socioeconomic status must almost always be used when ascribing childhood socioeconomic position.

occupying a given class decades ago tend to be very different now in terms of gender composition, educational preparation and job characteristics. Also, the status associated with any given occupation may rise or fall over time. Therefore any longitudinal or inter-jurisdictional comparisons using such scales will not be very illuminating. (Benzeval, Judge and Smaje, 1995; Illsley and Baker, 1991).

The problems inherently associated with the validity of the prestige component of occupationally-based socioeconomic measures has led to an understanding that any such index must reflect the education and income level associated with occupation, i.e. prestige is not a measurement of socioeconomic status *per se*. Blishen et al. (1987) have developed a contextual indicator that incorporates both of these factors specifically for the Canadian occupational structure. This is a quantitatively derived index that may also be disaggregated into its income, education and gender components. Only occupational information is required for the coding of this index.

Income-based measures of socioeconomic status

In Canada, income is probably the most widely used indicator of socioeconomic status (e.g. Kephart, Salazar Thomas and MacLean, 1998; Mustard et al., 1997; Mustard and Roos, 1994; Newbold, Eyles and Birch, 1995; Wilkins, Adams and Brancker 1989). Income reflects not only one's command over material resources, but may also reflect prestige, housing tenure, workplace demands and other factors. Income may vary widely within occupations and may not be consistent with educational standing, and may thus not be directly interchangeable with these measures. It may also be very unstable over a lifetime, does not take into account income indirectly derived from a spouse or parent, and is subject to temporal and geographic variations in cost of living[3] (Libertos, Link and Kelsey, 1988). This instability, however, may also be

[3] Variations in the cost of living are pertinent to employment-based income that changes with the cost of living.

regarded as a trait that may render income a very sensitive measure of changes in socioeconomic status over time.

Income, like many other indices of socioeconomic status, may be measured on several levels. One may consider an individual's employment income, an individual's income from all sources, family or household income. It may be measured individually or on an ecologic or regional level. In the latter case, the average income characteristics of an area, such as a census tract, are ascribed to each person or unit residing in that area. Furthermore, it is possible to measure the average income of an area, such as a neighbourhood or community, an approach that will be discussed in greater detail later in this chapter.

The use of household or family income as a socioeconomic indicator has been used in Canadian studies (e.g. Mustard et al., 1999), in lieu of *individual* indicators. Household-level indicators of socioeconomic status are usually based on an algorithm that ascribes the highest status in a household to all members of the household, or creates a weighted average of the individual incomes of all household members (Parker et al., 1994). It may alternatively reflect total self-reported household income. As a measure of economic standing, income may be more meaningful if weighted by the number of individuals in a household, as well as the ages of family members (Krieger, 1991; Krieger and Fee, 1994).

Alternatively, researchers in the U.K. have used a deprivation index to assess socioeconomic differences in health (Benzeval, Judge and Smaje, 1995). While this index of social and material deprivation, based on income, employment rights, family activity, integration, participation, recreation and education is said to be closely related to measures of occupation, it has not been widely used in health services research to date.

Education as a measure of socioeconomic status

Education as a measure of socioeconomic position is a variable that is relatively easy to attain reliably. It is stable over time, and while this has advantages (especially for the elderly, see below), it can obscure upward or downward mobility in social position, *vis à vis* changes in occupation or income that may contribute to (or occur as a result of) changes in health status (e.g. disability) (Libertos, Link and Kelsey, 1988). Education may not always mirror one's material position, but may more reliably reflect one's socio-cultural standing that may, in turn, affect behaviours, attitudes and responses. It also tends to be more strongly related to disease prevalence than economic indicators (Libertos, Link and Kelsey, 1988). However, while links between education and *inequalities* in health have been established, some authors argue that they yield only a fraction of the explanatory power that income yields (Krieger and Fee, 1994), although evidence to the contrary exists as well (e.g. Winkleby et al., 1992). Education has also frequently been used as a measure of socioeconomic status in Canadian studies, especially in tandem with income (e.g. Kephart, Salazar Thomas and MacLean, 1998; Mustard et al., 1997).

Other measures of socioeconomic status

Alternatives to occupation, income or education as a measure of socioeconomic status include housing tenure or car ownership; measures of consumption which may be easier to collect than conventional measures of socioeconomic status (Arber, 1991), especially if survey methods are employed in the research. However, this would inevitably result in a very broad characterisation of socioeconomic status that would obscure important differences because of the small number of categories possible from such taxonomy. The use of housing tenure as a socioeconomic indicator may not be very illuminative in the case of owner-occupied low-income households, since this measure does not capture total assets available for consumption.

Multidimensional indices of socioeconomic status

It is recognized, however, that socioeconomic status is not unidimensional. Therefore composite indexes, incorporating a range of indicators, have been developed. They tend to be more flexible and provide more information than unidimensional measures, and for this reason, are seen by many to be superior to their counterparts which reflect only income, education or occupation (Fox and Adelstein, 1978; Krieger and Fee, 1994). At the same time, use of a multidimensional index of socioeconomic status may obscure some of the important causal pathways, especially if they cannot be decomposed. For this reason, the construction of a reliable index hinges on two considerations. First, the selection of the appropriate variables for inclusion in such an index must be considered carefully, and may be justified in either theoretical or empirical terms. Second, the relative weightings of each variable, or assigning numerical values to reflect their importance in the index, must be ascertained (Frohlich and Mustard, 1996). Furthermore, in light of current multivariate statistical techniques available to most researchers, it has been suggested that they may have outlived their usefulness in an era where one can simultaneously quantitatively control for many variables (Libertos, Link and Kelsey, 1988). Well known composite measures include Duncan's Socioeconomic Index, Hollingshead's Index of Social Position and Nam-Powers' Socioeconomic Status Score, but they tend not to have been validated for studies other than for which they were initially intended (Libertos, Link and Kelsey, 1988).

In a specifically Canadian context, Mustard and Frohlich (1995) formed a quantitatively derived summary "socioeconomic risk index" from census indicators specific to the jurisdiction under investigation (Manitoba), an approach not uncommon in studies of socioeconomic and health status. This index differs from the ones cited above, since it based on the social and economic characteristics of areas rather than individuals[4], and as such represents a broader conceptualization of the pathways joining socioeconomic status and health. Their index incorporates the unemployment rate for those 15 to 24 years of age as well as for those 45 to 54 years of age, the proportion of single-parent households, the proportion of the population 25 to 34 years of age having graduated high school, the female labour force participation rate and mean dwelling value.

Approaches to the derivation of summary measures of socioeconomic status

In addition to considering which attribute of socioeconomic status is to be measured, the techniques used to manipulate these factors should also be considered. At the simplest level, absolute levels of education or income may be examined. In most cases, income may be construed as a continuous variable. However, it is often more useful to construct education, income or occupation as discrete categories for analysis. Mackenbach and Kunst (1997) identify other increasingly complex types of summary measures that have been applied in the literature on socioeconomic inequalities and health. These include ratio measurement indexes, correlation and regression techniques, Gini coefficients, and others, including population attributable risk and the index of dissimilarity. The first of these, or ratio level indices, may take the form of extreme groups[5] or may be assessed on their relative groupings, such as the percentile approach (for example, income quintiles) (e.g. Mustard and Roos, 1994; Mustard, et al., 1995; Roos and Shapiro, 1994). Second, indices based on regression are encountered less frequently in the literature, partly due to their computational complexity as well as more difficult interpretation. Thirdly, Gini coefficients measure concentration of wealth and health outcomes, as do other measures of relative dispersion such as an index of inequality (e.g. Pappas et al., 1993). These

---

[4] The area based, or ecological, measures of socioeconomic status are discussed in greater detail below.

[5] Extreme groups represent the ratio of morbidity or mortality in the lowest socioeconomic group to that of the highest group.

are used to compare the concentration of mortality, for example, between certain groups within a population, between populations, or over time. This approach examines the relationship between inequality or dispersion and health status, rather than socioeconomic status and health. All three approaches have the advantage of focusing on relative socioeconomic position rather than the typically skewed absolute levels of income or education within an age group.

While some authors assert that any reasonable measure of socioeconomic status must meet several requirements, including that they be able to capture socioeconomic differences in health, that they are able to represent the entire population, and that they be sensitive to change, other authors have less stringent demands concerning measures of social position[6]. While complex indicators have many advantages over simpler measures, the benefits, especially for policy makers, of basic, more easily interpretable measures such as ratios and quintiles should not be underestimated (Mackenbach and Kunst, 1997).

Levels of measurement

Income, education, unemployment, housing tenure or any other socioeconomic indicator may be used on one of several levels of measurement. On a purely individual level, one can ascertain one's employment income, total or average household income, or look at the overall average income on a community level. Furthermore, absolute or relative measures, such as quintiles or deciles may be entered into any analysis of the relationship between socioeconomic status and health outcomes. The issue of individual versus community, or area-based measures of socioeconomic status is discussed in greater detail in the following sections.

---

[6] These are discussed in greater detail in Mackenbach and Kunst (1997).

Conventional Indicators of Socioeconomic Status and the Elderly: Advantages and Disadvantages

The applicability of conventional indicators of socioeconomic status to the elderly has been considered in the literature only relatively recently (Morgan, 1983). The problem of selecting an appropriate measure of socioeconomic status for the elderly may be compounded since this group is comprised of a relatively high proportion of single (widowed) females, in itself identified as a group for which measures of socioeconomic status have been difficult to operationalize[7].

The most popular indicator, occupation, is perhaps the most problematic for retired persons. Is it more important to capture the last recorded occupation for a retired individual, a weighted average of all occupations (extremely sensitive to recall) or the "major" occupation over one's lifetime? Even if one was able to reliably define and assess the latter for the current retired cohort, this might become more problematic in the future with the increasing tendency toward non-linear career paths and shifts between occupations over the course of a working lifetime. Furthermore, with increased specialization and division of labour, it may be difficult to slot currently retired people into the increasingly complex occupational classifications. Occupational categories and the status associated with them are not static but change over time, which leads one to query at what point in the lifecourse occupation should be measured. At the very least, the use of occupationally based socioeconomic indices for the elderly is potentially problematic. Morgan (1983) reports that mortality ratios stratified by "last recorded occupation" based on a sample of the British 1971 census did not exhibit the characteristic social gradient. This

---

[7] The literature suggests that deriving a woman's socioeconomic status on the basis of the occupation, education or income of her spouse does not provide an adequate measure of her socioeconomic status. On the other hand, it has also been suggested that despite this limitation, a husband's socioeconomic status emerges as the predominant determinant of both spouses' social position, and may therefore present an adequate measure of social position for empirical studies (Baxter, 1994).

suggests that the last recorded occupation *per se* as a socioeconomic correlate of health status may decrease after retirement, and may be less reliable as an individual ages.

Income as a socioeconomic indicator also has disadvantages for the elderly. While occupation in itself cannot fully capture one's social position, the other economic indicators, income and wealth, provide two interrelated but distinct measures of socioeconomic status. The former is perhaps easier to ascertain (for example, asking about employment and pension income). For the elderly, wealth, or assets, may be a more important indicator of economic status since it may be able to more accurately may reflect lifetime income and socioeconomic status (Krieger and Fee, 1994). Data from the United States show that although elderly households had only about one half of the income of non-elderly households in 1979, they were doing as well as the non-elderly when housing equity, other assets and pension related benefits were taken into consideration, and were possibly better off when household composition was entered into the equation (Hurd, 1990). However, a comprehensive measure of income that includes employment income, investment income, pension benefits, other dividends, etc., and is adjusted for household size, could accurately assess socioeconomic status for the elderly (Crystal, 1986).

Clearly, disposable income, area of residence and perhaps broader cultural and social characteristics of individuals is related to one's overall assets, rather than current income alone. In the case of the elderly, the accumulation of assets prior to retirement, and the inequalities created during working years, will continue into the post-retirement years. Because a large proportion of this is tied to home equity, differences in assets between income groups may be greatly underestimated (Crystal and Shea, 1990). On the other hand, if researchers have survey-based data that incorporate broader indicators of wealth, as opposed to income, and which may incorporate some variables such as real estate assets not captured in income data, some of these concerns may be circumvented. For example, the data derived from the Health and

Retirement Survey in the United States provide measures of both income and wealth of older Americans (e.g. Kington and Smith, 1997). Again, lifetime earnings may be more pertinent than current earnings for some research questions; if so, would one attempt to produce a weighted average of earning over the lifecourse if it were possible to do so? There is no agreed upon solution to this problem, with the exception that age must always be included in the analysis to control for the different composition of assets and income over the lifecourse, particularly if many age groups are represented in the sample (Libertos, Link and Kelsey, 1988).

Housing tenure (owner-occupiers versus renters), viewed as reflective of economic resources, has been shown to be an accurate socioeconomic predictor of mortality, is equally applicable to men and women, and is relatively easy to ascertain using only a single question (Morgan, 1983). It may be suitably incorporated into a multidimensional indicator of socioeconomic status in the elderly for the reasons outlined above. On the other hand, it has limited utility as a socioeconomic indicator, since little variability results from the use of this bimodal measure, thereby obscuring important differences between socioeconomic groups that might be apparent if a more sensitive measure of social position was used.

Capturing the educational component of socioeconomic status has several benefits. Educational status is stable over time and therefore does not change with retirement. Unlike income, once a certain level of education has been attained it cannot fluctuate downward. An added advantage of this measure is that individuals are generally not averse to providing this information on questionnaires or in interviews compared to the more sensitive questions about income. On the other hand, at least in the present retired cohort, the majority of the population tend to be concentrated in one or two categories, allowing for little variability in the data (Morgan, 1983) and therefore minimizing the predictive utility of this indicator. (However, this may be changing due to mandatory minimum educational requirements now in place (Libertos, Link and Kelsey, 1988)). Again, it is important to clarify exactly what is to be measured on a conceptual level; while income, occupation or housing tenure may be indicative of wealth, education may be representative of individual attitudes and behaviours, but not necessarily material wealth in itself.

In general, research has shown that although for the very old socioeconomic differences in health status and/or mortality may narrow, health outcomes at least until the age of 75 may still be heavily influenced by factors operating earlier in life, perhaps *much* earlier (Fox et al., 1985; House et al., 1990). This prompts one to consider latent effects, since adverse health outcomes are not necessarily contemporaneous with economic standing, but tend to develop with time (Hertzman, Frank and Evans, 1994). For the elderly, this may mean a lot of time, and the way in which we define the socioeconomic components of our interest must reflect this. In other words, current income may be less important than accrued lifetime assets (e.g. Wolfson et al., 1993), which may be difficult to ascertain. Similarly, the most recently recorded occupational category may be secondary, or even insignificant, compared to careers that may have spanned several decades. Lastly, education, already identified as a comparatively stable variable, may result in strong associations with health status by serving as a proxy for socioeconomic position mirroring other variables with very long periods of latency.

In the following section, an ecological approach to measuring socioeconomic status that may, in part, circumvent some of the problems identified in this section, is presented.

Area-based Measures of Socioeconomic Status

Area-based measures of socioeconomic status, which involve classifying individuals by the social and economic characteristics of their neighbourhood or region at an ecological level, may be viewed as an extension of family and household indicators (Krieger and Fee, 1994; Libertos, Link and Kelsey, 1988). A major advantage of area-based measures is that they may be applied to anyone regardless of gender or employment status. They are particularly useful where there are no individual-level data on occupation, income, education or other measures of socioeconomic status are available.

Data sources for area-based measures are also relatively easy to obtain, but do require that relatively homogenous areas be defined. The required data are usually provided by the census, or in some cases large-scale economic surveys. Usually, the postal codes of individual respondents are used to link individual mortality, morbidity or utilization data with the socioeconomic data. Ideally, the delineation of the area should reflect a "meaningful" class category, such as according to a strict definition of a poverty area based on explicitly stated criteria (e.g. low income cut-off, housing tenure etc.) for example (Krieger and Fee, 1994), but more often than not already existing regional, census tract or enumeration area boundaries are followed. Area based measures may be ranked (e.g. on the basis of social advantage) or represent descriptive unranked homogenous areas in terms of their social and economic conditions (Morgan, 1983).

The major criticism of this approach concerns ecological fallacy, where an individual is assigned, perhaps erroneously, aggregate level characteristics. The error will occur if the socioeconomic profile of the area is not representative of each individual in that area. Although areas are assumed to be homogenous, they may not be, especially in urban centres[8]. Area-based measures have also been said to produce bias as a result of between-group correlations, or aggregation bias. As the size of an area increases, the differences between individuals residing therein may attenuate due to the greater degree of heterogeneity that may result. The ecological

---

[8] For example, the Winnipeg region examined by Roos et al. (1993) revealed a significant degree of heterogeneity in terms of socioeconomic status compared to other regions in their study.

fallacy, as well as cross-level bias, may be avoided if the entire analysis is performed at an ecological level, a type of analysis used to investigate regional variations.

With this approach, using data at the smallest grouping available is encouraged to maximize homogeneity within the ecological unit, and thus reduce the error of ecological fallacy. Also, the sources of socioeconomic data must provide good coverage of the target population, and be of proven validity and reliability. Canadian Census data, for example, satisfy both these concerns, especially if the smallest available geographical agglomeration, the enumeration area, is used in the analysis. Thus if used appropriately, the use of aggregated socioeconomic data has been judged to be a valid approach in studies where socioeconomic data would otherwise be absent (Curtis, 1990; Krieger, 1991; Krieger, 1992; Mustard et al., 1999), and if anything may underestimate relationships produced with individual data (Krieger, 1992). However, the literature also shows that for many outcome measures there may be no difference between effect sizes derived from individual versus area-level data (Mustard et al., 1999).

As discussed above, area-based measures may be used to proxy individual characteristics not available from existing data. But they may also be used to capture certain group or community-level characteristics of a neighbourhood, which may exert an independent effect on health status or other outcome. While in the past area-based measures may have been used mainly by default because of the absence of individual data, more recent data suggest that they may be perhaps the most suitable for ascribing socioeconomic status to the elderly. Several authors have underscored the appropriateness of considering the broader social milieu in terms of socioeconomic factors as opposed to individual factors as predictors of health status, regardless of age. The socioeconomic characteristics in one's immediate area have been shown to not only approximate but also modify individual characteristics, in overall mortality, birthweight, and respiratory illness (Krieger, 1991).

Recent studies of the use of socioeconomic indicators derived from aggregate level census data for linking with individual health outcomes demonstrated that the area-based and individual socioeconomic measures showed similar relationships to health outcomes measures (Krieger, 1992) and hospital utilization (Hofer et al., 1998). Mustard and colleagues (1999) assessed the validity of using both neighbourhood and household level income measures to study health status. Thirteen selected health outcomes, including mortality, admission to nursing home, treatment prevalence of various conditions, hospitalization for several diagnoses and incidence of live or stillbirth were associated with income when measured either at the neighbourhood or individual level. The vast majority of these measures were significantly related to both neighbourhood (11 of 13) and household (12 of 13) income in urban populations. The magnitude of the effects was equivalent for eight of these measures, regardless of the level at which income was captured. Major and minor mental health disorders did exhibit different effect sizes between the two income measures; neighbourhood income resulted in significantly smaller effect sizes compared to those derived on the basis of household income. Overall, however, these results refuted the hypothesis that risk estimates obtained from ecologic, or area-based measures would be attenuated compared to individual, or in this case household, income. The conclusions of this study support the notion that both ecologic and individual income measures are able to capture the association between income and health status.

Furthermore, the use of area based measures allows researchers to incorporate the effects of the interaction between the individual and neighbourhood-level socioeconomic characteristics, thus avoiding the "individualistic fallacy", where it is assumed that individual-level data are adequate to explain what is partially a social or group phenomenon. For health services research, this may elucidate the need for community based health interventions in addition to individually targeted strategies for improvement of health and reduction of disease (Krieger and

Fee, 1994). It is cautioned, however, that area-based measures may not *always* produce the same associations as individual measures, due to the underlying conceptual differences between the two. For this reason, it has been suggested that indicators at *both* levels of measurement be used where possible (Libertos, Link and Kelsey, 1988;).

If used alone, area-based measures of socioeconomic status may not only be valid substitutes for individual-level data, they may provide additional and very different insights. This has led some commentators to assert that area-based measures of socioeconomic status are able to capture the contextual effects of a neighbourhood that cannot be measured by individual measurements of income, education or other indicators, and may possibly produce larger differences between social groups than individual measures (Davey Smith et al., 1998; Hayward, Pienta and McLaughlin, 1997; Kaplan, 1996; MacIntyre, MacIver and Sooman, 1993). Factors such as community resources, social cohesion or disorganization, the concentration of poverty, differential political empowerment or environmental hazards may interact with individual factors, but are not identical. Studies showing the protective effect of rural residence, for example, after controlling for individual level socioeconomic variables, point to the effect of the social structural characteristics of certain areas that may work in combination with, or perhaps even dominate individual determinants of health (Hayward, Pienta and McLaughlin, 1997).

Similarly, Haan et al. (1987) report empirical results from the Alameda County Study that suggest that sociophysical attributes of the environment may be predictors of excess mortality that are independent of individually-derived factors even after adjustment for characteristics measured at the individual level, including income (Hart, et al., 1987; Kaplan, 1996). Other studies have similarly supported the link between socioenvironmental characteristics and risk for specific diseases, including cancer, ischemic heart disease or hypertensive diseases and all-cause mortality (Abramson et al., 1987; Harburg et al., 1973; McCord and Freeman, 1990).

Macintyre, Maciver and Sooman (1993) hypothesize that five characteristics of the local area may influence health. These include the physical features of the environment that are shared by all area residents, and include water or air quality, the availability of healthy or unhealthy home, work and leisure environments, public and private services, including education, transportation, welfare and community organisations, socio-cultural features of the neighbourhood (economic, political, ethnic characteristics; norms and values; community integration; networks) as well as the reputation of a neighbourhood.

The data reported by Kaplan (1996) offer a slightly different insight, and illustrate that low income areas may also be characterized by high demands (e.g. difficult, repetitive daily activity, unsafe environment, high crime) and low resources (e.g. low education, absence of health insurance, lack of emotional and tangible support, little decision latitude in daily activity). Therefore area-based measures may capture the salient psychosocial aspects of the environment as well. However, studies that focus on poverty areas may not be as informative of the entire range of areas, as defined by socioeconomic status. It has been suggested that the poorest neighbourhoods may be typified by a unique range of deleterious social, economic and physical characteristics, that present particular problems that middle or upper income neighbourhoods do not encounter (Massey, Gross, Shibuya, 1994).

Other authors, however, have argued that the accumulation of vulnerable populations in neighbourhoods, rather than the actual physical, social or economic characteristics of these neighbourhoods, is of predominant importance in forming the general health profile of small areas. According to one Canadian study, differential patterns of the utilization of mental health services by socioeconomic status in Canada, for example, have been thought to be a product of residential filtering processes. The socioeconomic characteristics of this community, such as housing type, higher unemployment, lower levels of education and a greater proportion of individuals living in poverty, then translate into increased utilization of mental health services (Joseph and Hollett, 1993).

In fact, many of these and other important socioeconomic indicators may be measurable only at the group level. There is a growing voice in the literature suggesting that rather than using area-based measures as a proxy for individual-level data, they should be investigated in their own right because of the influence they may exert on the health of populations (Kaplan, 1996).

Several authors have advocated the direct analysis of social and physical areas on health (Anderson et al., 1996; Kaplan, 1996; Macintyre, Maclver and Sooman, 1993). An examination of the contextual and individual level socioeconomic factors is warranted (Hayward, Pienta and McLaughlin, 1997; Leclere, Rogers and Peter, 1998). According to Kaplan (1996, P.518), "the results of these inquiries add plausibility to the assertion that studying the characteristics of where people live and how these vary by social class may help us go upstream in our understanding of the impact of social class on health".

The area-based approach may be particularly appropriate in studies examining the health status of, or health care utilization by the elderly. One's socio-environmental milieu may capture those attributes that may be almost impossible to measure in other ways, and may more accurately reflect life-time socioeconomic standing than can reasonably and reliably be collected on an individual basis.

In Canada, the area-based approach has successfully been used in Manitoba (Mustard, et al., 1995; Roos, et al., 1993) Roos et al. developed the socioeconomic risk index to compare both health status and health care utilization (hospital separation rates) for the general population in each of the provinces' 8 regions, choosing a number of indicators which were deemed to be particularly sensitive to health-related differences in socioeconomic status. Although the geographic areas the authors defined were quite large, both in terms of population and area, and therefore not homogenous (especially in Winnipeg), the analysis was able to differentiate strong health gradients between them. This suggests that the use of smaller, more homogeneous areas could improve the predictive value of the analysis.

Choosing the Appropriate Socioeconomic Indicators for the Elderly

In general, different measures of social position yield similar results in terms of their effects on health outcomes (e.g. Wood et al., 1999), and that selecting a specific socioeconomic indicator may be less important than including social position in our investigations of health status overall (Mustard and Frohlich, 1995) . However, it has also been argued that effect sizes will vary with measures of social position, and that different socioeconomic indicators produce more marked differences than the analytical method employed (e.g. odds ratios, slope, etc.) (Manor, Matthews and Power, 1997). To some degree, differences in results that are obtained by using different measures of social position might reflect the different stages in the life cycle captured by different measures of socioeconomic status. For example, one's level of education is usually defined relatively early in life, whereas current employment income may be more variable throughout the life cycle. Furthermore, while occupational measures, for example, may reflect status as much as income, education may encompass "cultural capital" which may be related to health-related behaviours, perceptions of illness and other factors (Manor, Matthews and Power, 1997). These considerations have important ramifications for choosing an appropriate socioeconomic indicator for the elderly.

Socioeconomic indicators may vary in their applicability to special groups such as the elderly and may not be equally appropriate for all theoretical frameworks or study objectives (Abramson et al, 1982; Morgan, 1983). Two factors are of utmost importance in any study utilizing measures of socioeconomic status in investigations of health. First, a reliable measure or set of measures must be found to capture socioeconomic position accurately and avoid misclassification. There is currently no gold standard for selecting appropriate socioeconomic measures for health research. Second, if the chosen indicator is not a valid one in the context of the research question, that is, if it does not measure what we want it to measure, erroneous results may be produced (Parker et al., 1994). This may be of lesser relevance if one simply wants to "control for" socioeconomic status rather than investigate the underlying pathways (Maddox and Clark, 1992). The researcher must also clarify the time relevance of the measure (e.g. are the occupational classifications in an occupational indicator appropriate for the period under study?), the role of socioeconomic position in the research (a confounder or a cause?), the extent to which the conceptualization of socioeconomic status is multidimensional, whether discreet or continuous measurement is desired, and comparability with other studies. (Libertos, Link and Kelsey, 1988). Thus both technical considerations such as data availability and theoretical considerations must be heeded when choosing an appropriate measure of socioeconomic status.

It has been suggested that if the sample includes a large proportion of individuals who are not currently employed, such as the elderly, then non-occupationally based indicators be used, such as education, an estimate of wealth or income, or a composite measure incorporating several dimensions of socioeconomic status (Morgan, 1983). Optimally, individual, household and area level measures of socioeconomic status should be used in tandem, such as in parallel analyses, for example, (Ecob and Jones, 1998; Macintyre, Maclver and Sooman, 1993; Krieger and Fee, 1994). Although it has been demonstrated that both levels may exert an independent, yet complementary effect on health outcomes (e.g. Ecob and Jones, 1998), incorporating data at both levels may not always be feasible due to constraints posed by existing or available data. In some cases, the area-level characteristics may be the socioeconomic variable of interest, leaving the requirement for individual-level data moot.

As stated above, area level measures may be the most pertinent and easily operationalizable, especially for the elderly. Most importantly, the latent manifestations of socioeconomic conditions earlier in life must be considered. Any measure of socioeconomic status for the elderly must try to capture lifetime experience. This may be best, albeit indirectly, reflected in area-based measures. In the remaining chapters, the area-based approach to measuring socioeconomic status will be applied to the investigation of the determinants of drug use by the elderly in British Columbia.

Chapter Four

Methods

This study utilizes a cross-sectional longitudinal design using administrative data. Factors related to prescription drug use for all residents of British Columbia aged 65 years and older who are residing in the community are explored using a variety of sources and methodologies. Data are extracted from three primary sources, including the British Columbia Linked Health Database (BCLHD), Canadian Census Data, and the Postal Code Conversion File. The major focus of this study is prescription drug utilization, which is captured in the Pharmacare Plan A database, one of the components of the BCLHD. However, the BCLHD contains other health care utilization data as well, including physician, hospital and continuing care use, which were used in the study. Canadian Census Data were the source of socio-economic information, while the Postal Code Conversion file was used to attach socio-economic data, on an ecological level, to each of the individuals represented in the prescription drug database. In the following sections, these databases will be discussed in greater detail. In addition, the study population, measurement of socioeconomic status, the specific construction of the databases, and the analytical methods employed in this study, will be reviewed.

Variables

In order to fulfill the study objectives outlined in the introductory chapter, four main types of variables need to be considered. These include socioeconomic status, prescription drug utilization, demographic and health care utilization variables. The first objective, the examination of patterns of prescription drug utilization by income, requires the identification of variables to measure both drug utilization and socioeconomic status.

Drug utilization, the dependent variable in this analysis, is measured in three ways: the number of prescriptions, drug quantity, and total ingredient costs. The latter refers to direct drug costs only, and does not include a dispensing fee. Drug quantity refers to the number of units prescribed.

However, it should be cautioned that these units may not be therapeutically equivalent (e.g. a 5 milligram unit versus a 10 milligram unit).

Socioeconomic status is measured in terms of income quintiles, an area-based measure of average household income. Income data were obtained from the Canadian Census (see discussion on data sources, below)[1]. Household income is defined to include the following: wages and salaries, net income from unincorporated non-farm business, net farm self-employment income, Old Age Security Pension and Guaranteed Income Supplement, benefits from the Canada or Quebec Pension Plan, Family Allowances, Federal Child Tax Credits, Benefits from Unemployment Insurance, other income from government sources, dividends and interest, retirement pensions, superannuation and annuities and other income. Average income refers to the weighted mean, by age-specific ten-year age groups, of income per number of households. A household is regarded as a person or group of related or unrelated persons occupying a single place of residence. Other variables considered from this data source include level of education, mortgage or rent payments as a percentage of total income, average dwelling value, unemployment, mobility (proportion residing in area less than five years), and proportion of single parent households. These variables were examined but ultimately not further used in the analysis. The selection of measures of socioeconomic status will be discussed further, below.

The second study objective is to determine whether there exists a socioeconomic gradient in rates of drug prescribing after controlling for demographic characteristics and health care utilization. Demographic characteristics include age and sex. Available health care utilization variables include the number of physician billings and services, for specialists and general practitioners, hospital separations, hospital days, and home care visits. Home care includes nursing care, physiotherapy, occupational therapy and homemaker services. These are outlined in Table 4.1. It should be noted, however, that where similar measures of utilization were

---

[1] Complete documentation for the data included in the census profiles is provided by Statistics Canada (Census of Canada, 1993).

available, (e.g. hospital days and hospital separations), only one was used in the multivariate regression analyses.

Table 4.1

Variable List by Major Constructs

Construct	Variable		
Socioeconomic status	• Income quintile • Income decile		
Drug Utilization	• Number of prescriptions • Number of units prescribed • Ingredient cost		
Demographic indicators	• Sex • Age		
Health Care Utilization	*Gastrointestinal (GI) Drug Group*	*Central Nervous System Drug Group*	*Cardiovascular Drug Group*
Physician services	• GP billing • Specialist billings • Number of GP services • Number of specialist services	• GP billing • Specialist billings • Number of GP services • Number of specialist services	• GP billing • Cardiovascular specialist billings • Number of GP services • Number of cardiovascular specialist services
Hospital services	• Hospital separations, GI • Hospital separations, other • Hospital days, GI • Hospital days, other • Procedures • Procedures, GI	• Hospital separations • Hospital days • Procedures	• Hospital separations, cardiovascular • Hospital separations, other • Hospital days, cardiovascular • Hospital days, other • Procedures • Procedures, cardiovascular
Home Care	• Homemaker • Home nurse • Physiotherapy • Occupational therapy	• Homemaker • Home nurse • Physiotherapy • Occupational therapy	• Homemaker • Home nurse • Physiotherapy • Occupational therapy

While the use of a comorbidity or severity index would have been beneficial to this study, a meaningful measure could not be constructed from the available data. Diagnostic information for the years studied is available only for the small proportion of individuals who have had an acute care admission during the years under study.

The third study objective, i.e. to examine trends in the relationship between socioeconomic status and overall drug utilization over time, requires no additional variables. In all cases, the unit of analysis is the individual.

Data Sources

The set of variables listed above was extracted from a variety of data sources, including the British Columbia Linked Health Database, Canadian Census data, and the Postal Code Conversion File (Statistics Canada). These are described in greater detail below.

The British Columbia Linked Health Database

The British Columbia Linked Health Database (BCLHD) was developed at, and is housed in, the Centre for Health Services and Policy Research at the University of British Columbia. The Linked Data Access Coordinator in the B.C. Ministry of Health controls access to these data, which are available to researchers. Created to maximize the potential for research using existing administrative data already available in the province, this database links statistics from four various program areas as well as Vital Statistics. These program areas include inpatient and surgical day care hospital separations (Hospital Programs), fee-for-service payments to physicians and some other providers (Medical Services Plan), home and facility-based continuing care services (Continuing Care), and pharmaceutical use for individuals aged 65 years and older (Pharmacare Program, Plan A). Linked databases allow for the building of health trajectories, to create a more or less comprehensive account of an individual's health services utilization over a specified period.

Each of these files were created for billing and other administrative purposes, thereby they undergo thorough audits to ensure accuracy. Physician fee items are checked by the Ministry of Health to ensure that the amount paid corresponds to fee schedule, and to verify that only non-specialists do not bill for specialist fee items, that total billings fall within acceptable guidelines and that that services are not provided more frequently than the minimal intervals stipulated by the Ministry of Health. Prices for pharmaceuticals and the types of medications or products dispensed are similarly verified. Physician claims or pharmaceutical billings that contain incorrect or disallowed information are returned to the practitioner or pharmacy for correction and resubmission. Similarly, hospital records are verified in the hospital and subjected to validity checks in the facility as well as by the Canadian Institute for Health Information. In this manner, the data are highly accurate and unlikely to contain incorrect information or contain invalid field values.

The data are individual-specific, although it is not possible to identify specific individuals within the database. Each linked record contains a unique identifier that links it to a registered person on the central file. Each unique identifier represents a Personal Health Number, or one individual. The unique identifier, however, has no intrinsic meaning in itself, and researchers are not granted direct access to the central file. This has considerable ethical and access implications for the use of these data for research purposes. The BCLHD can potentially be used at several levels of sensitivity, ranging from the use of data where no person-specific information is released to a study where personal identifiers are included for the purpose of contacting subjects or their families[2]. In this study, some person-specific information is included in the database (i.e. postal code), but all personal identifiers, such as name or address, have been removed. Thus it is not possible to identify individuals. The computer algorithms used to scramble the Personal Health Numbers of individuals contained in the database are known only to certain analytic staff at the Ministry. However, it is possible to facilitate accurate linkages between programs (e.g. hospital and prescription use), since the identical algorithm is used for each of the component databases. A data access manual published by the Ministry of Health and the Centre for Health Services and Policy Research outlines the policies surrounding uses and release of these data (Centre for Health Services and Policy Research, 1996).

Security of the data is ensured through thorough monitoring of Internet connections, either through filtering non-essential connections or inspecting essential connections for source and validity. Security alerts have been installed and are acted on as necessary. Also, files kept on site on magnetic tape or CD are kept in locked premises accessible only to a small number of data/analytic personnel, not including researchers. These, and other, security procedures have been reviewed by an audit team at the University of British Columbia at the request of the Vice-Provost of the University, and have been found to exceed security standards.

The linkage between the various administrative databases comprising the BCLHD was performed using a probabilistic linkage strategy. Again, these linkages were not performed for this study, *per se,* but as a separate undertaking to create a linked database of several administrative databases in British Columbia, as described above. The linkage was performed by creating a master, or Linkage Coordinating File containing records for all recipients of health care services in the province. The Linkage Coordinating File includes unique personal identifiers for each individual that allow for the linking of individuals between the various data files, such as Pharmacare or Medical Services Plan administrative files. The coordinating file contains all individuals registered for health care coverage in British Columbia. Hence there is virtually complete coverage of all residents of British Columbia receiving health care services in the province. Next, individual records in each of the program files were linked to the Linkage Coordinating File. A high rate of success in linking the program files to the Linkage Coordinating File at the level of the individual was achieved using this methodology. The percentage of

---

[2] The five levels of sensitivity considered by the Data Access Subcommittee are discussed in Chamberlayne, et al., 1996.

program file records linked to the Linkage Coordinating File range from 95.3% for long term care (for the period 1985/86 to 1993/94) to 99.8% for Medical Services Plan payments. A very high proportion (98.5%) of links for prescriptions for individuals 65 years of age and over was also achieved (for the period 1985 to 1995) (Chamberlayne, et al., 1998)[3]. The resultant number of potentially "linkable" files is very large. For example, the 1995 files include approximately 5.8 million prescription records and over 700,000 hospital separation records. Linked files at the Centre for Health Services and Policy Research data begin with 1985/86 and are processed as new data become available. This study used the data for the years 1989, 1991, 1993 and 1995.

Canadian Census Data

Canadian Census Data provided data for the socioeconomic indicators used in this study. Data were obtained for the smallest possible standard geographical unit for which they were available, i.e. the enumeration area. The enumeration area is most basic area for which census data are collected; larger geographical conglomerations such as census subdivisions or census tracts are based on a number of enumeration areas. Average household income was the primary variable of interest. However, other variables such as education, unemployment, etc. were used in preliminary analyses (see below). The 1991 census data were used for this analysis, since they were the most recently available data at the study outset for which a current Postal Code Conversion file was obtainable. Just as importantly, this year of data most accurately reflected the study period, 1989 to 1995, compared to either the 1986 or 1996 census. The data were obtained from the Profile tapes created by Statistics Canada, and distributed under the Canadian Association of Research Libraries Joint Data Purchasing Consortium through the University of Toronto for members of the University of Toronto community.

---

[3] Some program files, such as hospital separations or medical services plan billings, are organised by fiscal year, while others, such as the Pharmacare program, are organised by calendar year. When files organised by different forms are to be linked, two years of data from one file based on a fiscal year (e.g. 1985/86 and 1986/87) are merged, and only the records transacted in 1986 are linked with data from a file based on a calendar year.

Population data were obtained from the Short Form, Part A. These data represent 100% of Canadian households as at June 4, 1991, with the exception of some Indian reserves and Indian settlements, which were termed "incompletely enumerated" in this census year due to disruptions of the enumeration process. (Minister of Industry, Science and Technology, 1993). Furthermore, missed dwellings or individuals, who may not have a usual place of residence, were also not included. More detailed socioeconomic data including average household income, were obtained from the Long Form, or Part B of the Census. The Long Form, a very detailed list of questions, represents a 20% sample of Canadian households, on the same geographic basis as the Short Form.

Census data are usually regarded as reliable and valid, although they too are subject to several types of errors stemming from non response, incorrect responses or coverage errors, in which some individuals or dwellings are not enumerated or double counted, as well sampling and processing errors.

Postal Code Conversion File

The data collected at the level of enumeration area from the Canadian Census were linked to individual Pharmacare data on an ecological basis using the Postal Code Conversion File created by Statistics Canada. This is a computer file that maps virtually all postal codes to standard 1991 Census Geographic areas, at the level of enumeration area and higher. It was developed in order to enable researchers and others to link geographic group-level Census data to individuals or groups of individuals in specific geographical or census areas. It also includes an urban/rural indicator, as well as a Single Postal Code Indicator, which is used to identify which record to use if a postal code falls into, for example, two or more enumeration areas. This is based on a formula that uses address ranges, and is used where only one record per file is required for procedures such as linking to other files. The error rate linking postal codes to geographical areas varies by level of aggregation, ranging from 0.1% for federal electoral districts, which are broader areas, to 6.7% for enumeration areas, which are relatively small areas requiring the full postal code at the six digit level (Statistics Canada, 1991).

Enumeration areas are the smallest geographic agglomerations for which census data are available. Typically, they will include no more than 375 households in urban areas and no less then 115 households in rural areas. They must be small enough to be canvassed by one census representative. Additionally, it should be noted that the data at the level of the enumeration area may be suppressed, or censored, to protect the confidentiality of respondents if the areas contain less than 250 persons (i.e. for income data), or 40 persons if income is not reported (Minister of Industry, Science and Technology, 1993).

Study Population

In this study, all individuals eligible for, and enrolled in Plan A of Pharmacare, the British Columbia prescription drug insurance program[4] are included in the analysis. Individuals included in this study, therefore, must be at least 65 years of age, be permanent residents of British Columbia and reside in the community. If these three criteria are met, an individual is entitled to a Gold CareCard issued by the Medical Services Plan of British Columbia and enrolment in the Pharmacare program. By including all records available, the true trends in prescription drug use in the entire population may be determined. Therefore no sampling strategy is necessary. All records for the years 1989, 1991, 1993 and 1995 were considered in the first phase of the analysis. The total number of individuals, or beneficiaries, in the Pharmacare database receiving a prescription of any type, as well as the total number of valid prescription records, is provided in Table 4.2. In the second, multivariate stage of the analysis, only individuals who had at least one prescription for a drug in the three therapeutic drug categories considered (gastrointestinal,

[4] Pharmacare covers eligible drugs prescribed by a physician, dentist, midwife or podiatrist, insulin and needles for diabetics, blood glucose monitoring strips and certain designated ostomy supplies and permanent prosthetic appliances. Eyeglasses, hearing aids, patent medicines, over-the-counter drugs, medical devices or drugs purchased while out of the province are not covered.

central nervous system and cardiovascular drugs) were entered into the analysis. The construction of the databases for each of the two phases of study is discussed below.

Table 4.2

Number Beneficiaries and Prescription Records in the Pharmacare Database, 1989-1995

	Year			
	1989	1991	1993	1995
Number of Beneficiaries	320,588	326,778	373,822	386,843
Number of Prescriptions	4,211415	4,774,217	5,257,787	5,456,730

Measures of Socioeconomic Status

Selection of socioeconomic variables

Although several measures of socioeconomic status were initially considered, income quintiles, an area-based measure of average household income was selected for this study. As discussed in detail in Chapter Three, income as a socioeconomic variable has good face validity since it represents the material resources available to an individual or household, an integral facet of socioeconomic status. Income as a measure of socioeconomic status has proven to yield robust results in health services research and more explanatory power than other socioeconomic variables (Krieger and Fee, 1994). On the other hand, other measures of socioeconomic status may be problematic when used with the elderly. Occupational measures, for example, may be difficult to use since it may be difficult to slot currently retired people into the increasingly complex occupational classifications, and measures of education may not accurately represent socioeconomic standing in this age group.

Household, rather than individual, income has the added advantage of accurately representing the income status of women who may not have contributed to a pension fund to the same extent as their male spouses, especially in these age cohorts. Furthermore, area-based measures are appropriate since they can be applied to anyone regardless of age or employment status. Also, area income is a good indicator of assets in the elderly, and may be a fairly good correlate of real estate values and therefore a reasonable gauge of pre-retirement material standards of living.

However, the use of a composite area-based index of socioeconomic status, including income as well as other variables, was explored. Other Canadian studies have used income or education to reflect socioeconomic status, as well as a combination of individual socioeconomic indicators, in the form of a summary index, to examine relationships between health status or health care utilization by socioeconomic status (e.g. Frohlich and Mustard, 1996; Mustard and Frohlich, 1995; Mustard et al., 1997).

Preliminary analyses indicated that at least for this specific case, absolute values for individual socioeconomic indicators did not provide a better measure of drug utilization than did income quintiles. These variables included average household income (from which the income quintiles were derived), the proportion of households for whom mortgages exceeded 30 percent of their income, the proportion unemployed, average dwelling value, the proportion of population with a secondary school diploma, the proportion of population aboriginal, the proportion of individuals residing in the enumeration area less than five years, the proportion of households whose rent exceeded 30 percent of income, and the proportion of single parent families.

The results of individual least squares regressions between the number of prescriptions dispensed and nine separate measures of socioeconomic status, by three major drug groups are reported in Table 4.3. As evidenced by the data presented here, income emerges as the strongest correlate of prescriptions dispensed; the use of other socioeconomic variables would not yield better results. The use of a composite index was discounted, since while some variables were highly significant, especially average dwelling value, mobility and proportion of single parent families, many of these were highly intercorrelated. Thereby using them in tandem, in a composite index would have been redundant and statistically unsound.

Table 4.3

Individual Socioeconomic Indicators of Drug Utilization by Number of Prescriptions, 1991

Variable	Gastrointestinal Drugs	Central Nervous System Drugs	Cardiovascular Drugs
Average Household Income	56.57***	296.3***	29.2***
% Mortgage > 30% Income	5.62*	18.4***	4.2*
% Unemployed	2.4	88.1***	0.6
Average Dwelling Value	57.58***	32.6***	32.6***
% Secondary School Diploma	6.01**	62.6***	8.9*
% Aboriginal	9.16**	50.4***	2.0
% Residing in area < 5 years	35.04***	13.9**	8.0*
% Rent > 30% Income	4.74*	96.9**	0.6
% Single Parents	28.57***	135.7***	24.7***

Table values represent F-values computed for each individual regression analysis.
*** significant at p=.0001
** significant at p=.01
* significant at p=.05

Clearly, using income alone has several advantages over a composite index. First, unless a composite index can be decomposed, it is difficult to ascertain which of the variables included therein affect the dependent variable. Income quintiles are readily understandable; even though in an analysis of this type, causation cannot be ascertained, the basic relationships are relatively clear. Second, income has been established as a viable indicator of health care utilization, especially if the data are valid, reliable, and the definition of "income" is sufficiently all-encompassing (i.e. not just limited to employment income, for example) to capture non-capital assets accurately. Thirdly, since income is a widely used measure of socioeconomic status in Canadian and international studies, the use of income to reflect socioeconomic status here allows for comparability with other research.

Development of income quintiles

The Pharmacare population was divided into five quintiles of approximately equal size in order to facilitate the comparison of drug utilization according to level of income. The advantage of using quintiles for this analysis is that it allows for the analysis of utilization by relative income, or one's income peer groups rather than actual income alone. These quintiles were established by assigning an enumeration area to all unique identifiers using the Postal Code Conversion File. A single file containing population (total and 65 years and over) and average household income based on the 1991 census for each enumeration area was constructed.

The enumeration areas were ranked by average household income and divided into 5 quintiles of approximately equal size, as well as 10 deciles of approximately equal size for a more detailed analysis. A six-digit enumeration area code combining the codes for Province, Federal Electoral District and Enumeration area was used to ensure that a unique code was assigned to each enumeration area in the province. This code was instrumental in later linking each prescription record with the appropriate income quintile.

Two variations of the quintile were created. In the first version, the total British Columbia population was ranked by average household in order to define the boundaries of the income quintiles. In the second version, only individuals aged 65 years of age and over were considered in dividing enumeration areas into five quintiles. An analysis of the quintiles demonstrated that it was appropriate to consider only the population aged 65 years and over for the construction of the income quintiles, which is the same population included in the prescription drug data. Using total population for this purpose resulted in a markedly skewed distribution of Pharmacare subscribers by income quintiles, rendering it unacceptable for this analysis. Instead of resulting in a distribution of five income groups of approximately equal size, using the entire population to delineate quintile boundaries created very small quintiles for the highest income groups, and excessively large quintiles in lower income groups. This is due, of course, to the distribution of household income, which tends to be higher in the working-aged population. In order to effectively compare the *relative* incomes of the elderly, it was therefore essential to consider only the distribution of the income levels of those aged over 65 years of age. Subsequent analyses used only the measure of socio-economic status based on the elderly population rather than the total population.

The distribution of individuals, or users, per quintile using the elderly population and the entire population are presented in Tables 4.4 and 4.5. Table 4.4 provides the size of each income quintile for the four years under study. Some individuals in the Pharmacare data file were not successfully assigned a quintile. This ranged from 7.9 per cent in 1989 to 12.1 percent in 1995. Missing quintiles are due to missing postal codes, and infrequently, average household income data that are missing from the Census profile tapes due to a small number of respondents per enumeration area. Records with missing income data were excluded from the analysis. Table 4.5 shows the quintile distribution that resulted in using the average household income for the entire population to determine quintile boundaries, that was not used in the final analysis.

Table 4.4

Distribution of Individuals by Income Quintile Constructed Using Individuals 65 Years and Over, 1989-1995

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	Unknown
1989	62068	59403	55431	61074	57216	25396
1991	69556	64350	60943	66939	61300	26670
1993	75519	69293	63437	69900	62374	33299
1995	76142	70507	63171	68845	60103	48075

Table 4.5

Distribution of Individuals by Income Quintile Constructed Using All Population, 1989-1995

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	Unknown
1989	46465	43565	54778	62347	88037	25396
1991	52328	48969	58372	68535	94884	26670
1993	56654	63399	60874	72245	97351	33299
1995	57433	54321	60389	71862	94763	48075

Construction of Databases

Phase I: Analysis of drug utilization and socioeconomic status

In this phase of the study one database was constructed for each year of study, i.e. 1989, 1991, 1993 and 1995. Each record in the database represented one prescription. The construction of the database consisted of three phases; establishing a file containing income quintiles and deciles, linking a quintile/decile to each individual with a unique identifier in the Linkage Coordinating File, and then linking these to the Pharmacare database. The development of the income quintile file is described above. In the second step, i.e. linking income quintiles to individuals, the Postal Code Conversion File was used to append the unique enumeration area code to each record in the Linkage Coordinating File.

In the final step, the files containing the Personal Health Numbers and income quintiles and Pharmacare data were merged. This was done by selecting the required fields in the Pharmacare database. Since the Pharmacare database includes both debits (submitted when pharmacies are reimbursed for claims) and credits (used to correct errors for incorrectly submitted debits), debits (prescriptions paid by the Pharmacare program) and credits (monies returned to the Pharmacare program after initial disbursement) were reconciled before further processing, thereby eliminating incorrect entries.

Enumeration area data were appended to each record in the Pharmacare database using the Postal Code Conversion File. Following this, the quintile file was appended to each record in the database in order to create a database that included all Pharmacare records and the income quintiles associated with each individual therein. The construction of these databases is presented schematically in Figure 4.1.

Since the unit of analysis in the first phase of analysis was the individual, all prescription records were then aggregated to the level of the individual according to the Personal Health Number included on each.

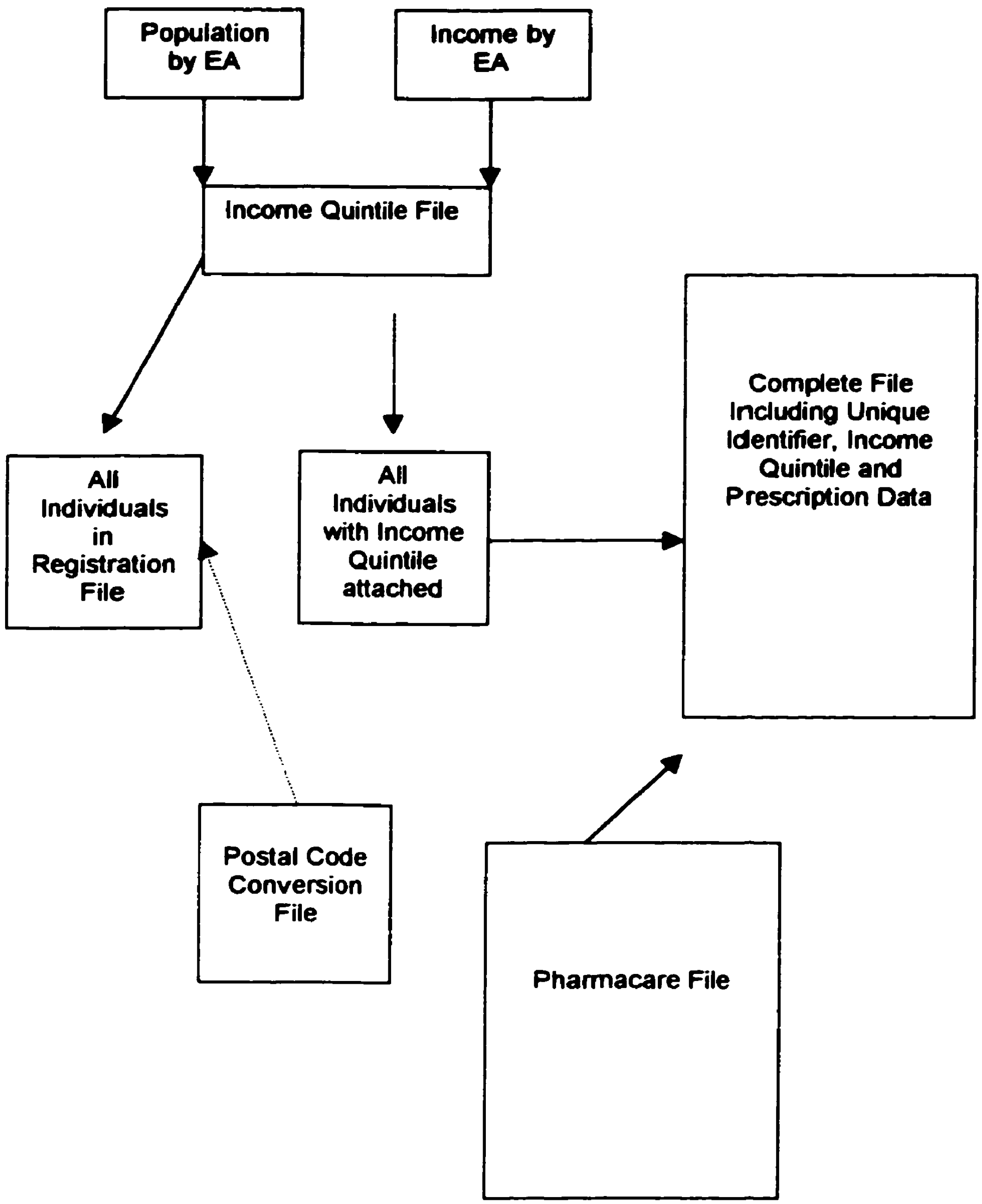


Figure 4.1

Schematic Representation of the Creation of Phase I Database

Lastly, the Registration and Premium Billing File was used to identify all individuals over the age of 65 in order to create a file including Personal Health Number, income quintile, age and sex. The Registration and Premium Billing File, which includes all individuals in the province registered with a British Columbia Medical Services Plan, provided the denominators with which to calculate per capita rates of drug utilization presented in Chapter Five. There are limitations associated with the use of the Registration and Premium Billing File in this manner. First, it is known that address information, including postal code, a key variable used to assign income quintiles to individuals, may not always be updated after initial registration. This means that this information may be outdated for some individuals, a problem that is especially important when considering the elderly who may have moved several times since registering with the Medical Services Plan. Second, the demographic information in this file is not as complete as, for example, the demographic information contained in the Pharmacare database. While 11.2 per cent of records for those over 65 years of age in the Registration, Premium and Billing File had missing sex codes, only 2.0 percent of the records in the Pharmacare database had missing sex codes. Accordingly, these records cannot be included when standardizing per capita utilization rates by age and sex. However, other commonly used sources of population, by sex and five-year age groups, do not contain postal code information required to append an income quintile.

Phase II: Multivariate analysis of selected drug groups

Separate databases were required in order to perform the multivariate analysis of drug utilization, which controlled for other health care utilization variables such as medical, hospital, and home care use. This required additional manipulation of the data. Due to size restrictions, the BCLHD is not kept as a single large file; rather, one coordinating file is constructed containing all users of the health care system and a unique linkage number. This process expedites and eases the process of linking one or more of the databases. The use of the linkage coordinating file has another important advantage: it eliminates the likelihood of propagation error, where one error in linkage results in subsequent errors. This might occur if data from two data sources were used to maximize the linkage to a third data source, rather than if each was linked independently, as it is with the Linkage Coordinating File methodology (see, for example, Chamberlayne et al., 1998).

Due to the large number of records and variables in the constructed database, and the resources required to construct the linked database, the multivariate analysis was restricted to one year of data, 1993. Since the initial bivariate analyses revealed a similarity in the relationships between socio-economic status and prescription drug use over the study period, this decision to select only one year of data for this portion of the analysis is not likely to obscure any temporal trends, nor lose other valuable information. Less importantly, the amount of programming and computer time, as well as file storage space prevents the construction of several aggregated databases for each of the four years studied.

In the first database, described above, each record represented one prescription, and needed further aggregation by individuals, quintiles and/or drug group. In the second set of databases, used for the multivariate analyses presented in Chapters Six, Seven and Eight, the data were already aggregated by individual in order to link to health care utilization data from other program areas. As a result, each record in the Phase II databases represents one *individual*, and the sum of the individual's prescription drug, hospital, medical and home care use over the year, and needed no further aggregation.

According to the method described above, three separate multivariate databases were constructed, one for each therapeutic drug group considered here. The multivariate databases for cardiovascular, central nervous system and gastrointestinal drugs were constructed by extracting the relevant prescriptions (by therapeutic drug code) from the Pharmacare data, and aggregating them to create one record per individual. At this point, this file was linked to the hospital files, medical services plan billings and continuing care files. Hospital records were appended using the hospital index file, which contains both the unique identifier and record number which facilitates finding the matching hospital records in the Hospital Programs database (175,254 records). Physician services were retrieved in the same fashion. This resulted in 330,715 unique identifiers identified as having at least one Medical Services Plan billing, representing 11,094,996 individual billings. After deleting out of province billings and non-physician charges as well as individuals who did not have a dispensed prescription during this period, 299,272 unique identifiers utilizing in-province physician services were identified. In this manner, any hospital, physician, or home care services an individual received in that year were appended to an individual's record.

Some diagnosis-specific information was extracted as well. Hospital data include not only total separations and days of stay, but those potentially related to the drug group (e.g. cardiovascular diagnoses for cardiovascular drugs). The cardiovascular diagnoses identified as constituting a cardiovascular separation included ICD-9 codes 392 to 449. The gastrointestinal diagnoses included the ICD-9 codes 531 to 537, and 574 to 579 (Appendix I). Due to the disparate and often non-specific nature of diagnoses that may be associated with central nervous system medications, it was not feasible to select specific diagnoses that would be treated with the use of these drugs. Medical service plan billings included total billings, billing for general practitioners only, and by specialists (either total specialists, or, for example, cardiovascular specialists for cardiovascular drugs). Lastly, enumeration area and socio-economic indicators were added in the same manner as described above for Phase I.

Analytic Methods

Descriptive analysis

Data were analysed with the statistical program SAS. In order to meet the first study objective, i.e. to describe drug utilization by the elderly in British Columbia as it varies by socioeconomic status, simple descriptive techniques were utilized to provide an overall account of prescription drug utilization by the elderly in British Columbia according to income quintile. Utilization rates and the ratios between the rates for the first and all other income quintiles were calculated. Three different numerators were used for the construction of these rates, including number of prescriptions, drug quantity and drug ingredient cost (which does not include the dispensing fee).

Both adjusted and unadjusted utilization rates were constructed for this study.

First, the utilization of prescription drugs per capita was explored. The elderly population of British Columbia was approximated using the British Columbia Medical Services Plan Registration Premium and Billing File, as described above. Since the vast majority of all permanent residents of British Columbia are registered in this file (and must do so in order to receive provincial health care benefits), it can be considered a good proxy for actual population. Per capita rates of drug utilization indicate the relative use of medications, or groups of medications on a province wide basis.

Second, the utilization of prescription drugs per user was determined. Utilization rates per user consider only those persons who have had at least one prescription for a drug, in the category analysed. In this manner, it is possible to, albeit not completely, control for the effects of incidence of symptoms or diseases on the use of medications. For example, while per capita rates of use for cardiovascular drugs represent the relative use of these in the Pharmacare population as whole, rates per user reflect the differential utilization of cardiovascular drugs only among individuals who have been prescribed them.

Age- and sex- standardized rates were calculated using the Direct Method, whereby age and sex specific rates were applied to a common population. In this case the British Columbia population (1991) served as the standard. This allowed for the comparison of utilization rates not only across the five income quintiles, which varied slightly in terms of their population distribution, but also to compare rates over the four years studied.

Third, a more detailed examination of rates of prescription drug use per user was carried out in order to determine whether statistically significant trends emerged for all drug use per therapeutic drug group and when stratified by age group and type of drug. Identical analyses were performed on each of these therapeutic drug groups. An analysis of variance (ANOVA) was carried out to test whether there exist statistically significant differences in the utilization of prescription drugs between the five income quintiles. ANOVA is designed to test whether there are significant differences between the means of three or more groups. This type of analysis measures both within-group variability and between-group variability to determine whether the underlying group means are statistically different. Simply stated, if the variation between groups is large compared to the variation within groups, the differences between the means of these groups can be said to be statistically significantly different. The F ratio used to determine this relationship is expressed as the sum of squares due to group differences (between mean square) divided by the sum of squares due to subject differences (within mean square or mean square error) (Hirsch and Riegelman, 1992).

However, ANOVA will uncover only statistically significant differences between *any* of the levels of the independent variable considered, in this case the income quintiles. By itself, this statistical procedure will give no indication whether *each* group, or income quintile, is statistically different from the others. Tukey's standardized range test, also known as the "honestly significant difference test", was used in order to test *which* income quintiles were different from others with respect to the utilization of prescription drugs, in terms of number of prescriptions, drug quantity and ingredient cost. Tukey's method tests each possible pair of income quintiles for statistically significant differences. Because of the number of groups involved, this test is superior to the use of t-tests to compare every pair of groups, with which there is a stronger likelihood of finding significant differences by chance. This ensures that the number of false significant differences is minimized (Rosner, 1990). This is just one of several available *a posteriori* tests available, but is considered to be a very powerful test of pairwise differences.

The results of Tukey's standardized range tests are easily presented in tabular form, in a very simple manner (Chapters Six and Seven and Eight), and thus are readily interpretable. Groups (income quintiles) whose means do not significantly differ are jointly underscored. If groups are statistically significantly different from one another, they will not be joined by a common underscore.

Multivariate analysis

In order to meet the second study objective, i.e. to determine whether there exists a socioeconomic gradient in rates of drug prescribing after controlling for demographic factors and health care utilization, multiple regression analysis was used. This allowed for the investigation of the relationship between income and other possibly predictive factors such as demographic variables and other health care utilization. The regression model for each of the three drug groups was determined separately. Before proceeding a test for normality was performed on the distribution of the dependent variables, including number of prescriptions per individual, total ingredient cost per individual, and drug quantity per individual. The All Possible Regressions (APR) technique was applied to this analysis (Kleinbaum and Kupper, 1988). The APR approach entails testing all combinations of regression equations which include all independent variables that are statistically significantly related to the dependent variable. Also, variables that were correlated with each other were not entered into the same analysis, since this would cause the regression model to become unstable and produce very large standard errors. First, individual regressions were performed with number of prescriptions as the dependent variable. Income quintile, demographic variables, and health care utilization variables served as the independent, or predictor, variables. A correlation analysis served to identify those variables that were correlated. Since many of these predictor variables were highly correlated, only variables with a Pearson Correlation Coefficient of 0.4 or less were included in the same regression analysis.

Second, variables which were both individually significant when regressed against the dependent variable and yielded the highest R square value were entered into a series of regression models in all possible combinations of two variables, three variables and so on, until the best fit was achieved. Variables were kept in the regression analysis if they were significant at p=.001, and if they contributed to a noticeable increase in the R square value. For example, if a fourth variable, were added to a three-variable model, yet the R square was not markedly higher than in the three-variable model, the fourth variable would not be included in the final model. Interactions between variables in the final model were also tested. In order to define a parsimonious model, the number of variables was kept to the minimum possible, with no marked reductions in the square value.

Once the model was defined using number of prescriptions as the dependent variable, this same model was then applied to the two other measures of utilization: drug quantity and drug cost. This was done in order to facilitate comparability between the three models in each drug group, as well as to streamline the model building process.

Summary

A variety of data sources and analytical methods were used in this study of trends in prescription drug utilization by the elderly in British Columbia. This is an investigation based on the analysis of administrative data. The main source of data, the British Columbia Linked Health Database, is in itself comprised of several databases, of which four were used here: the Pharmacare, Medical Services Plan, Hospital Records and Continuing Care database which included information on home care use. However, two other data files, including Canadian Census data and the Postal Code Conversion file were used to create files that contained income information and append them to prescription records, at the level of the enumeration area, for all individuals contained therein. Both simple descriptive and multivariate statistical methods were used to yield a full account of prescription drug use in the elderly.

Chapter Five

Drug Utilization by Socioeconomic Status: 1989 to 1995

In this chapter, trends in the utilization of prescription drugs by the elderly subscribers to Plan A of Pharmacare, the provincial drug benefit plan for seniors in British Columbia, are discussed for the years 1989, 1991, 1993 and 1995. An overview of the patterns of total prescription drug use by the elderly residing in the community is presented in the first section of this chapter. The remaining sections focus on the utilization of three distinct therapeutic drug groups. The utilization of gastrointestinal, central nervous system and cardiovascular drugs by income levels of the Pharmacare population is explored in detail.

Overall Patterns of Drug Use in British Columbia

In 1995, total Plan A direct drug costs amounted to over two hundred million dollars for prescriptions dispensed. An examination of prescription costs borne by Plan A of the British Columbia Pharmacare program reveals that cardiovascular, central nervous system and gastrointestinal drugs represent the largest proportion of expenditures (Figure 5.1). Ingredient costs for cardiovascular drugs, which include the cost of the preparations but not the dispensing fees, accounted for approximately 40 percent of the cost of all prescriptions dispensed under this plan in 1995. In this same year, central nervous system drugs and gastrointestinal drugs represented the second and third largest drug expenditure groups. These are followed by hormones, anti-infectives, autonomic system drugs and others[1].

---

[1] "Other" drugs include antihistamines, antineoplastics, blood formation drugs, electrolytics, enzymes, antitussives, eye ear nose and throat medications, gold compounds, heavy metal antagonists, serums and vaccines, skin preparations, smooth muscle preparations, vitamins and unclassified drugs.

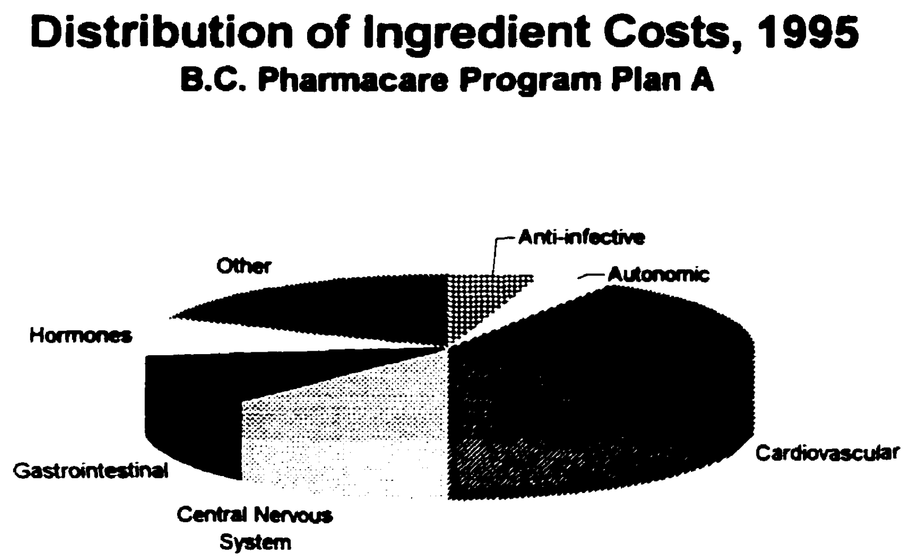


Figure 5.1

As depicted in Table 5.1, the share of expenditures for both cardiovascular and gastrointestinal drugs remained fairly stable over the study period. Cardiovascular drugs accounted for 40 percent of total ingredient costs in 1989 and 1993, 41 percent in 1995 and 39 percent in 1991. Gastrointestinal drugs accounted for approximately 11 percent of total ingredient costs in the years 1989, 1991 and 1995 and 12 percent in 1993. The proportion of total ingredient costs attributed to central nervous system drugs decreased over the period studied, ranging from 18 percent of total ingredient costs in 1989 to 12 percent in 1995.

In terms of drug quantity, or units dispensed, the pattern is similar for cardiovascular and central nervous system medications. Together, these two therapeutic groups account for approximately one half of all drugs dispensed by quantity. Gastrointestinal drugs, however, accounted for only 6.5 percent of all units dispensed in 1995 (Table 5.2). A greater number of units of hormonal preparations as well as autonomic system medications are prescribed than gastrointestinal drugs.

Table 5.1

Distribution of Drug Cost by Therapeutic Drug Groups
British Columbia Pharmacare Program, Plan A

Therapeutic Drug Group	1989		1991		1993		1996	
	$ (1,000)	%	$ (1,000)	%	$ (1,000)	%	$ (1,000)	%
Anti-infective	3852.5	3.8	6539.3	4.3	9012.9	4.6	9728.4	4.7
Autonomic	5054.9	5.0	8108.3	5.3	10033.9	5.1	8926.5	4.3
Cardiovascular	40589.1	40.0	59306.1	38.7	78575.1	40.1	86247.7	41.2
Central Nervous System	18136.5	17.9	23259.7	15.2	24176.9	12.3	24557.0	11.7
Gastrointestinal	10996.4	10.8	17411.3	11.4	23444.6	12.0	23068.4	11.0
Hormones	6383.9	6.3	10453.7	6.9	15102.4	7.7	17597.9	8.4
Other	16503.9	16.3	28028.4	18.3	35632.0	18.2	39123.9	18.7
Total	**101517.3**	**100.0**	**153106.9**	**100.0**	**195978.0**	**100.0**	**209249.7**	**100.0**

Table 5.2

Distribution of Drug Quantity by Therapeutic Drug Groups

British Columbia Pharmacare Program, Plan A

Therapeutic Drug Group	1989		1991		1993		1995	
	Units (1,000)	%	Units (1,000)	%	Units (1,000)	%	Units (1,000)	%
Anti-infective	13534.1	3.1	15484.1	3.2	16025.7	3.0	16069.4	3.0
Autonomic	53734.0	12.3	64228.5	13.1	71922.5	13.7	76952.2	14.2
Cardiovascular	118569.2	27.2	131377.2	26.8	139829.4	26.6	136222.1	25.1
Central Nervous System	91646.7	21.0	96526.4	19.7	98656.8	18.8	95795.6	17.7
Gastrointestinal	24041.8	5.5	30495.4	6.2	34637.5	6.6	35134.3	6.5
Hormones	44976.6	10.3	55788.8	11.4	6910.5	13.2	82595.9	15.2
Other	89093.6	20.5	95507.5	19.5	96045.4	18.3	99637.1	18.4
Total	**435596.0**	**100.0**	**489407.8**	**100.0**	**526307.9**	**100.0**	**542406.6**	**100.0**

A slightly different picture emerges when the numbers of prescriptions by therapeutic drug group are examined. As shown in Table 5.3, cardiovascular and central nervous system drugs shared an approximately equal share of the total number of prescriptions dispensed in 1995, a slight change from the situation in 1989, when the share of prescriptions for central nervous system medications was greater than that for cardiovascular medications. The third largest group of prescriptions was related to hormones, followed by gastrointestinal medications in all years studied. The temporal trends in drug utilization are also clearly illustrated in Tables 5.1, 5.2 and 5.3. While the proportion of most drugs remains relatively stable throughout the period, there has been a marked reduction in the proportion of central nervous system medications dispensed as well as an increase in the use of hormonal preparations.

Table 5.3
Distribution of Prescriptions by Therapeutic Drug Groups
British Columbia Pharmacare Program, Plan A

Therapeutic Drug Group	1989		1991		1993		1995	
	# (1,000)	%	# (1,000)	%	# (1,000)	%	# (1,000)	%
Anti-infective	313.4	7.4	377.3	7.9	421.7	8.0	426.5	7.8
Autonomic	196.2	4.7	240.1	5.0	269.1	5.1	272.6	5.0
Cardiovascular	856.5	20.3	972.4	20.4	1113.0	21.2	1191.7	21.8
Central Nervous System	1090.3	25.9	1171.9	24.6	1206.8	23.0	1178.5	21.6
Gastrointestinal	243.0	5.8	311.9	6.5	366.5	7.0	369.5	6.8
Hormones	383.3	9.1	465.0	9.7	569.4	10.8	661.0	12.1
Other	1128.8	26.8	1235.6	25.9	1311.3	24.9	1356.9	24.9
Total	**4211.4**	**100.0**	**4774.2**	**100.0**	**5287.8**	**100.0**	**5456.7**	**100.0**

In summary, cardiovascular drugs represent a fairly costly therapeutic drug group which have accounted for an increasingly greater share of not only total cost, but prescriptions as well. The cost of providing the less expensive (on average) central nervous system preparations, on the other hand, has fallen over the study period, relative to the other therapeutic drug groups, as has the amount of central nervous system drugs prescribed. Gastrointestinal drugs represent a larger share of total costs than they do either quantity or the number of prescriptions dispensed, and they too have witnessed a relative increase in their share of total drug utilization.

In the following sections, the relationship between income and the utilization of medications by the elderly in British Columbia will be explored. This discussion will concentrate on three major therapeutic drug groups: cardiovascular, central nervous system and gastrointestinal drugs. Not only do these groups combined represent the bulk of drug utilization by the elderly in this province, they are also sufficiently large to provide stable rates over the years examined. Furthermore, both cardiovascular and gastrointestinal medications are included in the ten most frequently prescribed, and therefore also most costly, drugs reimbursed by the Pharmacare plan. Data are presented by number of prescriptions dispensed, drug quantity dispensed and ingredient costs for the total, female and male Pharmacare population.

Income and Total Utilization of Prescription Drugs by the Elderly

The utilization of all drugs dispensed to elderly subscribers of the British Columbia Pharmacare Program by income quintiles is presented in Table 5.4. Quintile 1 includes those individuals with the highest incomes, while the lowest income elderly are included in the fifth quintile, as discussed in the previous chapter. In all years, there exists a monotonic gradient in the number of prescriptions per subscriber with decreasing income. For example, in 1989 individuals in the lowest income quintile were dispensed, on average 14.0 prescriptions, compared to 11.9 prescriptions for those in the first income quintile. It is also useful to note that while the average number of prescriptions per subscriber increased between 1989 and 1993, then leveled off[2], the relationship between the first and fifth quintile remains remarkably stable over the time period: between 16 and 18 percent more prescriptions, on average, for those in the fifth, lowest income quintile.

These data also indicate that after 1991, the quantity of drugs dispensed per subscriber is also stable. The average number of units dispensed per day ranges from 3.2 to 4.2 medication units. However, this amount was slightly lower in 1989, when the number of medication units dispensed did not exceed 3.9, even in the poorest income quintile. In both 1993 and 1995, poorer Pharmacare subscribers used 20 percent more medication, in terms of units dispensed, than their more affluent counterparts in the first income quintile.

While cost per subscriber is reported in actual dollars and therefore cannot be directly compared over the four years examined here, the relationships between the five income quintiles can be examined over time. Again, a monotonic gradient in the cost rates is evidenced in each of the four years considered here. The disparity between income groups is quite consistent throughout the period. In 1989 those in the poorest income quintile received drugs costing, on average, 9 percent more than those in the highest income quintiles. In the following years this difference was between 10 and 11 percent.

---

[2] The copayment for drugs under Pharmacare Plan A increased from 75 percent of the dispensing fee, to a maximum paid $125, to 100 percent, to a maximum paid $200 on April 1, 1994, thereby possibly affecting the number and size of individual prescriptions dispensed.

Table 5.4

Rates of Total Prescription Drug Use in British Columbia, 1989-1995

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
	Highest Income				Lowest Income
1989					
Number of Prescriptions	740544	743424	700918	807386	798747
Prescriptions per subscriber	11.9	12.5	12.6	13.2	14.0
Quantity per subscriber	**1239.3**	**1296.7**	**1322.0**	**1370.0**	**1434.0**
Quantity per subscriber per day	**3.4**	**3.5**	**3.6**	**3.8**	**3.9**
Cost per subscriber ($)	310.95	316.15	320.94	330.75	340.29
Cost per day ($)	0.85	0.87	0.88	0.91	0.93
1991					
Number of Prescriptions	880846	856298	819714	938668	910864
Prescriptions per subscriber	12.7	13.3	13.5	14.0	14.9
Quantity per subscriber	**1409.4**	**1494.8**	**1446.43**	**1501.4**	**1516.15**
Quantity per subscriber per day	**3.9**	**4.1**	**4.0**	**4.1**	**4.2**
Cost per subscriber ($)	420.34	429.68	434.34	446.23	465.74
Cost per day ($)	1.15	1.18	1.19	1.22	1.28
1993					
Number of Prescriptions	985464	956758	880431	1014837	951337
Prescriptions per subscriber	13.0	13.8	13.9	14.5	15.3
Quantity per subscriber	**1290.4**	**1413.7**	**1400.9**	**1457.8**	**1548.6**
Quantity per subscriber per day	**3.5**	**3.9**	**3.8**	**4.0**	**4.2**
Cost per subscriber ($)	502.52	517.37	521.15	531.19	553.92
Cost per day ($)	1.38	1.42	1.43	1.47	1.52
1995					
Number of Prescriptions	1007734	975907	882713	1004916	918991
Prescriptions per subscriber	13.2	13.8	14.0	14.6	15.3
Quantity per subscriber	**1287.5**	**1364.3**	**1395.4**	**1459.8**	**1546.3**
Quantity per subscriber per day	**3.5**	**3.7**	**3.8**	**4.0**	**4.2**
Cost per subscriber ($)	517.45	533.71	536.96	553.42	568.36
Cost per day ($)	1.42	1.46	1.47	1.52	1.56

Income and the Utilization of Prescription Drugs by Therapeutic Drug Group

In the remainder of this chapter, the utilization of prescription drugs by the elderly in British Columbia by income quintile for the three therapeutic drug groups that are the focus of this study is described. Utilization may be examined in a number of ways, including the number of prescriptions, expenditures, quantity prescribed, the number of individuals to whom drugs have been prescribed as well as unit or prescription costs. None of these components alone provides a complete understanding of utilization, and whether frequency of prescribing, the amount prescribed or even the average sizes of prescriptions underlie possible differences in drug use between income groups. However, viewed in tandem, a more comprehensive picture results. The utilization of prescription drugs may be viewed in the following terms:

$$\frac{Quantity}{User}$$

$$\frac{Costs}{Capita} = \frac{Users}{Population} \times \frac{Prescriptions}{User} \times \frac{Quanity}{Prescription} \times \frac{Cost}{Unit}$$

$$\frac{Prescriptions}{Capita}$$

In this equation, prescription costs per capita are a function of the number of individuals using at least one prescription medication, the number of prescriptions each user is dispensed, the size of the prescription, in terms of number of units dispensed, and the cost of each unit dispensed. Prescriptions per capita are a product of users per capita and prescriptions per user, whereas the quantity dispensed per user is a product of prescriptions per users and prescription size. As this equation shows, increases or decreases in *any* of these components will affect overall utilization. For this reason it is vital to examine all components of drug utilization. In the remainder of this chapter, each component of utilization will be examined for gastrointestinal, central nervous system and cardiovascular prescription medications.

Users per capita by income quintile

An analysis of prescription drug utilization by the elderly in British Columbia shows that drug use does differ according to income. The number of users per capita, or the number of individuals using at least one prescription in each of the three therapeutic drug groups is presented in Table 5.5. A clear income gradient in the number of users per capita emerged in all three therapeutic drug groups. In the gastrointestinal drug group, there were 19 percent more users per capita in the lowest income quintile in 1989, and 12 percent more users in the fourth lowest income quintile compared to the highest income quintile. In 1991,1993 and 1995, there were approximately 16, 17 and 13 percent more users per capita in the lowest income quintile respectively. The overall number of users per capita increased slightly in 1989, then remained relatively stable to 1995.

With central nervous system medications, the number of users per capita decreased over the study period, but an income gradient was evident in all four years. In 1989, 1991 and 1993 there were 10 percent more users per capita in the lowest income quintile compared to the highest income quintile. This difference decreased to 6 percent in 1995.

Lastly, the pattern of users of cardiovascular preparations also exhibited a monotonic gradient in users per capita. In 1989, there were 14 percent more users per capita in the lowest income quintile compared to the highest income quintile, and 7 percent more users in the fourth income quintile compared to the first, and highest income quintile. By 1995 the magnitude of this difference had lessened, with 6 percent more users in the lowest income quintile compared to the highest income quintile.

Table 5.5

Users per Capita by Income Quintile, 1989-1995

	Quintile 1 (Q1) Highest Income	Quintile 2 (Q2)		Quintile 3 (Q3)		Quintile 4 (Q4)		Quintile 5 (Q5) Lowest Income	
	Users per 1000 Pop	Users per Capita	Ratio Q2:Q1	Users per Capita	Ratio Q3:Q1	Users per Capita	Ratio Q4:Q1	Users per Capita	Ratio Q5:Q1
Gastrointestinal Drugs									
1989	0.160	0.171	**1.07**	0.182	**1.14**	0.180	**1.12**	0.190	**1.19**
1991	0.193	0.204	**1.06**	0.212	**1.10**	0.214	**1.11**	0.223	**1.16**
1993	0.206	0.223	**1.08**	0.226	**1.10**	0.229	**1.11**	0.241	**1.17**
1995	0.196	0.208	**1.06**	0.214	**1.08**	0.212	**1.08**	0.222	**1.13**
Central Nervous System Drugs									
1989	0.449	0.456	**1.01**	0.469	**1.04**	0.473	**1.05**	0.493	**1.10**
1991	0.463	0.471	**1.02**	0.482	**1.04**	0.488	**1.05**	0.508	**1.10**
1993	0.448	0.457	**1.02**	0.467	**1.04**	0.473	**1.05**	0.493	**1.10**
1995	0.426	0.430	**1.01**	0.435	**1.02**	0.434	**1.02**	0.449	**1.06**
Cardiovascular Drugs									
1989	0.314	0.328	**1.04**	0.337	**1.07**	0.336	**1.07**	0.357	**1.14**
1991	0.338	0.350	**1.04**	0.357	**1.06**	0.363	**1.08**	0.379	**1.12**
1993	0.357	0.371	**1.04**	0.376	**1.05**	1.379	**1.06**	0.393	**1.10**
1995	0.366	0.374	**1.02**	0.375	**1.02**	0.378	**1.03**	0.387	**1.06**

Utilization per capita by income quintile

Unadjusted prescriptions per capita by income quintiles in the three therapeutic drug groups highlighted are presented in Table 5.6. Two distinct patterns emerge. First, the monotonic gradient is evident in each of the three drug groups, albeit in varying degrees. Second, the ratios of per capita use rates between the first and other quintiles decreased over the four years analysed.

Table 5.6

Prescriptions per Capita by Income Quintile, 1989-1995

	Quintile 1 (Q1)	Quintile 2 (Q2)		Quintile 3 (Q3)		Quintile 4 (Q4)		Quintile 5 (Q5)	
	Highest Income							Lowest Income	
	Rx per Capita	Rx per Capita	Ratio Q2:Q1	Rx per Capita	Ratio Q3:Q1	Rx per Capita	Ratio Q4:Q1	Rx per Capita	Ratio Q5:Q1
Gastrointestinal Drugs									
1989	0.497	0.541	1.09	0.585	1.18	0.601	1.21	0.638	1.29
1991	0.626	0.676	1.08	0.708	1.13	0.743	1.19	0.791	1.26
1993	0.691	0.762	1.10	0.783	1.13	0.826	1.19	0.873	1.27
1995	0.668	0.723	1.09	0.747	1.12	0.771	1.15	0.810	1.21
Central Nervous System Drugs									
1989	2.277	2.404	1.06	2.487	1.09	2.652	1.16	2.953	1.30
1991	2.359	2.516	1.07	2.567	1.09	2.773	1.18	3.054	1.29
1993	2.275	2.461	1.08	2.524	1.11	2.686	1.18	2.963	1.30
1995	2.153	2.273	1.06	2.334	1.08	2.430	1.13	2.699	1.25
Cardiovascular Drugs									
1989	1.854	1.974	1.06	1.999	1.08	2.073	1.12	2.197	1.19
1991	2.041	2.161	1.06	2.178	1.07	2.276	1.12	2.407	1.18
1993	2.228	2.350	1.06	2.355	1.06	2.456	1.10	2.561	1.15
1995	2.290	2.369	1.03	2.371	1.04	2.455	1.08	2.513	1.10

Of the three therapeutic drug groups, the largest disparity in per capita prescriptions was evident with respect to central nervous system drugs. In 1989, those in the poorest income quintile received 30 percent more prescriptions than those in the most affluent income quintile. By 1995, this ratio had lessened somewhat, with the least affluent receiving 25 percent more prescriptions than the most affluent. This is despite an overall reduction in the number of prescriptions per capita across the board over this six year period. This decrease in the number of prescriptions per capita did not occur in the cardiovascular and gastrointestinal drug groups; rather, the average number of prescriptions *increased* between 1989 and 1995. Those in the fifth and poorest income quintile received 19 percent more prescriptions for cardiovascular medications, and 29 percent more prescriptions for gastrointestinal medications, than those in the first quintile in 1989.

The distinct monotonic nature of the gradients is a very important finding. This indicates that in the case of prescription drug use by the elderly in this population there is not simply a threshold effect, whereby the poorest individuals are dispensed a greater number of prescriptions than the most affluent, but that with decreasing neighborhood income, each quintile is dispensed, on average, successively more prescriptions. Consider, for example, the case of central nervous system drugs. In 1995, the fourth income quintile received 13 percent more prescriptions than the most affluent quintile (or 18 percent in 1993), while the third quintile received 8 percent more prescriptions, and the second quintile received 6 percent more than the most affluent quintile.

Cardiovascular and gastrointestinal drugs exhibited a similar gradient. However, it should be noted that in the case of cardiovascular drugs, the gradient is comparatively flat in the middle (second and third), rising more sharply between the third and fourth quintiles.

Unadjusted per capita rates of drug quantity for the three therapeutic drug groups are presented in Table 5.7. Drug quantity signifies the number of units of drugs dispensed, such as pills, capsules or doses. They may, however, represent different quantities of the actual drug dispensed. Although these rates must be interpreted with caution due to this restriction, they nevertheless provide an insight into the drug utilization of the Pharmacare population.

Table 5.7

Drug Quantity per Capita by Income Quintile, 1989-1995

	Quintile 1 (Q1) Highest Income	Quintile 2 (Q2)		Quintile 3 (Q3)		Quintile 4 (Q4)		Quintile 5 (Q5) Lowest Income	
	Units per Capita	Units per Capita	Ratio Q2:Q1	Units per Capita	Ratio Q3:Q1	Units per Capita	Ratio Q4:Q1	Units per Capita	Ratio Q5:Q1
Gastrointestinal Drugs									
1989	48.91	53.78	1.10	57.45	1.17	59.25	1.21	63.97	1.31
1991	60.38	65.27	1.08	68.51	1.13	72.68	1.20	79.55	1.32
1993	63.62	71.92	1.13	73.58	1.16	72.29	1.23	84.73	1.33
1995	62.06	68.51	1.10	69.93	1.13	73.10	1.18	79.11	1.27
Central Nervous System Drugs									
1989	192.08	201.56	1.05	212.08	1.10	223.18	1.16	248.12	1.29
1991	193.75	205.85	1.06	213.51	1.11	229.10	1.18	254.93	1.32
1993	186.31	199.88	1.07	207.61	1.11	220.54	1.18	243.51	1.31
1995	172.58	184.21	1.07	191.73	1.11	198.12	1.15	221.90	1.29
Cardiovascular Drugs									
1989	259.69	271.45	1.05	279.32	1.08	287.90	1.11	301.90	1.16
1991	276.71	289.88	1.05	294.80	1.07	309.24	1.12	327.29	1.18
1993	278.58	293.97	1.06	297.33	1.07	308.16	1.11	324.55	1.17
1995	259.33	269.77	1.04	271.15	1.05	279.69	1.08	292.09	1.13

These data suggest that less affluent elderly residents of British Columbia are being dispensed not only a greater number of prescriptions, but also greater quantities of prescription drugs in these three therapeutic drug groups. Again, an unmistakable monotonic gradient exists between income quintiles.

Generally, the relationships between income quintiles in this table mimic those in the previous table, in which the number of prescriptions per capita are presented. The differences between income quintiles are most marked in the central nervous system and gastrointestinal drug groups. In both of these categories the quantity of drugs prescribed per capita in the poorest quintile exceeds that in the most affluent by 27 to 33 percent. Again, each successively poorer income group exhibits a greater rate of drug utilization. Cardiovascular drug use, measured in terms of quantity of drugs dispensed, also shows this gradient, albeit to a slightly lesser extent. In this therapeutic drug group, the rate of drug use in the fifth and poorest quintile exceeded the first quintile by 16 percent in 1989 and 18 percent in 1991, dropping to 13 percent in 1995.

Lastly, ingredient cost represents the cost of each prescription to the Pharmacare Program (Plan A), and does not include the dispensing fee, which is highly variable throughout the province. Again, the monotonic gradient emerges in each case (Table 5.8). In general, the ratios between the use rates of individual quintiles are smaller than those evidenced with respect to either prescription rates or rates of drug quantity. Once again, the gradient is least pronounced in the cardiovascular drug group. The ratio between the least and most affluent income quintiles decreased markedly throughout the study period. However, the average per capita drug costs for those in the poorest income quintile exceed those of individuals in the most affluent income quintile by 10, 12, 9 and 4 percent in the four years respectively nevertheless. There is also a very slight dip in the per capita costs of cardiovascular drugs for those in the third quintile.

In 1995, central nervous system drug costs were 21 percent higher for the poorest quintile compared to the first quintile, while gastrointestinal drugs costs were up to 22 percent higher in the poorest quintile. While the total costs increased over the years studied, again, the ratios between quintiles changed only marginally between 1989 and 1995.

Table 5.8

Ingredient Cost per Capita by Income Quintile, 1989-1995

	Quintile 1 (Q1) Highest Income	Quintile 2 (Q2)		Quintile 3 (Q3)		Quintile 4 (Q4)		Quintile 5 (Q5) Lowest Income	
	Cost per Capita	Cost per Capita	Ratio Q2:Q1	Cost per Capita	Ratio Q3:Q1	Cost per Capita	Ratio Q4:Q1	Cost per Capita	Ratio Q5:Q1
Gastrointestinal Drugs									
1989	23.53	24.28	1.03	26.63	1.13	26.62	1.13	28.65	1.22
1991	35.44	37.44	1.06	39.64	1.12	41.30	1.17	44.40	1.25
1993	44.36	48.59	1.10	50.06	1.13	52.53	1.18	59.19	1.27
1995	41.78	45.01	1.08	46.23	1.11	48.05	1.15	50.78	1.22
Central Nervous System Drugs									
1989	39.10	40.38	1.03	42.56	1.09	44.39	1.14	47.34	1.21
1991	48.48	50.52	1.04	52.06	1.07	55.14	1.14	59.13	1.22
1993	46.89	49.85	1.06	52.03	1.11	53.64	1.14	57.09	1.22
1995	45.71	47.09	1.03	46.62	1.09	50.43	1.10	54.62	1.19
Cardiovascular Drugs									
1989	91.29	94.54	1.04	95.20	1.04	97.56	1.07	100.51	1.10
1991	128.27	134.30	1.05	132.98	1.04	137.03	1.07	143.13	1.12
1993	161.65	168.25	1.04	166.67	1.03	171.00	1.06	176.22	1.09
1995	170.11	173.76	1.02	171.76	1.01	173.76	1.02	176.13	1.04

Age- and sex-adjusted per capita rates are presented in tables 5.9, 5.10 and 5.11, and allow for a direct comparison of rates not only between quintiles but also between each of the four years under study. The data show that the ratios between the poorest and most affluent individuals in the population decreased over the study period for gastrointestinal drugs and cardiovascular drugs. While the poorest income quintiles received, on average, 25 percent more prescriptions per capita for gastrointestinal drugs in 1989, this ratio had decreased to 18 percent by 1995. Similarly, the difference in per capita rates of cardiovascular prescriptions dispensed was 15 percent greater for those in the poorest quintile in 1989, which decreased to 5 percent by 1995.

Table 5.9

Age and Sex Adjusted Prescriptions per Capita by Income Quintile, 1989-1995

	Quintile 1 (Q1)	Quintile 2 (Q2)		Quintile 3 (Q3)		Quintile 4 (Q4)		Quintile 5 (Q5)	
	Highest Income							Lowest Income	
	Rx per Capita	Rx per Capita	Ratio Q2:Q1	Rx per Capita	Ratio Q3:Q1	Rx per Capita	Ratio Q4:Q1	Rx per Capita	Ratio Q5:Q1
Gastrointestinal Drugs									
1989	0.500	0.538	1.08	0.580	1.16	0.593	1.19	0.623	1.25
1991	0.618	0.660	1.07	0.689	1.11	0.716	1.16	0.758	1.23
1993	0.693	0.760	1.10	0.777	1.12	0.814	1.17	0.953	1.23
1995	0.667	0.723	1.08	0.744	1.12	0.760	1.14	0.785	1.18
Central Nervous System Drugs									
1989	2.289	2.391	1.04	2.459	1.07	2.592	1.13	2.886	1.26
1991	2.316	2.467	1.07	2.494	1.08	2.668	1.15	2.936	1.27
1993	2.285	2.459	1.08	2.506	1.10	2.641	1.16	3.030	1.33
1995	2.161	2.278	1.08	2.328	1.12	2.240	1.14	2.651	1.23
Cardiovascular Drugs									
1989	1.861	1.965	1.06	1.981	1.06	2.041	1.10	2.134	1.15
1991	2.004	2.112	1.05	2.110	1.05	2.184	1.09	2.280	1.14
1993	2.227	2.342	1.05	2.235	1.05	2.400	1.08	2.467	1.11
1995	2.281	2.348	1.03	2.340	1.03	2.392	1.04	2.397	1.05

These trends are also apparent when age- and sex-adjusted per capita rates of drug quantity or cost are examined. The adjusted per capita drug quantity rates for cardiovascular drugs presented in

Table 5.10 illustrates that while the differences in rates between income quintiles for this drug group are relatively large in 1989, they become comparatively smaller by 1995. Differences in adjusted per capita prescription rates in the gastrointestinal and central nervous system drug groups between the poorest and most affluent income quintiles are between 23 and 29 percent throughout the study period.

Table 5.10

Age and Sex Adjusted Drug Quantity per Capita by Income Quintile, 1989-1995

	Quintile 1 (Q1)	Quintile 2 (Q2)		Quintile 3 (Q3)		Quintile 4 (Q4)		Quintile 5 (Q5)	
	Highest Income							Lowest Income	
	Units per Capita	Units per Capita	Ratio Q2:Q1	Units per Capita	Ratio Q3:Q1	Units per Capita	Ratio Q4:Q1	Units per Capita	Ratio Q5:Q1
Gastrointestinal Drugs									
1989	49.35	53.86	1.09	56.85	1.15	58.66	1.19	62.40	1.26
1991	59.94	63.53	1.06	66.51	1.11	69.55	1.16	76.03	1.27
1993	63.84	71.88	1.13	72.90	1.14	77.05	1.21	82.47	1.29
1995	61.87	68.47	1.11	69.35	1.12	72.01	1.16	76.37	1.23
Central Nervous System Drugs									
1989	193.14	200.91	1.04	209.99	1.09	218.96	1.14	243.05	1.26
1991	190.52	201.91	1.06	207.27	1.09	220.18	1.16	246.02	1.29
1993	187.07	199.67	1.07	205.59	1.10	216.98	1.16	239.53	1.28
1995	172.89	184.43	1.07	190.92	1.10	195.71	1.13	218.63	1.26
Cardiovascular Drugs									
1989	259.57	269.70	1.04	276.59	1.07	284.41	1.10	295.27	1.14
1991	270.39	282.94	1.05	285.47	1.06	297.81	1.10	313.27	1.16
1993	277.83	292.77	1.05	293.42	1.06	302.80	1.09	314.98	1.14
1995	257.95	267.38	1.04	267.27	1.04	272.96	1.06	279.45	1.08

Age- and sex-adjusted costs per capita reveal similar trends (Table 5.11). In 1995, the lowest income quintiles accounted for 18,percent greater cost than the most affluent in the gastrointestinal and central nervous system groups, and 2 percent greater cost than the highest income quintile in the cardiovascular drug group. The disparities in drug costs between the least and most affluent are slightly higher in 1991 and 1993 than in either the first or latest year of the study period. Also, a slight dip in the per capita cost rates for cardiovascular drugs in the third quintile in 1989 and 1991 persists.

Table 5.11

Age and Sex Adjusted Ingredient Cost per Capita by Income Quintile, 1989-1995

	Quintile 1 (Q1)	Quintile 2 (Q2)		Quintile 3 (Q3)		Quintile 4 (Q4)		Quintile 5 (Q5)	
	Highest Income							Lowest Income	
	Cost per Capita	Cost per Capita	Ratio Q2:Q1	Cost per Capita	Ratio Q3:Q1	Cost per Capita	Ratio Q4:Q1	Cost per Capita	Ratio Q5:Q1
Gastrointestinal Drugs									
1989	23.63	24.21	1.02	26.34	1.11	26.33	1.11	28.06	1.19
1991	34.88	36.56	1.05	38.43	1.10	39.80	1.14	42.61	1.22
1993	44.36	48.46	1.09	49.53	1.12	51.73	1.17	54.93	1.24
1995	41.70	44.93	1.08	45.99	1.10	47.27	1.13	49.07	1.18
Central Nervous System Drugs									
1989	39.29	40.15	1.02	42.11	1.07	43.56	1.11	46.39	1.18
1991	47.65	49.40	1.04	50.51	1.06	53.03	1.11	57.65	1.21
1993	46.90	49.61	1.06	51.60	1.10	52.89	1.13	56.28	1.20
1995	45.79	47.21	1.03	49.61	1.08	50.04	1.09	54.24	1.18
Cardiovascular Drugs									
1989	90.78	93.64	1.03	94.13	1.04	96.56	1.06	99.76	1.10
1991	125.12	130.59	1.04	128.82	1.03	132.67	1.06	138.28	1.11
1993	163.05	167.11	1.02	164.90	1.01	168.57	1.03	173.00	1.06
1995	169.01	172.26	1.02	170.36	1.01	171.59	1.02	172.09	1.02

Utilization per user by income quintile

While the examination of per capita use rates is both interesting and instructive, it is unclear from these data whether they reflect differences in drug utilization or differences in underlying morbidity. The study of utilization rates per user may alleviate this somewhat. Drug utilization per user is defined as prescription drug utilization by users of those drugs, rather than by the entire population of elderly residents of British Columbia. Unlike prescriptions per capita, discussed above, the denominator in this case is the number of individuals who receive *at least one prescription in that drug group*. For example, the rate per user for cardiovascular drugs compares the number of prescriptions received by individuals receiving cardiovascular drug therapy of any kind. In this manner, only individuals already requiring, or rather, receiving drugs in each group are compared. Therefore, this method may indirectly adjust the data for underlying differences in morbidity and possibly a portion of the underlying differences in contacts with the health care system or prescription drug use between the five income groups.

Unadjusted rates per user by income quintiles for the three major therapeutic drug groups are presented in Table 5.12. As expected, the rates are considerably higher than the comparable rates computed on a per capita basis, since the denominator considered here is smaller. Even when considering only those individuals who receive at least one drug in each of these therapeutic drug groups, a distinct income gradient emerges. Central nervous system drugs exhibit the greatest income differentials in utilization. In fact, the poorest income quintile utilized up to 19 percent more drugs in terms of numbers of prescriptions than their wealthier counterparts. Furthermore, the monotonic nature of the gradient evidenced with respect to overall per capita prescription rates is replicated with prescription rates per user. The second and third quintiles, although very similar, in their drug utilization, exhibit higher rates of prescriptions than the first, and most affluent quintile, but less than the fourth and fifth quintiles, respectively.

Table 5.12

Prescriptions per User by Income Quintile, 1989-1995

	Quintile 1 (Q1) Highest Income	Quintile 2 (Q2)		Quintile 3 (Q3)		Quintile 4 (Q4)		Quintile 5 (Q5) Lowest Income	
	Rx per User	Rx per User	Ratio Q2:Q1	Rx per User	Ratio Q3:Q1	Rx per User	Ratio Q4:Q1	Rx per User	Ratio Q5:Q1
Gastrointestinal Drugs									
1989	3.102	3.160	1.02	3.209	1.03	3.336	1.08	3.344	1.08
1991	3.245	3.309	1.02	3.338	1.03	3.476	1.07	3.544	1.09
1993	3.355	3.412	1.02	3.460	1.03	3.600	1.07	3.622	1.08
1995	3.398	3.474	1.02	3.497	1.03	3.630	1.07	3.649	1.07
Central Nervous System Drugs									
1989	5.065	5.276	1.04	5.230	1.03	5.611	1.11	5.988	1.18
1991	5.097	5.341	1.05	5.326	1.05	5.684	1.12	6.024	1.18
1993	5.077	5.383	1.06	5.403	1.06	5.678	1.12	6.013	1.18
1995	5.060	5.290	1.05	5.361	1.06	5.608	1.11	6.009	1.19
Cardiovascular Drugs									
1989	5.899	6.009	1.02	5.938	1.01	6.162	1.04	6.161	1.04
1991	6.054	6.184	1.02	6.098	1.01	6.267	1.04	6.363	1.05
1993	6.233	6.336	1.02	6.269	1.01	6.483	1.04	6.510	1.04
1995	6.252	6.325	1.01	6.320	1.01	6.501	1.03	6.486	1.04

One very interesting difference between these prescription rates per user and the prescription rates per capita discussed above, concerns trends over time for central nervous system drugs. While the number of prescriptions for central nervous system drugs in the population as a whole has decreased over time, utilization has not decreased when only those individuals receiving at least one central nervous system medication are taken into account. In fact, the number of prescriptions per user has remained relatively constant over this period. This is true in every income quintile, even though the disparities in prescribing between them are substantial. Fewer individuals were being prescribed central nervous system drugs over the study period, yet for those receiving these drugs, use did not decrease.

The difference in prescriptions per user between the lowest and highest income quintiles is less pronounced in the cardiovascular and gastrointestinal drug groups compared to central nervous system drugs. In the cardiovascular drug group, users in the least affluent quintile had up to 5 percent more prescriptions throughout the period under study. This curve is relatively flat until the fourth quintile; the second and third quintiles are similar, as are the fourth and fifth quintiles. In this case, the pattern resembles a threshold more than a monotonic gradient. Again, a barely appreciable dip in the third quintile is evidenced.

Gastrointestinal drugs prescription rates are between 7 percent (in 1995) and 9 percent (1991) higher for the poorest individuals compared to the most affluent. The rates increase monotonically as income decreases. Furthermore, when prescriptions per user are considered, it is evident that the number of prescriptions for those receiving at least one gastrointestinal drug has increased slightly every year under study.

Drug quantity per user is described in Table 5.13. In light of the data presented above, the patterns of drug quantity are as expected; however a few points are worthy of mention. For example, quantities of central nervous system medications dispensed per user declined over time, despite the constancy in prescription rates per user, as evidenced in the preceding table. In other words, it seems that prescription size has decreased over time - a factor that should be considered when examining these data (see next section for an examination of prescription sizes). However, the trend toward decreasing amounts of central nervous system drugs is apparent only after 1991. The ratios between the poorest and most affluent quintiles for the quantities of central nervous system and cardiovascular drugs dispensed are more variable, year to year, than for prescription rates per user.

Table 5.13

Drug Quantity per User by Income Quintile, 1989-1995

	Quintile 1 (Q1) Highest Income	Quintile 2 (Q2)		Quintile 3 (Q3)		Quintile 4 (Q4)		Quintile 5 (Q5) Lowest Income	
	Units per User	Units per User	Ratio Q2:Q1	Units per User	Ratio Q3:Q1	Units per User	Ratio Q4:Q1	Units per User	Ratio Q5:Q1
Gastrointestinal Drugs									
1989	305.12	314.32	1.03	315.18	1.03	328.94	1.08	335.36	1.10
1991	311.85	313.84	1.01	322.65	1.03	333.13	1.07	357.29	1.15
1993	308.83	322.15	1.04	325.26	1.05	341.31	1.11	351.65	1.14
1995	315.90	329.08	1.04	327.25	1.04	344.23	1.09	356.51	1.13
Central Nervous System Drugs									
1989	427.24	442.50	1.04	451.88	1.06	471.06	1.10	503.00	1.18
1991	439.69	455.63	1.04	453.87	1.04	485.04	1.10	516.44	1.17
1993	415.74	437.29	1.05	444.33	1.07	466.31	1.12	494.01	1.19
1995	405.55	428.66	1.06	440.56	1.09	457.18	1.13	494.01	1.22
Cardiovascular Drugs									
1989	826.18	826.71	1.00	829.64	1.01	855.91	1.04	846.30	1.03
1991	769.61	791.29	1.03	780.06	1.01	806.35	1.05	828.25	1.08
1993	779.36	792.63	1.02	791.38	1.02	813.25	1.04	825.18	1.06
1995	708.04	720.45	1.02	722.08	1.02	740.71	1.05	753.96	1.06

It is therefore slightly surprising that the rates of ingredient cost per user are not altogether similar to the trends uncovered to this point (Table 5.14). Three distinct scenarios emerge in each of the three therapeutic drug groups.

Table 5.14

Ingredient Cost per User by Income Quintile, 1989-1995

	Quintile 1 (Q1) Highest Income	Quintile 2 (Q2)		Quintile 3 (Q3)		Quintile 4 (Q4)		Quintile 5 (Q5) Lowest Income	
	Cost per User	Cost per User	Ratio Q2:Q1	Cost per User	Ratio Q3:Q1	Cost per User	Ratio Q4:Q1	Cost per User	Ratio Q5:Q1
Gastrointestinal Drugs									
1989	146.77	141.91	0.97	146.08	1.00	147.77	1.01	150.16	1.02
1991	183.41	183.33	1.00	186.78	1.02	193.16	1.05	198.76	1.08
1993	215.30	217.67	1.01	221.30	1.03	229.05	1.04	233.21	1.08
1995	212.65	216.19	1.02	216.37	1.02	226.26	1.06	228.85	1.08
Central Nervous System Drugs									
1989	86.99	88.62	1.02	90.65	1.04	93.89	1.08	96.00	1.10
1991	104.63	107.15	1.02	107.92	1.03	112.91	1.08	116.49	1.11
1993	104.62	109.05	1.02	111.36	1.06	113.39	1.08	115.82	1.11
1995	107.39	109.58	1.02	114.01	1.06	116.37	1.08	121.60	1.13
Cardiovascular Drugs									
1989	290.46	287.86	0.99	282.75	0.97	290.02	1.00	281.77	0.97
1991	380.04	383.79	1.01	371.93	0.98	376.99	0.99	377.75	0.99
1993	452.35	453.61	1.00	443.80	0.98	451.22	1.00	447.88	0.99
1995	464.26	464.03	1.00	457.34	0.99	460.16	0.99	454.43	0.98

First, a monotonic gradient is evidenced in the gastrointestinal drug group, which is almost identical for all years but 1989 which remains essentially flat across all income quintiles. Second, central nervous system drugs reveal a more classic monotonic pattern, with consumption of medications in this group, based on ingredient cost at levels which are between 10 and 13 percent higher in the poorest quintile compared to the most affluent quintiles in the years 1989 and 1995 respectively. Third, ingredient costs per individuals exposed to at least one cardiovascular drug, however, produce a virtually flat landscape between the first, most affluent and fifth quintiles in all years. This is in stark contrast to the pattern seen with respect to the quantity and number of prescriptions dispensed for cardiovascular drugs, which increase markedly with decreasing income.

When age and sex standardized rates based on rates per user are constructed and examined, these patterns do not change. Consider, for example, age- and sex- adjusted prescriptions per user (Table 5.15). The monotonic gradient still exists, and is very similar to the unadjusted rates. These rates are presented graphically in Figure 5.2.

Table 5.15

Age and Sex Adjusted Prescriptions per User by Income Quintile, 1989-1995

	Quintile 1 (Q1) Highest Income	Quintile 2 (Q2)		Quintile 3 (Q3)		Quintile 4 (Q4)		Quintile 5 (Q5) Lowest Income	
	Rx per User	Rx per User	Ratio Q2:Q1	Rx per User	Ratio Q3:Q1	Rx per User	Ratio Q4:Q1	Rx per User	Ratio Q5:Q1
Gastrointestinal Drugs									
1989	3.116	3.166	**1.02**	3.216	**1.03**	3.340	**1.07**	3.336	**1.07**
1991	3.249	3.303	**1.02**	3.319	**1.02**	3.461	**1.07**	3.532	**1.09**
1993	3.349	3.405	**1.02**	3.453	**1.03**	3.582	**1.07**	3.587	**1.07**
1995	3.380	3.457	**1.03**	3.473	**1.03**	3.593	**1.06**	3.583	**1.06**
Central Nervous System Drugs									
1989	5.078	5.266	**1.04**	5.262	**1.04**	5.621	**1.10**	5.956	**1.17**
1991	5.078	5.312	**1.05**	5.279	**1.04**	5.626	**1.11**	5.990	**1.18**
1993	5.052	5.349	**1.06**	5.361	**1.06**	5.609	**1.11**	5.972	**1.18**
1995	5.014	5.232	**1.04**	5.293	**1.06**	5.481	**1.09**	5.916	**1.18**
Cardiovascular Drugs									
1989	5.880	5.992	**1.02**	5.915	**1.01**	6.150	**1.05**	6.146	**1.05**
1991	6.019	6.138	**1.02**	6.040	**1.00**	6.209	**1.03**	6.302	**1.03**
1993	6.184	6.285	**1.02**	6.198	**1.00**	6.398	**1.03**	6.430	**1.04**
1995	6.199	6.269	**1.02**	6.245	**1.01**	6.400	**1.03**	6.366	**1.03**

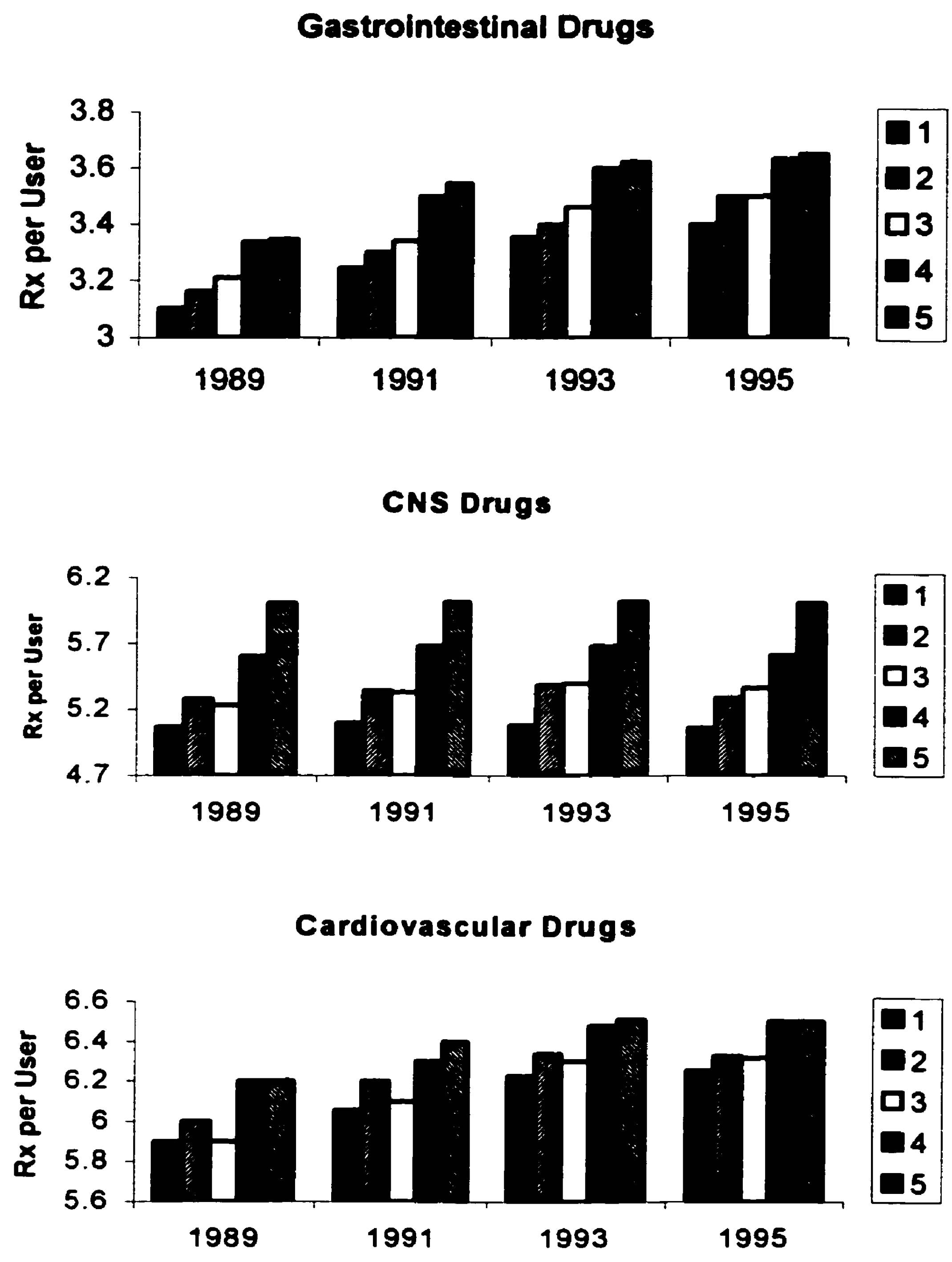


Figure 5.2

Age and Sex Adjusted Prescriptions per User by Income Quintile

When age- and sex- adjusted drug quantity per user are considered they too vary little from the unadjusted rates (Table 5.16; Figure 5.3). Again, the ratios of utilization rates between quintiles vary little year to year, especially in 1991 and later years.

Table 5.16

Age and Sex Adjusted Drug Quantity per User by Income Quintile, 1989-1995

	Quintile 1 (Q1)	Quintile 2 (Q2)		Quintile 3 (Q3)		Quintile 4 (Q4)		Quintile 5 (Q5)	
	Highest Income							Lowest Income	
	Units per User	Units per User	Ratio Q2:Q1	Units per User	Ratio Q3:Q1	Units per User	Ratio Q4:Q1	Units per User	Ratio Q5:Q1
Gastrointestinal Drugs									
1989	306.90	317.00	1.03	314.75	1.03	329.10	1.07	333.06	1.09
1991	314.28	318.48	1.01	320.21	1.02	335.12	1.07	353.39	1.12
1993	307.46	322.90	1.05	322.85	1.05	338.38	1.10	345.96	1.13
1995	312.83	328.31	1.05	323.22	1.03	340.41	1.09	347.97	1.11
Central Nervous System Drugs									
1989	428.06	442.53	1.03	449.71	1.05	467.82	1.09	501.64	1.17
1991	416.66	434.76	1.04	439.04	1.05	464.26	1.11	502.27	1.21
1993	413.31	433.86	1.05	440.07	1.06	460.81	1.11	491.55	1.19
1995	400.60	424.35	1.06	435.32	1.08	449.01	1.12	489.45	1.22
Cardiovascular Drugs									
1989	820.52	822.88	1.00	828.12	1.01	861.50	1.05	852.40	1.04
1991	812.96	823.03	1.01	817.53	1.01	849.35	1.05	868.78	1.07
1993	770.33	785.59	1.02	781.23	1.01	806.39	1.05	822.14	1.07
1995	698.95	712.71	1.02	712.96	1.02	730.51	1.05	742.55	1.06

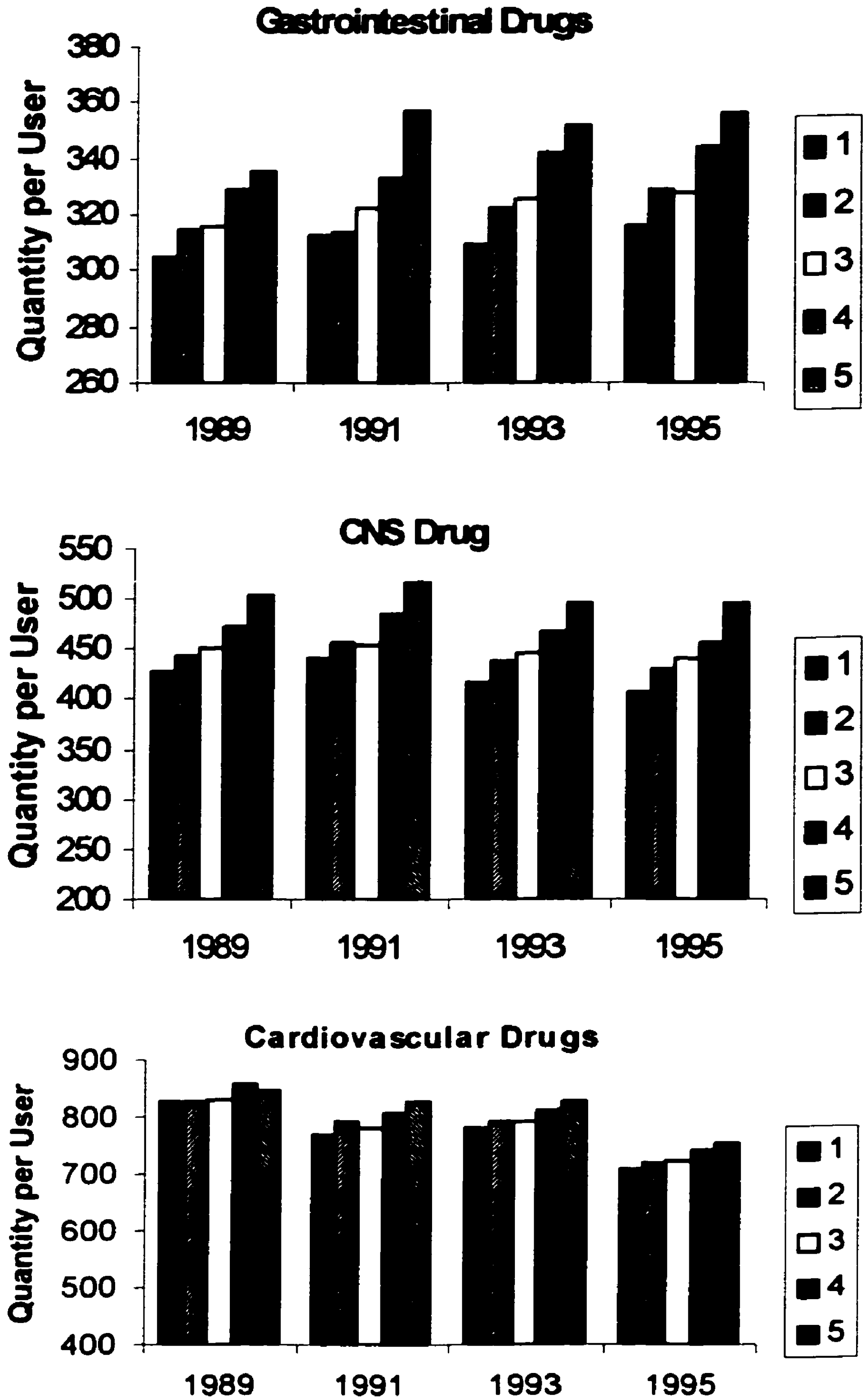


Figure 5.3

Age and Sex Adjusted Drug Quantity per User by Income Quintile

Lastly, an age and sex adjustment of rates of ingredient costs per user results in only minor changes to the unadjusted rates (Table 5.17; Figure 5.4). Again, the adjustment for this population's age and sex distribution renders an almost flat distribution of costs per user. The difference in the income-related differences in the rates of prescriptions and drug quantity dispensed in the cardiovascular group versus the relatively even distribution of costs per user among income quintiles will be addressed later in this chapter.

Table 5.17

Age and Sex Adjusted Ingredient Cost per User by Income Quintile, 1989-1995

	Quintile 1 (Q1) Highest Income	Quintile 2 (Q2)		Quintile 3 (Q3)		Quintile 4 (Q4)		Quintile 5 (Q5) Lowest Income	
	Cost per User	Cost per User	Ratio Q2:Q1	Cost per User	Ratio Q3:Q1	Cost per User	Ratio Q4:Q1	Cost per User	Ratio Q5:Q1
Gastrointestinal Drugs									
1989	146.96	142.27	0.97	145.64	0.99	148.04	1.01	149.97	1.02
1991	182.83	182.54	0.99	185.10	1.01	191.98	1.05	197.95	1.08
1993	213.65	216.42	1.01	219.42	1.03	226.97	1.06	230.19	1.08
1995	210.75	214.72	1.02	213.92	1.02	222.98	1.06	223.15	1.06
Central Nervous System Drugs									
1989	86.82	88.20	1.02	89.92	1.04	92.99	1.07	95.50	1.10
1991	104.18	106.06	1.02	106.63	1.02	111.72	1.07	117.95	1.13
1993	103.47	107.55	1.04	110.41	1.07	111.94	1.08	115.12	1.11
1995	106.14	108.17	1.02	112.74	1.06	114.73	1.08	121.29	1.14
Cardiovascular Drugs									
1989	287.73	286.83	1.00	283.06	0.98	293.38	1.02	289.77	1.01
1991	376.86	380.91	1.01	371.14	0.98	379.80	1.01	384.67	1.02
1993	447.79	450.03	1.00	441.98	1.00	451.98	1.01	454.46	1.01
1995	460.55	461.80	1.00	457.28	0.99	461.68	1.00	461.01	1.00

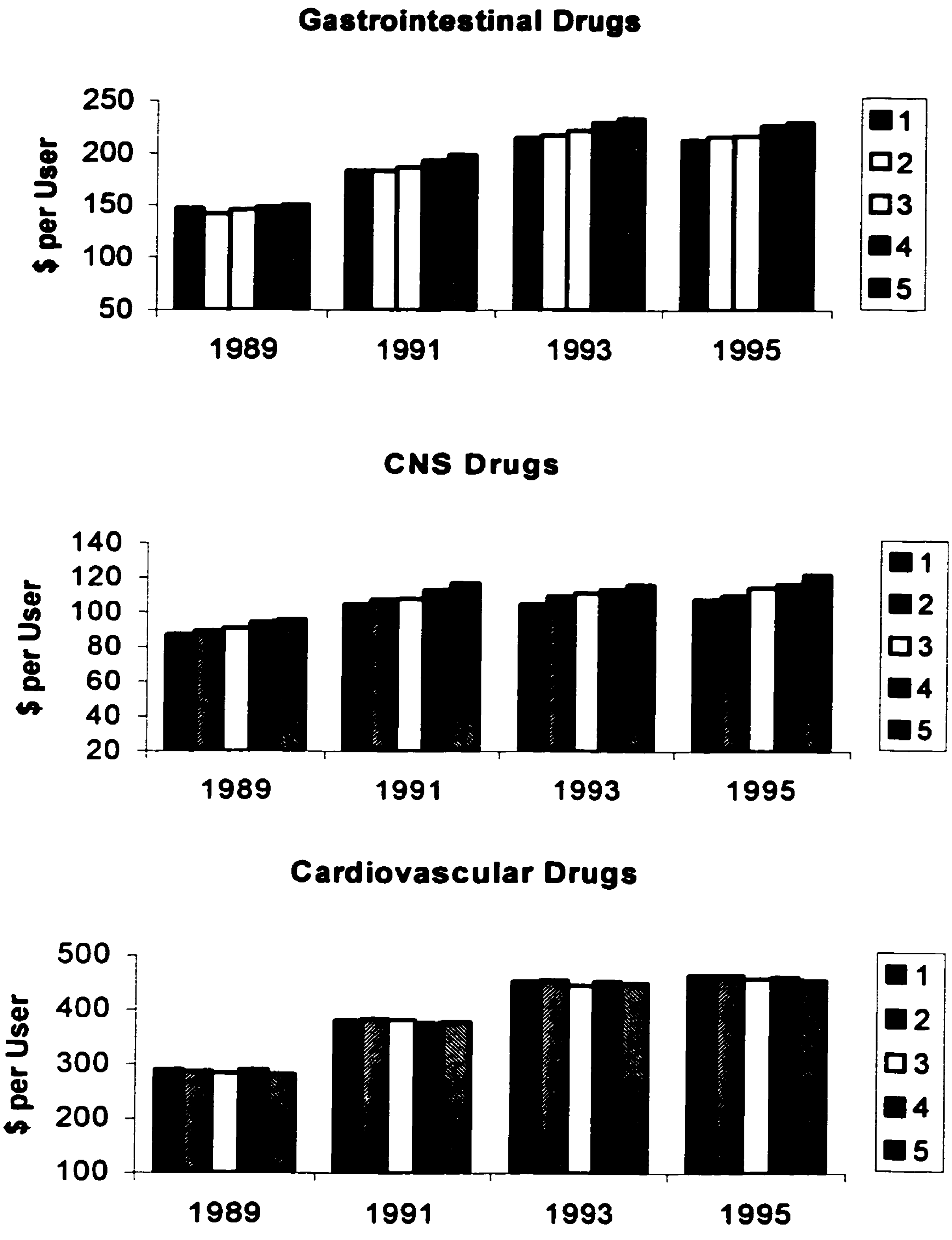


Figure 5.4

Age and Sex Adjusted Ingredient Cost per User by Income Quintile

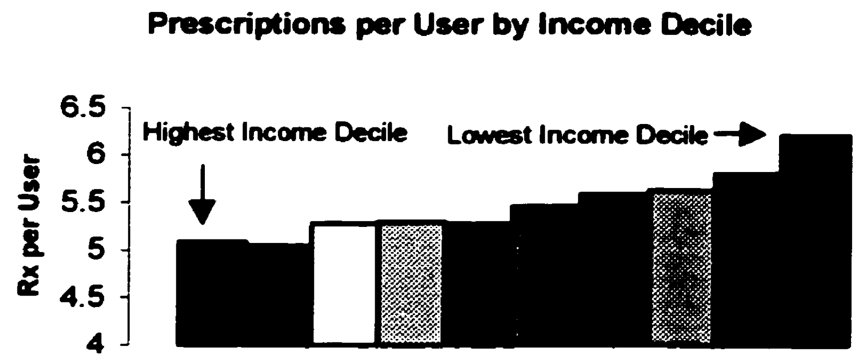
In order to confirm the gradient effect apparent in most of the tables presented above, this analysis was replicated according to income deciles. This provides a more detailed analysis of these same data, and the differences in utilization that may be related to income level. Although not shown here, an analysis of utilization by income deciles rather than quintiles simply underscores the presence of a monotonic gradient as opposed to a threshold effect. This is especially true for central nervous system and gastrointestinal drugs. In other words, the gradient continues into the highest decile, and does not drop off in the middle income, or even higher income categories, although the resulting distribution is not as smooth as when measured by larger income groups. This verifies that it is not merely the poorest income groups that display a higher than average use of prescription drugs, but that each successively less affluent portion of the population receives proportionately more drugs than those in the poorer divisions. An example of utilization per user by income decile for central nervous system medications for one year of data is shown in Figure 5.5

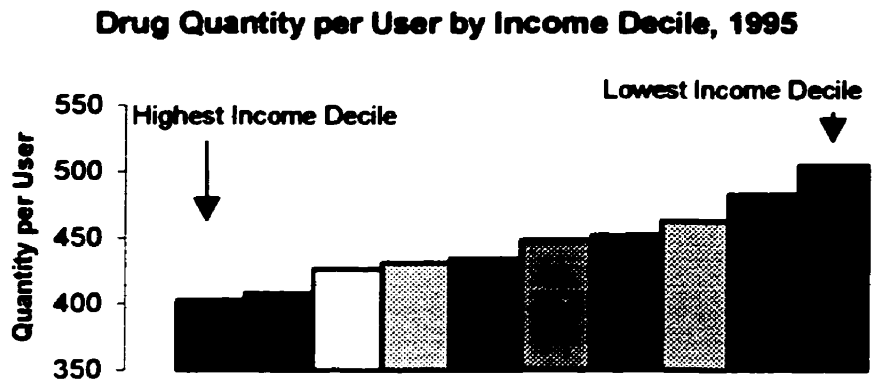
.

Prescription Drug Utilization by Income Quintile and Gender

Not surprisingly, gender-specific differences in the utilization of prescription drugs in these three therapeutic drug groups exist as well. Age adjusted prescription rates per drug user for males and females separately are presented Table 5.18. As shown below, slightly different patterns emerge for each.

In the gastrointestinal drug group, for example, it appears that female subscribers use, on average, slightly more prescriptions than males. While an income-related gradient in use rates is evidenced in these data, it is less variable for females. The ratio of prescription rates per drug user in the fifth, lowest income quintile to that of the first quintile ranges 7 and 8 percent for females. For males, however, those in the lowest income quintile had 4 percent more prescriptions than those in the first quintile in 1995, but 8, 11 and 7 percent more prescriptions in 1989, 1991 and 1993, respectively.





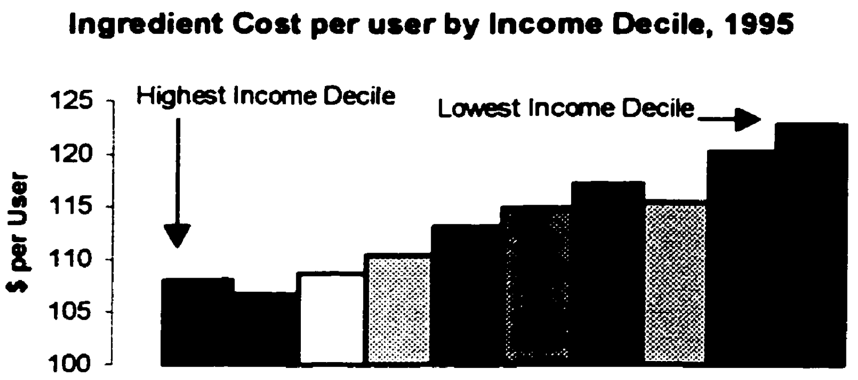


Figure 5.5

Central Nervous System Drug Utilization By Income Decile, 1995

Table 5.18

Age Adjusted Prescriptions per User by Gender and Income Quintile, 1989-1995

	Quintile 1	Quintile 2		Quintile 3		Quintile 4		Quintile 5	
	Highest Income							Lowest Income	
	Rx per User	Rx per User	Ratio Q2:Q1	Rx per User	Ratio Q3:Q1	Rx per User	Ratio Q4:Q1	Rx per User	Ratio Q5:Q1
Gastrointestinal Drugs									
Male									
1989	3.085	3.193	**1.03**	3.181	**1.03**	3.357	**1.09**	3.331	**1.08**
1991	3.210	3.302	**1.03**	3.298	**1.03**	3.468	**1.08**	3.550	**1.11**
1993	3.288	3.356	**1.02**	3.406	**1.04**	3.575	**1.08**	3.514	**1.07**
1995	3.284	3.281	**0.99**	3.282	**1.00**	3.399	**1.04**	3.409	**1.04**
Female									
1989	3.131	3.143	**1.01**	3.227	**1.03**	3.342	**1.07**	3.346	**1.07**
1991	3.274	3.305	**1.01**	3.347	**1.02**	3.455	**1.06**	3.512	**1.07**
1993	3.398	3.446	**1.04**	3.494	**1.05**	3.597	**1.06**	3.653	**1.08**
1995	3.455	3.592	**1.04**	3.626	**1.05**	3.742	**1.08**	3.731	**1.08**
Central Nervous System Drugs									
Male									
1989	4.541	4.805	**1.06**	4.810	**1.06**	5.038	**1.11**	5.505	**1.21**
1991	4.603	4.876	**1.06**	4.842	**1.05**	5.159	**1.12**	5.574	**1.21**
1993	4.562	4.840	**1.06**	4.863	**1.07**	5.109	**1.12**	5.523	**1.21**
1995	4.389	4.593	**1.05**	4.689	**1.07**	4.720	**1.08**	5.225	**1.19**
Female									
1989	5.519	5.661	**1.03**	5.646	**1.02**	6.012	**1.09**	6.339	**1.15**
1991	5.469	5.688	**1.04**	5.644	**1.03**	6.013	**1.10**	6.346	**1.16**
1993	5.453	5.772	**1.06**	5.766	**1.06**	6.023	**1.10**	6.365	**1.17**
1995	5.522	5.744	**1.04**	5.781	**1.05**	6.090	**1.10**	6.499	**1.18**
Cardiovascular Drugs									
Male									
1989	6.178	6.278	**1.02**	6.211	**1.01**	6.458	**1.05**	6.351	**1.03**
1991	6.308	6.396	**1.01**	6.313	**1.00**	6.433	**1.02**	6.592	**1.04**
1993	6.505	6.540	**1.01**	6.479	**1.00**	6.603	**1.02**	6.735	**1.04**
1995	6.411	6.432	**1.00**	6.336	**0.99**	6.489	**1.01**	6.456	**1.01**
Female									
1989	5.658	5.794	**1.02**	5.709	**1.01**	5.928	**1.05**	6.006	**1.06**
1991	5.812	5.966	**1.03**	5.845	**1.01**	6.060	**1.04**	6.105	**1.05**
1993	5.936	6.106	**1.03**	5.993	**1.01**	6.258	**1.05**	6.201	**1.05**
1995	6.029	6.150	**1.02**	6.178	**1.02**	6.345	**1.05**	6.307	**1.05**

Central nervous system drugs present another striking tendency. The pattern exhibited by females utilizing any central nervous system drug again exhibits a clear gradient, with those in the poorer quintile using between 15 percent (in 1989) and 18 percent (in 1995) more, in terms of number of prescriptions, than those in the most affluent quintile. For males, who had, on average, fewer prescriptions per user, a similar pattern emerges. However, the inter-quintile ratios for male users of central nervous system medications were higher; the ratios of the fifth to first quintile were as high as 1.21 in the years 1989, 1991 and 1993, and 1.19 in 1995. The rate of central nervous system drug use for both males and females rises sharply in the poorest (fifth) quintile.

An analysis of cardiovascular drugs by gender shows that males received a larger number of prescriptions per user compared to females. While an income-related gradient in use rates is evidenced for both males and females, it is more pronounced for female users of cardiovascular drugs. The ratio of prescription rates per drug user in the fifth, lowest income quintile to that of the first quintile ranges between 5 and 6 percent for females, and is slightly lower in the male population. The gradient effect virtually disappears for males in 1995. On the other hand, a curious dip in prescription rates is evidenced in the third quintile when only female drug recipients are considered.

Age has also been shown to affect utilization. Age effects are explored in greater detail in Chapters Six, Seven and Eight.

Unit Cost and Prescription Size

Both prescription and drug quantity rates suggest that the rates of drug utilization increase as income decreases. In most, yet not all scenarios, drug costs are also higher in the less affluent income groups. Yet this is not always the case, such as for cardiovascular drugs, where costs do not present the same gradient as drug quantity or number of prescriptions. This presents an interesting quandary. None of these three measures alone reveals much of the underlying reasons for these trends. All three measures of utilization used here, including number of prescriptions, drug quantity and drug cost refer to the amount of prescription medications dispensed in some manner. Taken together, these measures do tell a story about prescription drug utilization by the elderly. At the same time, it should be considered that each is limited in what it can reveal. To consider the number of prescriptions, by itself, is essentially unreliable in itself, since prescription size may vary widely. Similarly, drug quantity is equally unreliable in itself, since this measure represents the number of units prescribed; one unit may represent different quantities of the active drug (e.g. 5 mgs, 10 mgs, 50 mgs). Lastly, the mix of drugs may vary between quintiles, so that the average unit cost of the specific drugs most utilized in each may not be comparable.

Do income related differences exist only with respect to the quantity of medications dispensed, or are there also systematic differences in the type and cost of drugs dispensed? An examination of the unit cost of drug utilization in each of the therapeutic drug groups and income quintiles provides insight into this question.

While drug quantity, number of prescriptions and ingredient cost (albeit much less strikingly in the cardiovascular drug group) increased with decreasing income quintiles, the unit cost in each of the three therapeutic drug groups decreases slightly with income level. The average unit costs per income quintile are presented in Table 5.19. For gastrointestinal preparations, the data suggest that the poorer individuals receive medications that cost, on average, between 5 and 7 percent less than those in the most affluent income quintile. Differences in the cost of drugs according to income also emerge in the central nervous system group of medications. The average unit cost of medications for those in the poorest quintile is approximately 6 to 7 percent less than in the most affluent quintile.

Lastly, income-specific differences in the unit price of drugs dispensed for cardiovascular drugs also emerge. The data display a monotonic gradient. Users of cardiovascular drugs in the fifth, and poorest quintile were prescribed medications that were 93 percent of the price of medications prescribed to the most affluent recipients in 1995, and 94 or 95 percent of this price in the remaining years.

Table 5.19

Average Unit Cost by Income Quintile, 1989-1995

	Quintile 1 (Q1) Highest Income	Quintile 2 (Q2)		Quintile 3 (Q3)		Quintile 4 (Q4)		Quintile 5 (Q5) Lowest Income	
	Unit Cost	Unit Cost	Ratio Q2:Q1	Unit Cost	Ratio Q3:Q1	Unit Cost	Ratio Q4:Q1	Unit Cost	Ratio Q5:Q1
Gastrointestinal Drugs									
1989	0.48	0.45	**0.94**	0.46	**0.96**	0.45	**0.93**	0.45	**0.93**
1991	0.59	0.57	**0.98**	0.58	**0.98**	0.57	**0.97**	0.56	**0.95**
1993	0.69	0.68	**0.97**	0.68	**0.98**	0.67	**0.96**	0.66	**0.95**
1995	0.67	0.66	**0.98**	0.66	**0.98**	0.66	**0.98**	0.64	**0.95**
Central Nervous System Drugs									
1989	0.20	0.20	**0.99**	0.20	**0.99**	0.20	**0.98**	0.19	**0.94**
1991	0.25	0.25	**0.98**	0.24	**0.97**	0.24	**0.96**	0.23	**0.93**
1993	0.25	0.25	**0.99**	0.25	**1.00**	0.24	**0.97**	0.23	**0.93**
1995	0.26	0.26	**0.97**	0.26	**0.98**	0.25	**0.96**	0.25	**0.93**
Cardiovascular Drugs									
1989	0.35	0.35	**0.99**	0.34	**0.97**	0.34	**0.96**	0.33	**0.95**
1991	0.46	0.46	**0.99**	0.45	**0.97**	0.44	**0.96**	0.43	**0.94**
1993	0.58	0.57	**0.99**	0.56	**0.97**	0.55	**0.96**	0.54	**0.94**
1995	0.66	0.64	**0.98**	0.63	**0.97**	0.62	**0.95**	0.60	**0.93**

Since these income-specific differences translate to only an extremely slight difference in the actual cost of one unit, which amount to only a penny in some cases, caution should be used in interpreting these data. However, at the same time these data should not be ignored. The trend toward the dispensing of less costly drugs for the poorest individuals is one which is replicated in each year under study and thus appears to represent a systematic phenomenon in drug prescribing to British Columbia seniors.

In order to facilitate the interpretation of prescription rates, either per capita or per user, average prescription sizes per therapeutic drug group and income quintile were computed. These are presented in Table 5.20.

Table 5.20

Average Prescription Size by Income Quintile, 1989-1995

	Quintile 1 (Q1) Highest Income	Quintile 2 (Q2)		Quintile 3 (Q3)		Quintile 4 (Q4)		Quintile 5 (Q5) Lowest Income	
	# Units	# Units	Ratio Q2:Q1	# Units	Ratio Q3:Q1	# Units	Ratio Q4:Q1	# Units	Ratio Q5:Q1
Gastrointestinal Drugs									
1989	98.4	99.5	1.01	98.2	1.00	98.6	1.00	100.3	1.02
1991	96.4	96.7	1.00	96.8	1.00	97.9	1.02	100.6	1.04
1993	92.1	94.4	1.03	94.0	1.02	94.8	1.03	97.1	1.05
1995	93.0	94.7	1.02	93.6	1.01	94.8	1.02	97.7	1.05
Central Nervous System Drugs									
1989	84.4	83.9	0.99	85.3	1.01	84.1	1.00	84.0	1.00
1991	82.1	81.8	1.00	83.2	1.01	82.6	1.01	83.5	1.02
1993	81.9	81.2	0.99	82.3	1.00	82.1	1.00	82.2	1.00
1995	80.1	81.0	1.01	82.2	1.03	81.6	1.02	82.2	1.03
Cardiovascular Drugs									
1989	140.1	137.6	0.98	139.7	1.00	138.9	0.99	137.4	0.98
1991	135.6	134.1	0.99	135.4	1.00	135.9	1.00	136.0	1.00
1993	125.0	125.1	1.00	136.3	1.01	125.5	1.00	126.7	1.01
1995	113.2	113.9	1.01	114.4	1.01	113.9	1.01	116.2	1.03

The data show that virtually no differences exist in the average prescription size of both central nervous system and cardiovascular drugs. For gastrointestinal prescriptions, a clear pattern is not evident, especially for the first four quintiles. Very little systematic variations exists with respect to the central nervous system and cardiovascular drug groups.

An examination of the average ingredient cost per prescription (Table 5.21) indicates that the cost of a prescription does not vary by income quintile for gastrointestinal drugs, except for the base year, 1989. However, for central nervous system and cardiovascular drugs each successively less affluent income quintile received prescriptions that were slightly less costly than the more affluent income quintile. For example, in 1995 individuals in the lowest income quintile received prescriptions that cost, on average, 5 percent less than those in the highest income quintile. In that same year, those in the lowest income quintile received prescriptions at a 6 percent lower cost than those in the highest income quintile.

Table 5.21

Ingredient Cost per Prescription by Income Quintile, 1989-1995

	Quintile 1 (Q1) Highest Income	Quintile 2 (Q2)		Quintile 3 (Q3)		Quintile 4 (Q4)		Quintile 5 (Q5) Lowest Income	
	Cost per Rx	Cost per Rx	Ratio Q2:Q1	Cost per Rx	Ratio Q3:Q1	Cost per Rx	Ratio Q4:Q1	Cost per Rx	Ratio Q5:Q1
Gastrointestinal Drugs									
1989	47.31	11.91	0.95	45.52	0.96	44.30	0.94	44.91	0.95
1991	56.58	55.43	0.98	56.60	0.99	55.61	0.98	56.15	0.99
1993	64.18	63.79	0.99	63.96	1.00	63.63	0.99	64.38	1.00
1995	52.58	62.23	0.99	61.88	0.99	62.33	1.00	62.71	1.00
Central Nervous System Drugs									
1989	17.17	16.80	0.98	17.11	1.00	16.73	0.97	16.03	0.93
1991	20.55	20.08	0.98	20.28	0.99	19.88	0.97	19.36	0.94
1993	20.61	20.26	0.98	20.61	1.00	19.97	0.97	19.26	0.93
1995	21.22	20.71	0.98	21.27	1.00	20.75	0.98	20.23	0.95
Cardiovascular Drugs									
1989	49.24	47.90	0.97	47.62	0.97	47.07	0.96	45.74	0.93
1991	62.85	62.14	0.99	61.06	0.97	60.21	0.96	59.47	0.95
1993	72.55	71.60	0.99	70.77	0.98	69.92	0.96	68.81	0.95
1995	74.28	73.36	0.99	72.39	0.97	70.78	0.95	70.08	0.94

Rebuilding the Equation: An Overview of Prescription Drug Use by Income Quintile

In the previous sections in this chapter, various components of the utilization equation were analysed by income quintile. Reconstructing this equation identified which components most contribute to the observed income gradients. A summary of the various components of utilization is presented in Table 5.22.

Table 5.22

Summary of Prescription Drug Utilization by Income Quintile, 1989 - 1995

	Gastrointestinal Drugs	Central Nervous System Drugs	Cardiovascular Drugs
Users per Capita	Users ↑ as income ↓	Users ↑ as income ↓	Users ↑ as income ↓
Prescriptions per Capita	Rx ↑ as income ↓	Rx ↑ as income ↓	Rx ↑ as income ↓
Prescriptions per User	Rx ↑ as income ↓	Rx ↑as income ↓	Rx ↑ as income ↓
Quantity per User	Quantity ↑ as income ↓	Quantity ↑ as income ↓	Quantity ↑ as income ↓
Ingredient Cost per User	Cost ↑ as income ↓	Cost ↑as income ↓	No difference between income quintiles
Quantity per Prescription	Prescription size ↑ as income ↓	No difference between income quintiles	No difference between income quintiles
Ingredient Cost per Unit	Unit cost ↓ as income ↓	Unit cost ↓ as income ↓	Unit cost ↓ as income ↓

This summary first points out that the observed gradients in each therapeutic drug category examined are formed by slightly different factors. The data show that gastrointestinal drug utilization increases as income decreases, whether utilization is measured in terms of the number of users, number of prescriptions, quantity dispensed or total average ingredient cost. Although prescription sizes increase as income decreases, the unit costs decrease with income. However, this cost difference per unit is not enough to offset the effects of greater amounts of drugs dispensed in the less affluent quintiles, so that total ingredient cost continues to increase as income decreases.

Much like gastrointestinal drugs, prescribing of central nervous system drugs increases as income decreases. As income decreases, individuals are more likely to receive a greater quantity of central nervous system preparations, more frequently, and at greater total average cost. Again, the average unit cost of a central nervous system preparation decreases with income, but again, this is not a sufficiently large price difference to offset the increases in quantity and frequency of drugs prescribed.

Lastly, the income gradients for cardiovascular drugs are the product of slightly different factors. Like the other therapeutic drug groups examined here, the number of prescriptions and quantity dispensed increases as income decreases. In contrast, there is no income gradient in the total average ingredient cost of the drugs dispensed or prescription size. The decrease in average unit cost that is associated with decreasing income is sufficiently large to result in a flat cost curve despite increased utilization across as income decreases. The more specific sources of this pattern are examined in the following section.

Variations in Type of Drugs Prescribed by Income Quintile

While the data presented above clearly indicate that an income effect on the utilization of prescription drugs does exist, it is still not clear if this occurs only because of income-related differences in the amount of drugs prescribed, or whether the types of drug vary by income quintile. Clearly, this is due, in part, to a greater number of prescriptions as well as larger amounts of medications per user dispensed as income decreases. However, it is also possible that a different pharmaceutical basket of goods is being prescribed for individuals across the income spectrum. An analysis of the distribution of medications, by type, within each therapeutic drug group offers a partial answer to this question.

Gastrointestinal preparations

The three major types of drugs represented in the gastrointestinal therapeutic drug group, at the four digit level of the Therapeutic Drug Code used in British Columbia include antidiarrheal preparations, antiemetics[3] and antiulcer drugs. At this level of disaggregation, trends are not as apparent as when larger aggregations are considered; however, it is possible to make several observations about the income-related differences in dispensing within these categories. The data show that the largest of

[3] Antienemics are medicinal agents which alleviate or eliminate nausea and vomiting.

these, antiulcer medications, are prescribed in relatively equal proportions over all income quintiles. Approximately 85 percent of all prescriptions in 1995 were written for antiulcer medications. In the first, most affluent quintile, 85.1 percent of all prescriptions were for antiulcer preparations. This decreased minutely to 84.1 percent in the fifth, and poorest quintile. This similarity in the distribution of antiulcer medications is also true if drug quantity, drug cost or the number of individuals prescribed this drug in each income quintile is considered.

One type of antiulcer medication which has received much attention in recent years is the relatively new class of drugs, the proton pump inhibitors such as omeprazole. Although the indications and optimal treatment course of proton pump inhibitors varies slightly compared to the more frequently used H2 inhibitors, the former are known not only for their effectiveness but also their comparatively high cost. A subanalysis reveals that these drugs comprised less than one percent of all antiulcer prescriptions in 1989. By 1995 this proportion had increased to 28 percent. However, the number or quantity of proton pump inhibitors dispensed per user differs between income quintiles only very slightly.

The less frequently prescribed antiemetic preparations did, however, exhibit some income-specific differences. The proportion of prescriptions written for antiemetics increased with each successively lower income quintile, although the differences were small, ranging from a 2.5 percent difference between poorest and most affluent in 1989, to a difference of just under one percent in 1993 and 1995. This trend was also evident when drug costs and the proportion of individuals receiving antiemetics were considered. The slight increase in the proportion of prescriptions for antiemetics, or antinauseants, might be partially due to the substitution of prescription preparations for over the counter preparations in order to lessen out of pocket expenses for less affluent patients. No income-specific trend was apparent for antidiarrheal preparations, which represented under 5 percent of all prescriptions for gastrointestinal drugs in 1995. Tables of the distribution of prescriptions, costs and quantity by income quintile for gastrointestinal drugs are included in Appendix II.

Central Nervous System drugs

Central nervous system drugs, at the four digit level of the Therapeutic Drug Code, are comprised mainly of analgesics, antidepressants and antipsychotics, sedatives which taken together, amount to approximately 96 percent of all prescriptions in this category. No distinct income-specific pattern emerges with respect to analgesics. Approximately 50 percent of all central nervous system prescriptions are written for analgesics, and this proportion does not change markedly between income quintiles. Nor does the proportion of central nervous system drug costs or quantity that can be attributed to analgesics. Therefore, it appears that analgesics are prescribed in the same proportions in all income quintiles. Similarly, no discernable pattern is evident with respect to sedatives.

When the antidepressant and antipsychotics group is considered, an income-dependent trend is apparent. These medications are prescribed to a larger proportion of those in the lower income quintiles compared to the higher income quintiles. In other words, proportionally fewer prescriptions for these preparations are dispensed to wealthier individuals compared to less affluent ones. However, this difference is very slight, and as such probably does not affect overall utilization patterns to any discernable extent. The corresponding data are included in Appendix III.

Cardiovascular drugs

Well-defined income-related trends emerge in the cardiovascular drug group, which is comprised mainly of antihypertensive-antianginal medications, antihyperlipidemics, and vasodilators and antianginals, as differentiated at the four digit level of the therapeutic drug code. Again the differences in the distribution of medication type by income quintile are not large; however they do tend to be replicated in most years. The pattern may partially be able to explain the gradient in both prescriptions and drug quantity and lack of gradient with respect to drug costs reported in the previous sections. In essence, income may be one determinant of not only of the quantity of drugs prescribed, but of the types of medication prescribed as well as their cost. These data are included as Appendix IV.

The most evident pattern exists with respect to vasodilators and antianginals. The distribution of prescriptions for these medications was not equal over the five income groups. The proportion of prescriptions for vasodilators and antianginals in the first income quintile is lower than that in the fifth quintile. However, this difference does not exceed 2.4 percent in any year, and is, in fact, less than one percent in 1995. Still, this does suggest that to some extent, as income decreases, one is also more likely to receive a prescription for a vasodilator.

Antihyperlipidemic drugs also exhibit a tendency to be prescribed in lesser proportions to those in the lower income groups. Furthermore, the unit price of these medications decreased as income decreased. With the introduction of new and costly drugs in this group, the average unit price for antihyperlipidemic medications has increased greatly over the past decade. Thus even minimal nuances in their utilization by income quintile may have a significant effect on overall drug costs.

Thus there is some evidence to suggest that for some drugs, the type, not only the quantity of medication prescribed is related to income. This partially explains why decreasing income is related to the increasing quantities of these medications, as well as a greater number of prescriptions, but not increased costs for cardiovascular drugs.

The data presented in Table 5.23 provide considerable insight into this question. Here, the utilization rates per user are presented for drug quantity and cost for the three main types of medications in this therapeutic drug group. The results indicate marked differences in the utilization of cardiovascular drugs by drug type. Antihypertensives and antianginals, for example, result in a relatively flat curve of rates for both cost and quantity in 1989 and 1991. By 1993, however, there is a noticeable decrease in the unit cost of antihypertensives as income decreases, accompanied by a corresponding increase quantity dispensed of three to four percent. Costs per user, however, did not increase as income decreased. The differences in utilization between income quintiles are not very large.

A very different pattern emerges when antihyperlipidemics are considered. This group of drugs, which has increased dramatically in price since 1989 due to the introduction of new drugs, is used in a manner that markedly varies with income. Individuals in the lower income quintiles are prescribed less of this medication in terms of both quantity and even more so, cost. The average unit costs of this relatively expensive drug decrease as income decreases.

Conversely, vasodilators, the least expensive of the three groups of cardiovascular medications considered, are prescribed in greater amounts as income decreases. In fact, in 1995 individuals in the poorest income quintile received 34 percent more units of these drugs, amounting to 38 percent excess in drug costs over the more affluent quintiles. The proportional difference in price was approximately equal to the proportional difference in drug quantity between quintiles in all years except 1993. The unit cost of vasodilators remained constant over the five income quintiles.

Systematic income-specific variations in the unit cost of antihypertensives and antihyperlipidemics, combined with a propensity for poorer individuals to use more vasodilators, and fewer antihyperlipidemic preparations than their more affluent counterparts, combine to create a pattern of increasing drug quantity used while drug costs per user remain constant between income quintiles. In effect, decreased quintile-specific costs related to the increasingly expensive antihyperlipidemics act to offset the effect of the relatively inexpensive vasodilators. More generally, not only does the amount of prescription drugs vary by income, the type of drug dispensed may also be dependent on it.

Table 5.23
Utilization of Cardiovascular Drugs per Total Number of Cardiovascular Drug Users by Drug Type and Income Quintile, 1989-1995

	Quintile 1	Quintile 2		Quintile 3		Quintile 4		Quintile 5	
	Highest Income							**Lowest Income**	
			Ratio to Q1		**Ratio to Q1**		**Ratio to Q1**		**Ratio to Q1**
Antihypertensives									
1989									
Cost per user	231.50	230.12	**0.99**	223.8	**0.97**	229.74	**0.99**	223.59	**0.97**
Quantity per user	580.30	582.55	**1.00**	568.38	**0.98**	586.30	**1.01**	581.42	**1.00**
Unit Cost	.40	.40	**1.00**	.39	**0.98**	.39	**0.98**	.38	**0.95**
1991									
Cost per user	294.89	295.15	**1.00**	284.45	**0.96**	287.60	**0.98**	287.04	**0.97**
Quantity per user	577.97	584.34	**1.01**	571.00	**0.99**	576.62	**1.00**	587.65	**1.02**
Unit Cost	.51	.51	**1.00**	.50	**0.98**	.50	**0.98**	.49	**0.96**
1993									
Cost per user	399.99	340.16	**1.00**	330.43	**0.97**	335.38	**0.99**	334.20	**0.98**
Quantity per user	559.81	565.97	**1.01**	557.89	**1.00**	566.27	**1.01**	575.22	**1.03**
Unit Cost	.61	.60	**0.98**	.59	**0.97**	.59	**0.97**	.58	**0.95**
1995									
Cost per user	339.07	339.42	**1.00**	331.82	**0.98**	336.08	**0.99**	333.74	**0.98**
Quantity per user	524.51	529.80	**1.01**	526.61	**1.00**	538.33	**1.03**	542.93	**1.04**
Unit Cost	.65	.64	**0.98**	.63	**0.97**	.62	**0.95**	.61	**0.94**
Antihyperlipidemics									
1989									
Cost per user	27.19	24.98	**0.92**	26.16	**0.96**	25.93	**0.95**	20.89	**0.77**
Quantity per user	76.40	67.59	**0.88**	85.43	**1.12**	90.34	**1.18**	67.30	**0.88**
Unit Cost	.36	.37	**1.01**	.31	**0.86**	.29	**0.81**	.31	**0.86**
1991									
Cost per user	52.58	51.64	**0.98**	50.61	**0.96**	50.92	**0.97**	45.04	**0.86**
Quantity per user	103.93	96.87	**0.93**	101.73	**0.98**	121.03	**1.16**	99.09	**0.95**
Unit Cost	.51	.53	**1.0**	.50	**0.98**	.42	**0.82**	.45	**0.88**
1993									
Cost per user	72.24	68.05	**0.94**	66.70	**0.92**	64.85	**0.90**	56.38	**0.78**
Quantity per user	91.90	86.78	**0.94**	86.81	**0.94**	93.30	**0.85**	78.41	**0.85**
Unit Cost	.79	.78	**0.99**	.77	**0.97**	.70	**0.89**	.72	**0.91**
1995									
Cost per user	86.73	81.89	**0.94**	81.41	**0.94**	75.52	**0.87**	67.82	**0.78**
Quantity per user	65.78	62.80	**0.95**	62.54	**0.95**	58.19	**0.88**	52.79	**0.80**
Unit Cost	1.32	1.30	**0.98**	1.30	**0.98**	1.30	**0.98**	1.28	**0.97**
Vasodilators									
1989									
Cost per user	31.71	32.72	**1.03**	32.77	**1.03**	34.32	**1.08**	37.25	**1.17**
Quantity per user	169.44	176.55	**1.04**	175.81	**1.04**	179.22	**1.06**	197.55	**1.17**
Unit Cost	.19	.19	**1.00**	.19	**1.00**	.19	**1.00**	.19	**1.00**
1991									
Cost per user	35.54	36.96	**1.04**	36.84	**1.04**	38.44	**1.08**	45.65	**1.28**
Quantity per user	137.85	147.73	**1.07**	151.74	**1.10**	153.10	**1.11**	177.32	**1.29**
Unit Cost	.24	.25	**1.04**	.24	**1.00**	.25	**1.04**	.26	**1.08**
1993									
Cost per user	40.08	45.38	**1.13**	46.65	**1.16**	50.95	**1.27**	57.27	**1.43**
Quantity per user	127.57	139.84	**1.10**	146.56	**1.15**	153.79	**1.21**	171.69	**1.35**
Unit Cost	.31	.32	**1.03**	.32	**1.03**	.33	**1.06**	.33	**1.06**
1995									
Cost per user	38.43	42.70	**1.11**	44.10	**1.15**	48.54	**1.26**	52.85	**1.38**
Quantity per user	117.79	127.94	**1.09**	133.58	**1.13**	144.25	**1.22**	158.07	**1.34**
Unit Cost	.33	.33	**1.00**	.33	**1.00**	.34	**1.03**	.33	**1.00**

What is not known, however, is why these income-based differences exist. They may be due to one's ability to navigate the health care system, general knowledge about available drugs, the response of medical professionals to individuals of varying socioeconomic strata, or underlying morbidity which in itself may be related to socioeconomic status or other factors. While these data cannot uncover the exact sources of these differences, the existence of systematic income-related dispensing differences is unequivocal. This is discussed in greater detail in the final chapter.

Summary

As income levels decrease, the number of prescriptions, drug quantity and drug costs increase in a monotonic fashion. Per capita prescription rates for gastrointestinal, central nervous system as well as cardiovascular drugs all increase as income decreases. The same is true of the quantity of drugs dispensed and ingredient costs for gastrointestinal and central nervous system medications.

An examination of utilization rates per user, or, considering only that group of individuals receiving at least one drug in each therapeutic drug group limits the analysis to only those individuals who have been diagnosed and treated. While this does not ensure that all individuals who are sick and requiring medications are considered, since there still may be income-related differences in screening (such as for cholesterol levels, for example) or testing, this does ensure that only those people being medically treated are included. Rates of prescriptions dispensed, drug quantity and drug cost per user exhibited the same patterns as per capita utilization rates. The only exception to this is in the context of cardiovascular drugs. Although the use of these drugs did increase with decreasing income when measured by number of prescriptions or drug quantity, income level had no effect on drug costs. Patterns in utilization were also shown to vary by gender, including the combined effect of gender and income.

There is also some evidence that a different mix of medications may be prescribed at different income levels, especially for cardiovascular drugs. This effect, combined with the effect of increased utilization rates of prescription medicines with decreasing income, produce income-specific patterns of drug utilization documented here. In the following three chapters, the effect of income on prescription drug utilization, in combination with other demographic and health care utilization variables will be discussed in greater detail.

Chapter Six

Gastrointestinal Drugs: Utilization, Income Level and Other Health Care Utilization

In the previous chapter, drug utilization in the three therapeutic drug groups was considered at the aggregate level. Utilization rates were constructed for each of the five discrete income groups in the context of either drug utilization for the entire population or per user in each drug category in order to describe drug exposure. In this sense, these rates provided an overview of the drug utilization at the broadest, or population level. In the following chapters, prescription drug use for the year 1993 will be examined for variations between income groups while controlling for other factors. Demographic factors, as well as health care utilization factors including hospital, medical and home care will be examined in relation to prescription drug utilization. In this chapter, the gastrointestinal medications are considered. Chapters Seven and Eight focus on central nervous system and cardiovascular medications, respectively.

As previously discussed, the gastrointestinal drug group includes a variety of medications, although the anti-ulcer drugs represent the largest proportion of prescriptions dispensed (84 percent). Anti-ulcer medications include H2 inhibitors such as ranitidine or cimetidine as well as the newer proton pump inhibitors such as omeprazole. Non-ulcer medications refer to the remaining drugs in this therapeutic drug category, and include, for example, digestants, laxatives, antiemetic and antidiarrheal preparations. Within this group of non-ulcer medications, antiemetics constitute the greatest number of prescriptions, or 10 percent of all prescriptions for gastrointestinal drugs (Figure 6.1).

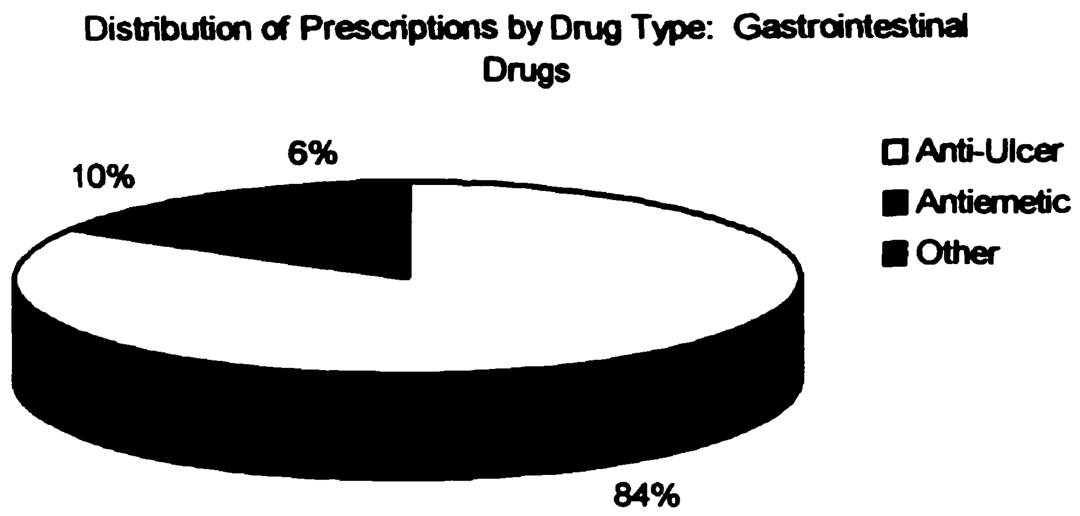


Figure 6.1

Descriptive Analysis

The analysis in this chapter focuses on each user's complete aggregated prescription record within a drug group in relation to other health care utilization variables in tandem. A summary of the major demographic and health care utilization variables by income quintile of gastrointestinal drug users is presented in Table 6.1. The proportions of female to male users who had at least one record for gastrointestinal drugs increased somewhat between the first, most affluent, and fifth, or poorest quintiles. Similarly, the average age of users increased slightly (i.e. less than one and a half years) between the first and fifth quintile. The difference in average age between income quintiles was minimized by the method used to construct them (see Chapter Four). However, minimal differences remain. The data show that there are no systematic differences in the proportion of users residing in an urban area between the least and most affluent income quintiles.

Some categories of health care utilization remain seemingly constant between the five income groups. Hospitalizations, defined in this case as a separation record from an acute care facility, vary only by one tenth of one separation between the groups. The number of physician billings, indicating frequency of contact, also varies only minimally. Home care visits, which are dominated by homemaker services, do increase with decreasing income. Although visits by nurses constitute a much smaller proportion of total home visits, these too increase as income decreases. Conversely, visits by occupational therapists virtually disappear in the poorest income quintiles. However, occupational therapy visits constitute a very small proportion of the total number of home care visits at any income level.

Table 6.1
Demographic and Health Care Utilization Variables by Income Quintile: Users of Gastrointestinal Drugs

Variable	1st Quintile		2nd Quintile		3rd Quintile		4th Quintile		5th Quintile	
	Highest Income								Lowest Income	
	N=19,627		N=19,478		N=17,903		N=19,999		N=18,583	
Sociodemographic variables										
% Females*	55.7		56.6		56.8		58.2		61.4	
% Males	42.4		41.6		41.1		39.6		36.1	
% Residing in Urban Area	91.5		89.2		83.7		85.8		91.4	
	Mean (*Standard Deviation*)									
Age	72.7	*(5.9)*	72.8	*(5.9)*	73.1	*(6.0)*	73.5	*(6.0)*	74.1	*(6.3)*
Utilization Variables										
Hospitalizations	0.7	*(1.3)*	0.7	*(1.3)*	0.7	*(1.3)*	0.8	*(1.3)*	0.8	*(1.3)*
With GI procedure	0.04	*(0.3)*	0.04	*(0.3)*	0.05	*(0.3)*	0.1	*(0.3)*	0.1	*(0.3)*
Without GI procedure	0.7	*(1.2)*	0.7	*(1.2)*	0.7	*(1.2)*	0.7	*(1.2)*	0.7	*(1.2)*
Physician Billings (#)	34.5	*(31.2)*	34.7	*(32.7)*	34.4	*(32.2)*	35.1	*(32.1)*	34.6	*(31.4)*
General Practitioner	12.1	*(9.8)*	12.7	*(10.5)*	12.8	*(10.3)*	13.3	*(7.5)*	13.3	*(10.6)*
Specialist (Int. Med.)	3.5	*(7.5)*	3.4	*(8.0)*	3.3	*(8.3)*	3.3	*(7.5)*	3.2	*(7.2)*
Other Specialist	18.9	*(21.1)*	18.7	*(22.1)*	18.3	*(21.5)*	18.6	*(21.8)*	19.1	*(21.3)*
Home Care Visits	12.9	*(45.5)*	18.0	*(53.2)*	20.4	*(56.8)*	25.8	*(63.3)*	31.6	*(63.4)*
Homemaker	11.5	*(42.9)*	16.5	*(50.6)*	18.7	*(53.6)*	24.0	*(60.3)*	29.5	*(65.0)*
Occupational Therapist	0.7	*(0.8)*	0.6	*(0.7)*	0.1	*(0.9)*	0.1	*(0.7)*	0.1	*(0.9)*
Physiotherapist	0.1	*(1.5)*	0.1	*(1.1)*	0.1	*(1.2)*	0.1	*(1.4)*	0.1	*(1.2)*
Nurse	1.3	*(9.5)*	1.4	*(8.9)*	1.5	*(10.4)*	1.6	*(11.5)*	1.9	*(11.5)*

*The proportion of males and females may not add up to 100 percent due to some records with missing gender data.

The Effect of Income on Gastrointestinal Drug Utilization

An analysis of variance (ANOVA) was performed in order to discern whether significant differences in the mean utilization of gastrointestinal drugs between income quintiles exist. The results of this analysis are shown in Table 6.2. Three models of gastrointestinal drug utilization are represented by the total number of prescriptions, total drug cost and drug quantity, respectively, and are computed separately for all gastrointestinal drugs, ulcer medications and non-ulcer medications. As previously discussed, ulcer medications include H2 inhibitors such as ranitidine or cimetidine as well as the newer proton pump inhibitors such as omeprazole. Non-ulcer medications refer to the remaining drugs in this therapeutic drug category, and include, for example, digestants, antiemetics and antidiarrheal preparations.

Table 6.2

ANOVA of Drug Utilization by Income Quintile: Gastrointestinal (GI) Drugs

Drug Group	Means						
	Quintile 1 (Highest Income)	Quintile 2	Quintile 3	Quintile 4	Quintile 5 (Lowest Income)	F value	p
Model 1: Prescriptions							
All GI Drugs	3.34	3.39	3.45	3.58	3.60	24.43	.0001
Anti-Ulcer Drugs	2.79	2.85	2.90	3.01	3.00	19.29	.0001
Non-Ulcer Drugs	0.55	0.54	0.56	0.57	0.62	6.24	.0001
Model 2: Drug Quantity							
All GI Drugs	305.9	319.1	323.0	336.7	348.6	21.86	.0001
Anti-Ulcer Drugs	249.3	265.3	262.5	277.0	280.8	21.20	.0001
Non-Ulcer Drugs	56.6	53.9	60.5	59.7	67.7	5.63	.0002
Model 3: Ingredient Cost							
All GI Drugs	217.5	220.0	224.8	231.6	235.7	14.67	.0001
Anti-Ulcer Drugs	196.7	199.3	204.1	210.8	212.6	13.62	.0001
Non-Ulcer Drugs	20.9	20.8	20.7	20.8	23.0	2.35	.05

The results indicate that significant differences exist in the number of gastrointestinal prescriptions, drug costs and drug quantity across income quintiles. However, this association is weakest in the non-ulcer medications, which are purchased through the Pharmacare plan far less frequently than ulcer medications, presumably since they are most often obtained as over the counter preparations without a physician's prescription. It is precisely in this category that a monotonic gradient is absent; rather, mean utilization is relatively stable in the four highest-income quintiles, rising markedly in the fifth, and lowest-income, quintile. In all three models, the F value associated with this test is highest for all gastrointestinal drugs, and lowest for the non-ulcer preparations.

However, this test indicates only whether there exist significant differences between any two group means. In order to facilitate pairwise comparisons between each of the five income quintiles Tukey's standardized range test was used. This test indicates that, in fact, each of the five group means was not always significantly different from each other. These differences are shown in Table 6.3. A common underscore indicates that individual group means are not significantly different. For example, when all gastrointestinal medications are considered, the two highest income quintiles (1 and 2) are statistically significantly different from the mean of the middle quintile, which in turn are both statistically separate from the lowest income quintiles (4 and 5). The model incorporating drug quantity as the dependent variable results in the greatest degree of differences between the income quintiles; only the second and third quintiles are not statistically significant from each other. All analyses for all pairs of gastrointestinal drugs as well as ulcer medications are significant at a .0001 level. These results indicate that although adjacent income group means may not differ from each other in a statistically significant manner, there is marked differentiation between pairs of income quintiles, and most certainly a distinction in the group means between the lowest and highest income quintiles.

Similar results are produced for ulcer medications, when considered separately. However, very few differences between the group means are shown to exist with respect to the non-ulcer medications. There is virtually no difference between the group means when measured in terms of drug costs, and only the poorest income quintile emerges as statistically distinct when prescriptions are used for the basis for the model. Some differentiation between the groups is evidenced when drug quantity serves as the dependent variable.

Table 6.3

Between Group Differences in Drug Utilization by Income Quintile

	Model 1: Prescriptions	Model 2: Drug Cost	Model 3: Drug quantity
All Gastrointestinal Drugs	1 2 3 4 5***	1 2 3 4 5***	1 2 3 4 5***
Ulcer Medications	1 2 3 4 5***	1 2 3 4 5***	1 2 3 4 5***
Non-Ulcer Medications	1 2 3 4 5***	1 2 3 4 5*	1 2 3 4 5**

Statistically significant differences between drug utilization in each income quintile were computed using Tukey's standardized range test. Quintiles with a common underscore are not significantly different at a significance level of 0.05.

*** significant at p=.0001
** significant at p=.01
* significant at p=.05

Further insights are offered by the analysis of differences between utilization between the five income quintiles when disaggregated by age. As shown by the common underscores presented in Table 6.4, differences in utilization between income quintiles are attenuated or eliminated with increasing age. Considering all gastrointestinal drugs, for example, the results indicate that there are marked differences in the average number of prescriptions of gastrointestinal drugs between each of the five income groups in the youngest group, i.e. those aged between 65 and 74 years of age. This difference is statistically significant at p=.0001 (as shown by the asterisks). Conversely, the differences in drug utilization between income quintiles for only the oldest

Pharmacare users, those 85 years and over, are not statistically distinct from each other. The pairwise analysis shows that in the oldest age group, none of the income quintiles are significantly different from each other. Ingredient cost and drug quantities follow a similar pattern. The group means for the number of prescriptions, ingredient cost and drug quantity by age group are displayed in Appendix V.

When the number of prescriptions for ulcer medications is considered, the only notable differences in utilization between income quintiles exist for the two youngest user groups. Although statistically significant differences do not exist between each of the quintiles, distinct contrasts between the most affluent, middle, and two least affluent income quintiles are apparent. Almost by definition, a monotonic gradient will not display sharp differences between each successive income quintile unless the slope of the curve is quite steep. Analyses performed for those 85 years of age and over do not yield a statistically significant result, even at the .05 level.

Non-ulcer medications, comprising only a small proportion of gastrointestinal drug utilization, exhibit statistically significant differences between quintiles for the youngest elderly, as well as in the middle age group when prescriptions and ingredient cost are considered. However, upon closer inspection of this comparatively small drug category, even in the 65 to 74 year age group, there are few significantly significant differences between each quintile with its adjacent quintile.

Table 6.4

Between Group Differences in Drug Utilization by Income Quintile by Age Group: Gastrointestinal Drugs

	65-74 Years	75-84 Years	85 Years and Over
Prescriptions			
All Gastrointestinal Drugs	1 2 3 4 5 ***	1 2 3 4 5**	1 2 3 4 5
Ulcer Medications	1 2 3 4 5***	1 2 3 4 5**	1 2 3 4 5
Non-Ulcer Medications	1 2 3 4 5*	1 2 3 4 5*	1 2 3 4 5
Ingredient Cost			
All Gastrointestinal Drugs	1 2 3 4 5***	1 2 3 4 5**	1 2 3 4 5
Ulcer Medications	1 2 3 4 5***	1 2 3 4 5*	1 2 3 4 5
Non-Ulcer Medications	1 2 3 4 5*	1 2 3 4 5*	1 2 3 4 5
Drug Quantity			
All Gastrointestinal Drugs	1 2 3 4 5***	1 2 3 4 5**	1 2 3 4 5
Ulcer Medications	1 2 3 4 5***	1 2 3 4 5*	1 2 3 4 5*
Non-Ulcer Medications	1 2 3 4 5**	1 2 3 4 5	1 2 3 4 5

Statistically significant differences between drug utilization in each income quintile were computed using Tukey's standardized range test. Quintiles with a common underscore are not significantly different at a significance level of 0.05.

*** significant at p=.0001
** significant at p=.01
* significant at p=.05

Regression Models of Gastrointestinal Drug Utilization

The final task in this analysis was to examine variations in prescription gastrointestinal drug use by income quintile in the context of other demographic and especially, health care utilization variables. This was achieved by a multiple regression analysis. The first step in this analysis involved simple regressions on all available variables. The results of these simple bivariate regressions are presented in Table 6.5.

Not unexpectedly, many of the relationships between drug utilization and other variables yielded highly significant results. Of the social and demographic variables, income quintile yielded the highest beta value for Model 1 (prescriptions). When drug costs or drug quantity are modeled, however, the beta value associated with age is slightly higher than that for income quintile. Gender was not significant when drug costs or drug quantity were considered.

In contrast to the socio-demographic variables, the other health care utilization variables produced relatively higher beta values. In particular, use of physician services proved to be an important predictor of gastrointestinal drug use, whether this was measured in terms of physician billings or number of physician services that were billed during the period. The use of services by general practitioners proved to be more important to the utilization of gastrointestinal drugs than specialist services, or indeed, all types of physicians considered together. Home care visits were the next most important predictors of drug use. Hospitalizations were most useful when total hospital days or separations were considered, rather than just separations associated with a gastrointestinal procedure.

Table 6.5

Simple Regressions of Gastrointestinal Drug Use per User by Income Quintile

	Model1: Prescriptions	Model 2: Drug Costs	Model 2: Drug Quantity
Socio-Demographic variables			
Sex (Male)	-.012**	.005	.000
Age	.017***	.026***	.034***
Income Quintile	.032***	.023***	.029***
Utilization variables			
Hospitalizations (separations)			
With gastrointestinal procedure	.044***	.049***	.034***
Without gastrointestinal procedure	.092***	.077***	.043***
Total	.096***	.081***	.047***
Hospitalizations (days)			
With gastrointestinal procedure	.030***	.028***	.019***
Without gastrointestinal procedure	.038***	.024***	.014***
Total	.041***	.027***	.016***
Procedures			
Gastrointestinal	.044***	.040***	.028***
Other	.064***	.056***	.030***
Total	.068***	.060***	.033***
Number of Physician billings			
General Practitioner	.151***	.106***	.081***
Internal Medicine Specialist	.070***	.071***	.031***
Other Specialist	.089***	.090***	.053***
Total Billings	.126***	.112***	.069***
Number of Physicians			
General Practitioner	.077***	.039***	.031***
Specialist: Internal Medicine	.079***	.083***	.036***
Other Specialist	.077***	.077***	.042***
Total	.097***	.087***	.048***
Number of Physician Services			
General Practitioner	.133***	.089***	.069***
Specialist: Internal Medicine	.067***	.066***	.039***
Other specialist	.080***	.078***	.046***
Total	.092***	.099***	.061***
Home Care Visits			
Homemaker	.100***	.069***	.068***
Occupational Therapist	.015***	.008*	.010*
Physiotherapist	.022***	.020***	.013***
Nurse	.044***	.028***	.020***
Total	.100***	.069***	.068***

Table values represent standardized regression coefficients computed for each individual regression analysis.

*** significant at p=.0001; ** significant at p=.01; * significant at p=.05

In order to construct a parsimonious and theoretically meaningful multivariate model of drug utilization it was neither possible nor desirable to include all of these variables. First, several of these variables represented different measures of essentially the same concept. For example, physician utilization may be represented by either physician billings, number of individual services that were billed for, or the number of separate physicians seen by an individual. As another example, both hospital days (length of stay) and hospital separations are measures of hospital utilization. Second, other variables that did not represent different measures of the same aspect of utilization were highly correlated. For example, the number of general practitioner services billed and total hospital days were fairly highly correlated (Pearson Correlation Coefficient = .42), and thus could not be used in the same multivariate regression model. Therefore at this point in the analyses, variables were selected on the basis of their statistical probability, F values and their statistical independence from one another (see Chapter Four). Also, a decision, based on these same considerations, was made on the level of aggregation to consider, such as, for example, between total billings, billings for general practitioners or those for specialist services.

The final models were determined using the technique of all possible combinations of the selected variables, starting with models incorporating two independent variables, then adding additional variables. All possible interactions between the statistically significant predictor variables were also tested. This model is presented in Table 6.6 for each of the three measures of gastrointestinal drug utilization: total number of prescriptions, total drugs cost, and total drug quantity.

The standardized regression coefficient, or beta, informs of the relative contribution of each variable to the equation. As the data show, income quintile is a significant predictor of total gastrointestinal drug utilization, and in most cases is the variable that contributes most to the regression equation. At the same time, one should note the significant and strong effect of the interaction between age and income. This suggests that income does not affect prescriptions dispensed, drug quantity or cost equally over the age continuum represented in this population of Pharmacare subscribers. The number of general practitioner billings, which are closely related to the number of physician contacts an individual may have over the course of a year, also prove to be influential in determining total drug use in these models. However, the relative effect of general practitioners' billings is most pronounced when the number of gastrointestinal prescriptions is considered. For drug costs and quantity, income quintile is the single variable that contributes most to the regression equations.

Table 6.6

Multivariate Regression Models of Prescription Drug Utilization: Gastrointestinal Medications

	Model 1: Prescriptions		Model 2: Drug Cost		Model 3: Drug Quantity	
Variable	Beta	P	Beta	P	Beta	p
All GI Drugs						
Income Quintile	.075	.0001	.127	.0008	.166	.0001
Billings (GP)	.144	.0001	.101	.0001	.076	.0001
Home Visits	.078	.0001	.054	.0001	.054	.0001
Hospital Days	-.020	.0001	-.016	.0001	-.021	.0001
Sex	.003	.3501	.016	.0001	.012	.0001
Age	.033	.0001	.029	.0002	.045	.0001
Age*Income	-.164	.0001	-.117	.0026	-.152	.0001
R-Square	.03		.01		.01	
Anti-Ulcer Drugs						
Income Quintile	.196	.0001	.141	.0002	.187	.0001
Billings (GP)	.119	.0001	.095	.0001	.070	.0001
Home Visits	.067	.0001	.050	.0001	.053	.0001
Hospital Days	-.026	.0001	-.030	.0001	-.024	.0001
Sex	.021	.0001	.023	.0001	.022	.0001
Age	.031	.0001	.035	.0001	.041	.0001
Age*Income	-.187	.0001	-.131	.0008	-.174	.0001
R-Square	.02		.01		.01	
Non-Ulcer Drugs						
Income Quintile	.007	.8545	-.016	.8167	.032	.4027
Billings (GP)	.079	.0001	.034	.0001	.035	.0001
Home Visits	.033	.0001	.018	.0001	.021	.0001
Hospital Days	.007	.0339	.028	.0001	.004	.2633
Sex	-.035	.0001	-.018	.0001	-.010	.0039
Age	.010	.1971	-.011	.1443	.021	.0070
Age*Income	.013	.7436	.018	.6509	-.025	.5251
R-Square	.01		.01		.01	

When antiulcer drugs are considered separately, income emerges as the most important single variable in the regression equation. Again, the effect of the interaction term between age and income quintile is not only statistically significant, but is also associated with a relatively large beta value. The results indicate that anti-ulcer medications are significantly related to general practitioner billings, acute care home care visits, hospital days, sex and age.

The relationships discussed above did not appear to be true for the remaining drugs in the gastrointestinal therapeutic drug group, i.e. the non-ulcer drugs. When the model developed for all gastrointestinal drugs was applied to this latter group, income quintile ceased to be a significant variable for either the prescription, drug cost or drug quantity models. Additionally, hospital days were not significantly related to the quantity of non-ulcer drugs dispensed.

Even though the regression equations were statistically significant, both overall and in terms of individual variables, this constellation of variables was not an especially good predictor of prescription drug use in this therapeutic drug category. While patterns were discovered, the total explained variance was low. In fact, it was only able to explain three percent of the total variation in prescriptions dispensed for all gastrointestinal drugs. Clearly, other factors may be more responsible for individual drug use, such as diagnosis or severity of illness beyond that which could be estimated by physician or hospital use. This will be discussed in greater detail in Chapter Nine.

As was the case with the analysis of variance, differences in the discriminatory power of these models emerged when the data were stratified by age group. Given the strong observed interaction between income quintile and age, the regression analyses applied to three discrete age groups in order to assess the relative differences between them. As shown in Table 6.7, this analysis was most predictive of the use of all gastrointestinal medications in the younger age category, i.e. that including those individuals between 65 and 74 years of age. Considering the number of prescriptions dispensed, for example, it is evident that value of the standardized correlation coefficient for income quintile decreases with age. In fact, it becomes non-significant in the two oldest age groups, at a significant level of p=.05. A similar pattern emerges when drug costs are examined. Income is a statistically significant predictor of the total quantity of gastrointestinal drugs dispensed to individuals aged between 65 and 74 years only at a significant level of p=.10.

Table 6.7

Multivariate Regression Models by Age Group: All Gastrointestinal Drugs

	65-74 Years		75-84 Years		85 Years and over	
Variable	Beta	P	Beta	P	Beta	P
Model 1: Prescriptions						
Income Quintile	.197	.0239	.030	.8661	-.114	.8216
Billings (GP)	.154	.0001	.124	.0001	.101	.0001
Home Visits	.070	.0001	.095	.0001	.071	.0001
Hospital Days	-.010	.0238	-.028	.0006	-.057	.0003
Sex	.007	.1039	-.003	.5968	.016	.3066
Age	.046	.0001	-.009	.5248	-.020	.5918
Age*Income	-.178	.0431	-.019	.9143	-.090	.8595
R-Square	.03		.03		.02	
Model 2: Drug Cost						
Income Quintile	.205	.0193	.118	.5051	-.017	.9727
Billings (GP)	.109	.0001	.080	.0001	.086	.0001
Home Visits	.054	.0001	.064	.0001	.043	.0054
Hospital Days	-.012	.0010	-.018	.0044	-.033	.0363
Sex	.016	.0001	.015	.0115	-.021	.0298
Age	.069	.0001	-.015	.2785	.014	.5619
Age*Income	-.094	.0286	-.105	.5539		.9775
R-Square	.02		.01		.01	
Model 3: Drug Quantity						
Income Quintile	.152	.0830	.149	.3999	.012	.9809
Billings (GP)	.087	.0001	.057	.0001	.038	.0177
Home Visits	.053	.0001	.062	.0001	.036	.0198
Hospital Days	-.013	.0025	-.026	.0001	-.040	.0118
Sex	.013	.0015	.010	.0811	.024	.1242
Age	.048	.0001	.002	.9011	-.015	.6886
Age*Income	-.127	.1508	-.140	.4307	-.017	.9736
R-Square	.01		.01		.01	

Anti-ulcer medications follow the same general pattern. In this case, however, the income quintile is significant only for the youngest recipients of these drugs, i.e. those aged between 65 and 74 years of age (Table 6.8). Again, area income is the strongest contributor to the model, followed by the number of general practitioner billings, home care visits and age. The interaction term between income and age remains significant even within this ten-year age span. For those over 75 years of age, income was not a significant variable, although general practitioner billings and home care visits were consistently significant up to and including the oldest group of users of anti-ulcer medications.

Table 6.8

Multivariate Regression Models by Age Group: Anti-Ulcer Drugs

	65-74 Years		75-84 Years		85 Years and over	
Variable	Beta	P	Beta	P	Beta	P
Model 1: Prescriptions						
Income Quintile	.230	.0087	.040	.8187	-.208	.6823
Billings (GP)	.125	.0001	.107	.0001	.078	.0001
Home Visits	.060	.0001	.082	.0001	.077	.0001
Hospital Days	-.018	.0001	-.033	.0001	-.049	.0019
Sex	.023	.0001	.018	.0021	.022	.1595
Age	.044	.0001	-.009	.5071	-.018	.6236
Age*Income	-.210	.0175	-.034	.8453	.181	.7213
R-Square	.02		.02		.01	
Model 2: Drug Cost						
Income Quintile	.213	.0151	.073	.3987	-.036	.9430
Billings (GP)	.100	.0001	.080	.0001	.081	.0001
Home Visits	.051	.0001	.060	.0001	.045	.0036
Hospital Days	-.024	.0001	-.032	.0001	-.030	.0577
Sex	.024	.0001	.023	.0001	.033	.0327
Age	.069	.0001	-.016	.2656	-.018	.3217
Age*Income	-.200	.0240	-.061	.7315	.028	.9555
R-Square	.02		.02		.01	
Model 3: Drug Quantity						
Income Quintile	.243	.0057	.068	.6944	-.072	.8884
Billings (GP)	.075	.0001	.061	.0001	.038	.0170
Home Visits	.047	.0001	.067	.0001	.046	.0030
Hospital Days	-.017	.0007	-.031	.0001	-.034	.0316
Sex	.023	.0001	.024	.0001	.024	.1121
Age	.056	.4882	-.010	.4882	.001	.9794
Age*Income	-.221	.7478	-.057	.7478	-.085	.8679
R-Square	.01		.01		.00	

Summary

The predominant message that emerges from the regression analyses is that socioeconomic status is a significant determinant of prescription drug use, especially for the younger recipients of gastrointestinal medications. Furthermore, the results indicate that income affects utilization differently at different ages, even within fairly narrowly defined ten-year age groups. For those aged 75 years and over, other health care utilization may be a far more important factor determining gastrointestinal drug use. The data show that billings by general practitioners for each individual are also important contributors to gastrointestinal drug use. Second, the number of home care visits to each individual by nurses, home care workers, occupational therapists or physical therapists are also important correlates of prescription gastrointestinal drug use. Still the explanatory power of these variables is low.

In light of the low levels of variance explained by the models, it is likely that other factors such as the clinical characteristics of these individuals account for some of the unexplained differences in gastrointestinal drug utilization. In the absence of detailed disease severity and morbidity data, their effect cannot be established, but only surmised by the current findings. Although at an aggregate level, significant differences between income quintiles do emerge in terms of prescription drug use in this therapeutic drug category, at the individual level other factors may be as, or more, important determinants of utilization.

The results also raise questions about not only how we measure socioeconomic status in the elderly population, but also its relative importance in predicting drug utilization in the oldest Pharmacare subscribers. The marked effect of age on the strength of these associations may be as much a reflection of our ability to accurately capture socioeconomic status with increasing age as it is in the importance of this factor in contrast with other variables as an individual ages. These considerations, as well as the relationships between health care utilization morbidity and socioeconomic status will be examined further in the concluding chapter.

Chapter Seven

Central Nervous System Drugs:

Utilization, Income Level and Other Health Care Utilization

In this chapter, individuals' utilization of central nervous system drugs is examined, in relation to their demographic and medical utilization data. This therapeutic drug group is comprised of two general groups of medications, analgesics and psychoactive drugs. One half of all prescriptions for central nervous system medications were written for analgesics (Figure 7.1). Virtually all of the remaining prescriptions were divided between sedatives (33.6 percent), and antidepressants (12.0 percent). The relatively few prescriptions written in the other category included drugs such as anticonvulsants, sympathomimetic preparations, antimanic medications and anorexiants. Although these two general groups constitute the same therapeutic drug group, they are usually indicated for different indications. Here, they will be considered separately as well as a single collective grouping.

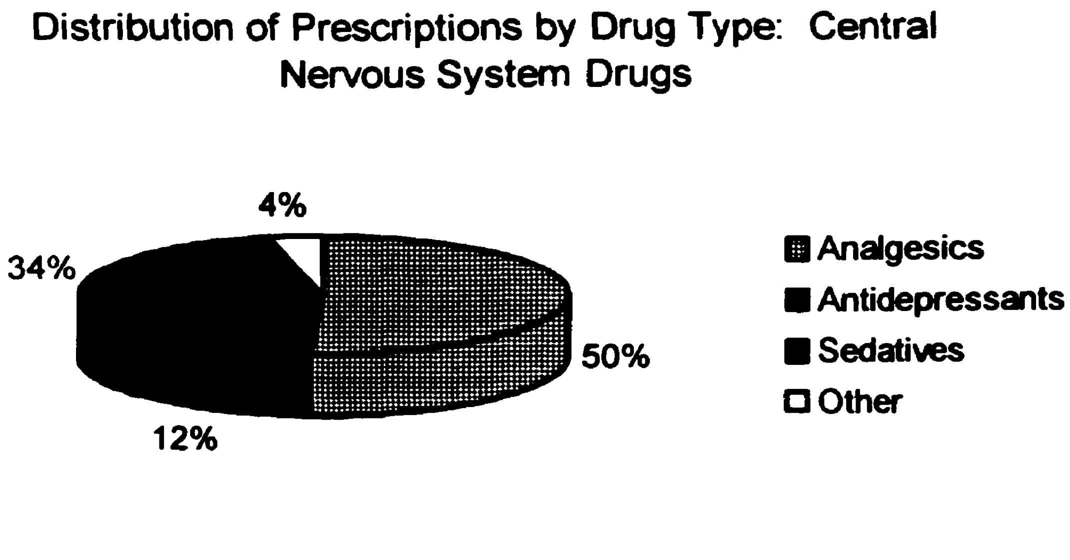


Figure 7.1

Descriptive Analysis

A total of 194,370 individuals with prescriptions for at least one central nervous system medication were considered, along with their use of hospital, medical and home care services. The data presented in Table 7.1 provide an overview of the main features of their demographic and health care utilization profile by income quintile. This group is considerably larger in number than that prescribed gastrointestinal drugs; in fact it is just over twice the size of that group. Like the gastrointestinal group, females outnumber males in all quintiles, as is characteristic of this age group in general. The proportion of females compared to males increases with income quintile, or as average income decreases. Similarly, the average age of the users within each income quintile decreases with increasing affluence. The average age of individuals in the first, most affluent quintile is 73.8 years, compared to 75.3 years in the fifth, and least affluent quintile. These individuals are, on average, slightly older than those in the gastrointestinal group - on average about one year per quintile.

The health care utilization variables such as hospitalizations or physicians billings do not vary greatly by income quintile, but with gastrointestinal drug users, marked differences in home care use are evident. The average number of home care visits increase sharply with income quintile, from 10.6 visits for the most affluent quintile, to 26.8 visits for the least affluent income quintile. Most of these were homemaker services, which accounted for most of the variation in utilization. The source of these differences in the use of home care services by income quintile is not clear. On the one hand, these variations could signify differences in the overall health status of the individuals within these quintiles. On the other hand, they may be a reflection of the potential use of home services paid for with personal funds rather than the public health care system by those in the more affluent income quintiles who could afford them. The very large standard deviations for the means of both physicians billings in all categories as well as home care visits, point to the very high variability in the utilization of these services within each income quintile. For physician billings there is greater variation in utilization for specialist visits compared to general practitioners. In home care, the highest variability is evidenced for homemaker services.

Table 7.1

Demographic and Health Care Utilization Variables by Income Quintile:
Users of Central Nervous System Drugs

Variable	1st Quintile		2nd Quintile		3rd Quintile		4th Quintile		5th Quintile	
	Highest Income								Lowest Income	
	N=42,698		N=39,887		N=36,975		N=41,249		N=38,011	
Sociodemographic variables										
% Females*	55.5		56.5		57.0		58.4		61.6	
% Males	42.6		41.6		40.9		39.3		36.0	
% Residing in Urban Area	91.6		89.1		83.6		85.8		91.2	
	Mean (*Standard Deviation*)									
Age	73.8	*(6.2)*	73.9	*(6.3)*	74.3	*(6.4)*	74.7	*(6.5)*	75.3	*(6.7)*
Utilization Variables										
Hospitalizations	0.5	*(1.0)*	0.6	*(1.1)*	0.6	*(1.1)*	0.6	*(1.1)*	0.6	*(1.1)*
Physician Billings (#)	30.2	*(27.7)*	30.5	*(29.2)*	30.2	*(28.2)*	30.8	*(28.4)*	31.2	*(28.6)*
General Practitioner	10.8	*(8.9)*	11.4	*(9.5)*	11.4	*(9.5)*	11.8	*(9.7)*	11.8	*(9.9)*
Specialist	19.5	*(22.6)*	19.1	*(24.0)*	18.8	*(22.8)*	19.0	*(22.8)*	19.4	*(22.9)*
Home Care Visits	10.6	*(40.8)*	15.4	*(49.0)*	17.3	*(51.8)*	21.7	*(57.9)*	26.8	*(63.1)*
Homemaker	9.5	*(38.8)*	14.1	*(46.8)*	16.0	*(49.5)*	20.2	*(55.5)*	25.1	*(60.3)*
Occupational Therapist	0.3	*(0.8)*	0.1	*(0.8)*	0.1	*(0.8)*	0.1	*(0.7)*	0.1	*(0.9)*
Physiotherapist	0.1	*(0.8)*	0.1	*(1.2)*	0.1	*(2.4)*	0.1	*(1.3)*	0.1	*(1.2)*
Nurse	0.9	*(7.3)*	1.1	*(7.9)*	1.1	*(7.8)*	1.3	*(8.9)*	1.5	*(10.3)*

*The proportion of males and females may not add up to 100 percent due to some records with missing gender data.

The Effect of Income on Central Nervous System Drug Utilization

The average per capita number of prescriptions, drug costs and drug quantity, as well as drug exposures were described for those purchasing central nervous system drugs under the Pharmacare Plan in Chapter Five. Here, an analysis of variance is applied to estimate whether a statistically significant difference in utilization of central nervous system drugs exists between the five income quintiles. The overall results indicate that whether measured in terms of prescriptions, drug cost or drug quantity, significant differences do exist between income quintiles for all central nervous system drugs, and within this broad drug group, psychoactive medications and analgesics. The analysis examining all central nervous system drugs in total produced the highest F values as opposed to the more specific sub-categories within this therapeutic drug group (Table 7.2). Conversely, the lowest F values were derived for analgesic preparations only. Also, utilization, when measured in terms of prescriptions or drug quantity yielded markedly higher F values than when drug costs were used to define utilization in any of the three drug categories considered here.

Table 7.2
ANOVA of Drug Utilization by Income Quintile: Central Nervous System (CNS) Drugs

Drug Group	Means						
	Quintile 1 (Highest Income)	Quintile 2	Quintile 3	Quintile 4	Quintile 5 (Lowest Income)	F value	p
Model 1: Prescriptions							
All CNS Drugs	5.08	5.38	5.40	5.68	6.01	97.4	.0001
Psychoactive	2.35	2.40	2.45	2.61	2.88	76.1	.0001
Analgesics	2.73	2.95	2.98	3.07	3.14	54.11	.0001
Model 2: Drug Cost							
All CNS Drugs	112.45	117.39	119.70	112.26	125.12	16.2	.0001
Psychoactive	37.92	38.16	40.33	42.00	45.31	26.2	.0001
Analgesics	74.53	79.23	79.37	79.81	80.26	5.4	.0002
Model 3: Drug Quantity							
All CNS Drugs	415.74	437.29	444.33	466.31	494.01	77.4	.0001
Psychoactive	162.65	164.67	168.84	176.72	197.20	61.1	.0001
Analgesics	253.09	272.62	275.49	289.59	296.81	41.0	.0001

Quintile-specific results of this analysis are presented in Table 7.3. The analysis comparing the number of prescriptions dispensed to individuals between income groups indicates that each quintile is significantly different from the other, with the exception of the second and third quintiles, which do not exhibit statistically significant differences. The same result occurs when utilization is measured in terms of drug quantity. However, drug costs did not vary in a precise, monotonic fashion. While distinct differences did emerge between the average number of prescriptions in the first, third and fifth quintile, for example, the second and third were not statistically significantly different. Similarly, the third and fourth, and fourth and fifth quintiles, respectively did not exhibit statistically significant differences. A less distinct gradient emerges when psychoactive and analgesic medications are considered separately. Again, there is a distinct difference between the first, middle, and last income quintiles, but the differences between each individual quintile are not always statistically significant. The exception to this is evidenced in drug costs for analgesic medications, where a barely noticeable gradient emerges. In this case, only the first income quintile differs from either the second, third, fourth or fifth quintile.

Table 7.3

Between Group Differences in Drug Utilization by Income Quintile: Central Nervous System Drugs

	Model 1: Prescriptions	Model 2: Drug Cost	Model 3: Drug quantity
All CNS Drugs	1 2 3 4 5***	1 2 3 4 5***	1 2 3 4 5***
Psychoactive Medications	1 2 3 4 5***	1 2 3 4 5***	1 2 3 4 5***
Analgesic Medications	1 2 3 4 5***	1 2 3 4 5**	1 2 3 4 5***

Statistically significant differences between drug utilization in each income quintile were computed using Tukey's standardized range test. Quintiles with a common underscore are not significantly different at a significance level of 0.05.

*** significant at p=.0001
** significant at p=.01
* significant at p=.05

Thus while there is a distinct gradient in drug utilization by income quintile when measured as prescriptions or drug quantity, it is not always clearly delineated between every one of the five quintiles defined in this study. Broader income categories, such as quartiles, may have yielded more statistically significant results between the middle income groups. These results should be interpreted as showing a gradient in drug use in this category by income group.

The utilization of central nervous system drugs by income quintile also shows marked variations by age category. The results are similar to those reported for gastrointestinal drugs, but perhaps more dramatic for this drug group. In general, the differences in utilization between income quintiles tended to lessen, and eventually disappear, with increasing age (Table 7.4). Consider, for example, prescriptions for all central nervous system drugs. The pattern for those individuals aged between 65 and 74 years of age is that discussed above: there are statistically significant differences between all quintiles except the second and third. For the next age group, those between 75 and 84 years of age, only quintiles one, two and three taken as a group are statistically significantly different from quintiles three, four and five. For the oldest Pharmacare users, those aged 85 years or more, drug use does not vary, at least in a statistical sense, between any of the income quintiles. An identical progression occurs for all three utilization measures (prescriptions, drug cost and drug quantity) whether all central nervous system drugs are considered together, or as psychoactive or analgesic drug sub-groups. It should also be noted, that whereas all analyses of variance for the youngest age group considered here are highly significant (p=.0001), they become less so for the middle age group. In most cases the analysis did yield a statistically significant result for this middle age group; drug costs for analgesic medications did not. The oldest age group yielded no significant differences whatsoever, as discussed above. The group means for drug utilization by type of central nervous system drug and age group are shown in Appendix VI.

Table 7.4

Between Group Differences in Drug Utilization by Income Quintile:
Central Nervous System Drugs

	65-74 Years	75-84 years	85 Years and Over
Prescriptions			
All CNS Drugs	1 2 3 4 5***	1 2 3 4 5***	1 2 3 4 5
Psychoactive Medications	1 2 3 4 5***	1 2 3 4 5***	1 2 3 4 5
Analgesic Medications	1 2 3 4 5***	1 2 3 4 5**	1 2 3 4 5
Drug Cost			
All CNS Drugs	1 2 3 4 5***	1 2 3 4 5	1 2 3 4 5
Psychoactive Medications	1 2 3 4 5***	1 2 3 4 5***	1 2 3 4 5
Analgesic Medications	1 2 3 4 5***	1 2 3 4 5	1 2 3 4 5
Drug Quantity			
All CNS Drugs	1 2 3 4 5***	1 2 3 4 5***	1 2 3 4 5
Psychoactive Medications	1 2 3 4 5***	1 2 3 4 5***	1 2 3 4 5
Analgesic Medications	1 2 3 4 5***	1 2 3 4 5*	1 2 3 4 5

Statistically significant differences between drug utilization in each income quintile were computed using Tukey's standardized range test. Quintiles with a common underscore are not significantly different at a significance level of 0.05.

*** significant at p=.0001
** significant at p=.01
* significant at p=.05

Regression Models of Central Nervous System Drug Utilization

In order to assess the effect of income quintile within the context of other demographic and health care utilization variables, a series of regression analyses were performed. Single order demographic and health care utilization variables were regressed against the utilization variables including number of prescriptions, drug costs and drug quantity for each individual. As could be expected for such a large sample size, all regressions yielded highly significant results (Table 7.5). The relative strength of these associations can be seen by comparing the standardized regression coefficients (beta) of each. The strongest associations emerged between drug utilization and the other health care utilization variables, especially physician billings and physician services. Hospitalizations, whether measured as separations or hospital days produced weaker results within the set of health care utilization variables considered. Similar results (not reported here) occurred when considering psychoactive drugs and analgesic drugs as separate categories. As described in the previous chapter, since many of the health care utilization variables are highly correlated, and may, in fact, measure different aspects of the same construct[1], the resultant regression coefficients, F values and correlation coefficients were used to select those variables to be considered further.

The technique of all possible regressions was utilized in order to derive the final regression models. The remaining variables were entered into all possible combinations of regression models, starting with all possible bivariate regression models. When two independent variables were considered in tandem, the combination of billings by general practitioners and income quintiles yielded the best overall results, closely followed by the combination of hospitalizations and billings by general practitioners and billings and home care visits. The final regression model was developed using the total number of prescriptions per individual as the dependent variable.

---

[1] For example, both the number of physician services and physician billings measure utilization of physicians.

The resultant model was then applied to drug costs and drug quantity for each drug group.

Table 7.5

Simple Regressions of Central Nervous System Drug Use by Income Quintile

	Model 1: Prescriptions	Model2: Drug Costs	Model 3: Drug quantity
Socio-Demographic variables			
Gender (Male)	-.059***	-.037***	-.034***
Age	.021***	-.008**	.017***
Income Quintile	.042***	.018***	.038***
Utilization variables			
Hospitalizations (separations)	.125***	.064***	.086***
Hospitalizations (days)	.088***	.056***	.063***
Procedures	.070***	.028***	.045***
Physician billings			
General Practitioner	.270***	.149***	.198***
Specialist	.128***	.072***	.093***
Total Billings	.194***	.108***	.141***
Number of Physicians			
General Practitioner	.164***	.074***	.098***
Specialist	.137***	.070***	.091***
Total	.223***	.082***	.108***
Number of Physician Services			
General Practitioner	.248***	.147***	.183***
Specialist	.118***	.063***	.084***
Total	.180***	.101***	.130***
Home Care Visits			
Homemaker	.162***	.090***	.132***
Occupational Therapist	.042***	.027***	.036***
Physiotherapist	.037***	.026***	.028***
Nurse	.086***	.102***	.093***
Total	.162***	.090***	.133***

Table values represent standardized regression coefficients (beta) computed for each individual regression analysis.

*** significant at p=.0001
** significant at p=.01
* significant at p=.05

The final models for number of prescriptions, drug costs and drug quantity for all central nervous system drugs per individual are presented in Table 7.6. Estimates of beta are provided for each variable. The regression models included income quintile, billings by general practitioners (per individual), number of home care visits, gender and age. An interaction term between age and income quintile proved to be significant and therefore included in the models as well. Income emerged as a statistically significant explanatory variable in all three models (prescriptions, drug cost and drug quantity) for all central nervous system drugs, as well as for psychoactive drugs and analgesics considered separately. The statistically significant and large effect of the interaction term, judging by the relatively large beta value associated with it, should be noted as well, since it suggests that socioeconomic status, measured by area income, may exert different effects on central nervous system drug utilization at different ages.

Table 7.6

Multivariate Regression Models of Prescription Drug Utilization: Central Nervous System Drugs

	Model 1: Prescriptions		Model 2: Drug Cost		Model 3: Drug Quantity	
Variable	Beta	P	Beta	P	Beta	P
All CNS Drugs						
IncomeQuintile	.297	.0001	.163	.0001	.281	.0001
Billings (GP)	.253	.0001	.140	.0001	.183	.0001
Home Visits	.127	.0001	.074	.0001	.107	.0001
Sex (Male)	-.048	.0001	-.030	.0001	-.024	.0001
Age	. 019	.0003	-.008	.1284	.024	.0001
Age*Income	-.286	.0001	-.162	.0001	-.269	.0001
R-Square	.09		.03		.05	
Psychoactive Drugs						
IncomeQuintile	.224	.0001	.125	.0001	.202	.0001
Billings (GP)	.193	.0001	.134	.0001	.152	.0001
Home Visits	.102	.0001	.065	.0001	.084	.0001
Sex (Male)	-.077	.0001	-.047	.0001	-.074	.0001
Age	.024	.0001	-.012	.0216	.008	.1300
Age*Income	-.215	.0001	-.119	.0001	-.192	.0001
R-Square	.06		.03		.04	
Analgesics						
IncomeQuintile	.240	.0001	.120	.0001	.222	.0001
Billings (GP)	.203	.0001	.087	.0001	.131	.0001
Home Visits	.095	.0001	.050	.0001	.081	.0001
Sex (Male)	.008	.0002	-.008	.0010	.020	.0001
Age	.003	.5181	-.002	.6468	.025	.0001
Age*Income	-.233	.0001	-.113	.0001	-.213	.0001
R-Square	.06		.01		.03	

In addition to income, general practitioner billings and home care visits were the two variables that contributed most to determining drug utilization. In order of importance, gender was the fourth most significant single variable considered, with increased use shown by female users.

The explained variance (r square) for these equations was .09 for prescriptions, .03 for drug costs and .05 for drug quantity when all central nervous system drugs were considered. Interestingly, when more specific drug categories were considered separately, i.e. psychoactive drugs and analgesics, the R square values decreased somewhat, although even these represent fairly broad therapeutic drug groups.

There was some question whether differences in prescription drug utilization could be attributed to potentially different access to health care services in rural versus urban areas of residence, or whether the generally larger geographical areas which define a census area (and therefore income quintile) in rural areas would affect the results. An analysis by rural or urban residence yielded no differences in the results of these models.

Also, excluding those individuals utilizing any home care services from the analysis (since they, presumably, may have lower health status and a preponderance of chronic conditions) did not affect the results to any discernable degree.

The results of the regression analyses for all central nervous system medications stratified by age group are presented in Table 7.7. Three age groups are considered: those individuals under 75 years of age, those between 75 and 84 years of age, and finally, those over 85 years of age. The nature of the relationship between area income and utilization changes quite dramatically between the three age groups. These results indicate that for the youngest elderly users of the Pharmacare plan, i.e. those between 65 and 74 years of age, income quintile is a significant determinant of the use of central nervous system drugs. Even within these age groups, however, a significant interaction between income quintile and age is evident.

Table 7.7

Multivariate Regression Models by Age Group: All Central Nervous System Drugs

	65-74 Years		75-84 Years		85 Years and over	
Variable	Beta	P	Beta	p	Beta	p
Model1: Prescriptions						
Income Quintile	.343	.0001	.133	.2744	-.040	.3944
Billings (GP)	.273	.0001	.215	.0001	.156	.0001
Home Visits	.141	.0001	.131	.0001	.084	.0001
Sex	-.037	.0001	-.065	.0001	-.062	.0001
Age	.037	.0001	-.013	.1745	-.047	.0626
Age*Income	-.319	.0001	-.133	.2767	.030	.9349
R-Square	.12		.08		.04	
Model 2: Drug Costs		.0001		.0001		.0001
Income Quintile	.056	.0095	-.038	.7638	-.229	.5349
Billings (GP)	.154	.0001	.107	.0001	.082	.0001
Home Visits	.090	.0001	.070	.0001	.056	.0001
Sex	-.029	.0001	-.027	.0001	-.029	.0092
Age	.019	.0022	-.031	.0015	-.048	.0632
Age*Income	-.148	.0147	.035	.7796	-.243	.5107
R-Square	.04		.02		.02	
Model 3: Drug Quantity		.0001		.0001		.0001
Income Quintile	.295	.0001	.122	.3261	.274	.4568
Billings (GP)	.208	.0001	.130	.0001	.090	.0001
Home Visits	.123	.0001	.112	.0001	.069	.0001
Sex	-.016	.0001	-.035	.0001	-.038	.0005
Age	.041	.0001	-.016	.1047	-.045	.0790
Age*Income	-.270	.0001	-.120	.3374	-.275	.4560
R-Square	.07		.04		.02	

The results indicate that the number of prescriptions and drug units dispensed are determined, in order of decreasing importance, by income quintile, general practitioners' billings, number of home visits, sex and age. Not surprisingly, the central nervous system drugs are more likely to be dispensed to females, as shown by the sign of the standardized beta coefficient associated with sex. The R square values for the models describing prescriptions, cost and drug quantity are .12, .04 and .07 respectively. While area income ceases to be a significant predictor of drug utilization in the two oldest age groups, general practitioner billings, home care visits and sex were significantly related to the number of prescriptions and units dispensed as well as their cost.

Lastly, the proportion of variance explained by the entire model, including billings and home visits, decreases with age. For all central nervous system prescriptions, for example, the R square changes from .12 for the youngest group to .08 and .04 for the oldest groups respectively. This same trend is evident for the models for drug costs and drug quantity.

The data for psychoactive medications only is presented in Table 7.8. The same pattern emerges for this drug category as for all medications in this therapeutic drug group considered together. Income is a significant explanatory variable in the youngest Pharmacare subscribers, but not for those 75 years of age or older. Again, it is evident that income may affect utilization quite differently at different ages within this age group. General practitioner billings, home care visits, sex (male) were also significant for all age groups.

Analgesics also displayed this same general pattern. Again, income was only a significant predictor for the youngest recipients of analgesics, and only at a significance level of p=.10 when drug costs were considered (Table 7.9). Again, a strong interaction effect was noted between age and income quintile in the youngest age group. General practitioner billings and home care visits were also highly significant predictors of analgesic use. As well, utilization was higher for females in most of the regression equations.

Table 7.8

Multivariate Regression Models by Age Group:
Psychoactive Drugs

	65-74 Years		75-84 Years		85 Years and over	
Variable	Beta	P	Beta	p	Beta	p
Model1: Prescriptions						
Income Quintile	.231	.0001	.064	.6019	-.102	.1292
Billings (GP)	.206	.0001	.170	.0001	.132	.0001
Home Visits	.116	.0001	.103	.0001	.060	.0001
Sex	-.073	.0001	-.084	.0001	-.068	.0001
Age	.027	.0001	-.005	.5978	-.031	.2231
Age*Income	-.211	.0004	-.062	.6163	.085	.8170
R-Square	.07		.05		.03	
Model 2: Drug Costs						
Income Quintile	.132	.0284	.003	.9808	.218	.5554
Billings (GP)	.140	.0001	.119	.0001	.101	.0001
Home Visits	.072	.0001	.075	.0001	.032	.0042
Sex	-.049	.0001	-.042	.0001	-.029	.0079
Age	.008	.1801	-.021	.0369	-.030	.2501
Age*Income	-.121	.0470	.002	.9856	-.219	.5542
R-Square	.03		.03		.01	
Model 3: Drug Quantity						
Income Quintile	.195	.0011	.024	.8485	.145	.6945
Billings (GP)	.163	.0001	.129	.0001	.107	.0001
Home Visits	.095	.0001	.087	.0001	.043	.0001
Sex	-.072	.0001	-.078	.0001	-.062	.0001
Age	.020	.0018	-.018	.0729	-.022	.3872
Age*Income	-.176	.0035	-.019	.8791	-.158	.6682
R-Square	.05		.04		.02	

Table 7.9

Multivariate Regression Models by Age Group: Analgesics

	65-74 Years		75-84 Years		85 Years and over	
Variable	Beta	P	Beta	p	Beta	p
Model1: Prescriptions						
Income Quintile	.317	.0001	.145	.2430	.059	.8738
Billings (GP)	.226	.0001	.158	.0001	.094	.0001
Home Visits	.108	.0001	.097	.0001	.064	.0001
Sex	.019	.0001	-.009	.0249	-.018	.0993
Age	.032	.0001	-.016	.1111	-.039	.1281
Age*Income	-.279	.0001	-.148	.2358	-.055	.8819
R-Square	.07		.04		.02	
Model 2: Drug Costs						
Income Quintile	.108	.0765	-.045	.1172	.136	.7142
Billings (GP)	.101	.0001	.058	.0001	.040	.0022
Home Visits	.065	.0001	.040	.0001	.047	.0001
Sex	-.006	.0366	-.008	.0563	-.016	.1537
Age	-.018	.0049	-.025	.0119	-.038	.1389
Age*Income	-.105	.0877	.040	.7551	-.152	.6824
R-Square	.02		.01		.01	
Model 3: Drug Quantity						
Income Quintile	.246	.0001	.138	.2709	.241	.5155
Billings (GP)	.157	.0001	.076	.0001	.038	.0006
Home Visits	.094	.0001	.082	.0001	.056	.0001
Sex	.028	.0001	.009	.0332	-.004	.6879
Age	.039	.0001	-.008	.4136	-.041	.1144
Age*Income	-.227	.0002	-.139	.2718	-.232	.5307
R-Square	.04		.01		.01	

Summary

In summary, the data show that income level does indeed play a significant role in the utilization of central nervous system drugs by the elderly. These differences however, do seem to be restricted to the younger elderly; income does not affect drug use in those over 75 years of age. At the same time, billings by general practitioners as well as home care visits are also influential in determining central nervous system drug use in all age groups. The final models do not explain a large proportion of the variance in central nervous system drug utilization, in terms of either prescriptions, drug costs or drug quantity, but are able to portray the interplay between at least some of significant determinants of the utilization of prescription medications within this therapeutic drug group. The ramifications of these results will be discussed further in Chapter Nine.

Chapter Eight

Cardiovascular Drugs:

Utilization, Income Level and Other Health Care Utilization

In this chapter, the relationship between income and prescription drug utilization in the cardiovascular drug group is investigated in the context of other demographic and health care utilization variables. As described in Chapter Five, the cardiovascular drug group is comprised of three broad therapeutic drug groups, including antihypertensive-antianginal agents, antihyperlipidemic preparations and sclerosing agents. As depicted in Figure 8.1, the antihypertensive drugs form by far the largest group of drugs, and account for 92.7 percent of all prescriptions. This group consists of antihypertensive agents including beta adrenergic receptor blocking agents, calcium channel blockers and angiotensin converting enzyme (ACE) inhibitors. Also included are combination antianginal-antihypertensive agents and antiarrhythmic drugs. Antihyperlipidemic and antihypercholesterolemic agents constituted 7.3 percent of all prescriptions. Also, 221 prescriptions for sclerosing agents were dispensed, which amounts to a small fraction of one percent of all prescriptions reimbursed by the Pharmacare program in 1993.

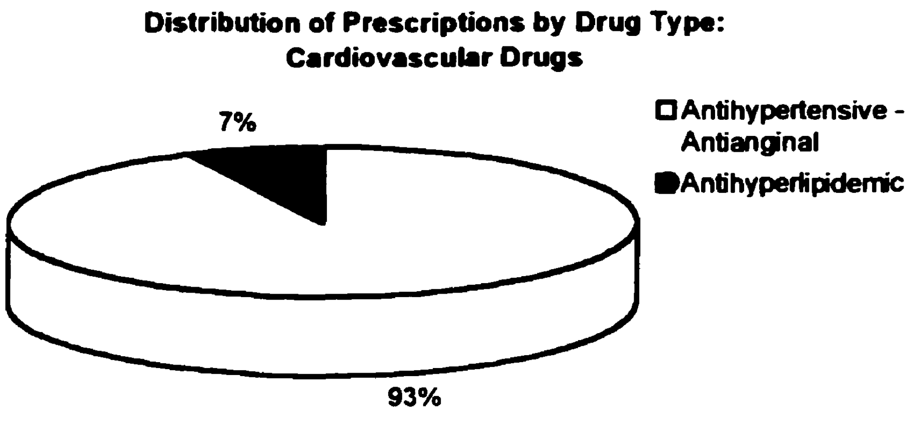


Figure 8.1

Descriptive Analysis

The pattern of demographic and other health care utilization variables is similar to that of both the gastrointestinal and central nervous system medication users in the Pharmacare population (Table 8.1). Although the average age of those prescribed any cardiovascular medication is approximately one year lower compared to the two drug groups discussed in the previous chapters, it too increases slightly with income quintile, or as average income, represented by the area in which they reside, decreases. In fact, those in the highest income quintile (Quintile 1) tend to be, on average, almost two years younger than those in the lowest income quintile (Quintile 5). Also, the proportion of females in this group increases slightly as the average area income decreases. On average, fewer female users were cardiovascular drug users compared to the proportion of female users of gastrointestinal or central nervous system drugs. Here, 54.5 percent of all individuals were females, as opposed to 58.0 percent of all individuals prescribed central nervous system medications, or 57.5 percent of all individuals prescribed gastrointestinal medications in 1993. The proportion of recipients residing in an urban area was approximately equal to that of the other two drug groups, and was lowest in the middle quintiles.

Other health care utilization also appears quite similar to the previously discussed therapeutic drug groups. The average number of hospitalizations per individual, defined as the number of separations from an acute care facility per individual were equal to those for central nervous system drug users. The number of hospitalizations did not differ markedly by income quintile. Approximately one-sixth of these were hospitalizations involving a cardiovascular procedure. The number of physician billings were slightly higher than for those prescribed central nervous system drugs, although slightly lower than for those prescribed gastrointestinal medications, and also increased very slightly as income decreased. On the other hand, cardiology billings were equal for all five income quintiles. However, there is a wide degree of variation in both hospitalizations and physician billings between individuals, as indicated by the large standard deviations. Lastly, home care visits varied the most, both between income quintiles and between individuals within each quintile. Although the average number of home care visits was slightly lower than for either central nervous system or gastrointestinal medication users, here too they increased sharply as average income decreased. The total number of home care visits was more than double for those in the fifth quintile, or the lowest income group, compared to the higher income quintiles. In particular, homemaker visits for those in the fourth quintiles were double those in the first, highest income quintile. Individuals in the lowest income group had two and a half times the number of homemaker visits of those in the most affluent quintile. As a measure of central tendency, the standard deviations associated with each quintile indicate that there is a huge variability in the individual utilization of these services.

Table 8.1

Demographic and Health Care Utilization Variables by Income Quintile:
Users of Cardiovascular Drugs

Variable	1st Quintile		2nd Quintile		3rd Quintile		4th Quintile		5th Quintile	
	Highest Income								Lowest Income	
	N=34,053		N=32,368		N=29,728		N=33,035		N=30,338	
Sociodemographic variables										
% Females*	54.1		52.9		53.5		55.8		58.9	
% Males	46.6		45.1		44.3		41.7		38.2	
% Residing in Urban Area	91.0		88.7		82.9		85.7		91.1	
					Mean (*Standard Deviation*)					
Age	74.1	*(6.4)*	74.2	*(6.4)*	74.7	*(6.5)*	75.1	*(6.6)*	75.9	*(6.7)*
Utilization Variables										
Hospitalizations	0.5	*(1.0)*	0.6	*(1.1)*	0.6	*(1.1)*	0.6	*(1.1)*	0.6	*(1.1)*
With CV procedure	0.1	*(0.5)*	0.1	*(0.5)*	0.1	*(0.5)*	0.1	*(0.6)*	0.1	*(0.5)*
Physician Billings (#)	31.7	*(28.9)*	31.7	*(29.6)*	31.5	*(29.6)*	32.1	*(29.1)*	32.6	*(30.1)*
General Practitioner	11.1	*(8.9)*	11.6	*(9.5)*	11.6	*(9.4)*	12.1	*(9.8)*	12.0	*(9.8)*
Cardiologist	0.1	*(0.9)*	0.1	*(0.8)*	0.1	*(0.7)*	0.1	*(0.8)*	0.1	*(0.8)*
Home Care Visits	10.5	*(40.5)*	15.1	*(48.8)*	18.1	*(51.6)*	21.6	*(58.1)*	26.7	*(62.7)*
Homemaker	9.5	*(38.6)*	13.9	*(46.5)*	15.8	*(49.3)*	20.1	*(55.4)*	25.0	*(59.7)*
Occupational Therapist	0.1	*(0.7)*	0.1	*(0.6)*	0.1	*(0.8)*	0.1	*(0.6)*	0.1	*(0.9)*
Physiotherapist	0.1	*(1.2)*	0.1	*(2.3)*	0.1	*(1.5)*	0.1	*(1.1)*	0.1	*(1.1)*
Nurse	0.8	*(6.8)*	1.1	*(7.7)*	1.1	*(8.2)*	1.3	*(9.1)*	0.5	*(10.2)*

*The proportion of males and females may not add up to 100 percent due to some records with missing gender data.

The Effect of Income on Cardiovascular Drug Utilization

The key question here, however, concerns the effect of income on the utilization of prescription drugs in the cardiovascular drug groups. As per the previously discussed drug groups, an analysis of variance was carried out in order to ascertain whether statistically significant differences exist between the means of the drugs dispensed to individuals in each income quintile. Once again, drug utilization was measured in terms of the number of prescriptions per individual, drug cost and drug quantity, and for all cardiovascular drugs and antihypertensive medications and antihyperlipidemic agents separately. The overall results of this analysis are presented in Table 8.2.

The data indicate that in all cases, with the exception of one, a statistically significant difference in the utilization of cardiovascular drugs by income was demonstrated. This phenomenon emerged most significantly when medications were measured as the number of prescriptions, and also in terms of drug quantity, with the exception of antihyperlipidemic agents where the significance level was comparatively lower. As was the case in the previously discussed drug groups the differences that emerge with respect to drug costs are not as apparent. While a statistically significant difference between means was not demonstrated with respect to all cardiovascular drugs, both antihypertensive and antihyperlipidemic agents did show a statistically significant difference between means.

Table 8.2

ANOVA of Drug Utilization by Income Quintile: Cardiovascular (CV) Drugs

Drug Group	Means						
	Quintile 1 (Highest Income)	Quintile 2	Quintile 3	Quintile 4	Quintile 5 (Lowest Income)	F value	p
Model 1: Prescriptions							
All CV Drugs	6.20	6.24	6.31	6.43	6.46	13.3	.0001
Antihypertensive Medications	5.68	5.77	5.82	5.96	6.05	23.3	.0001
Antihyperlipidemic Agents	0.52	0.49	0.48	0.47	0.41	23.0	.0001
Model 2: Drug Cost							
All CV Drugs	454.27	458.62	462.056	462.39	463.96	2.1	.0826
Antihypertensive Medications	386.05	388.70	394.44	395.36	400.63	5.7	.0002
Antihyperlipidemic Agents	73.65	69.50	68.19	66.67	57.97	22.8	.0001
Model 3: Drug Quantity							
All CV Drugs	778.4	791.3	791.4	812.5	824.1	13.8	.0001
Antihypertensive Medications	685.9	703.4	703.9	717.7	744.6	28.3	.0001
Antihyperlipidemic Agents	94.8	92.4	87.8	78.4	79.5	3.9	.0035

This portion of the analysis is only able to confirm that the means of all the income quintiles are not equal. The extent to which each quintile differs from the next may be measured using Tukey's standardized range test. As shown in Table 8.3, the mean of every quintile does not differ significantly from the adjacent quintile. For example, the average number of prescriptions for all cardiovascular drugs does not differ between the first and second quintiles. Similarly, the second and third quintiles do not differ significantly, nor do the fourth and fifth quintiles. Still, the first income quintile does differ significantly from the third, and both differ significantly from the fifth. The same pattern emerged for the number of antihypertensive prescriptions. The first, middle and fifth income quintiles exhibit statistically significant differences if antihyperlipidemic agents are considered. Again, a strictly monotonic gradient may have emerged had broader income groupings been applied.

Table 8.3

Between Group Differences in Drug Utilization by Income Quintile: Cardiovascular Drugs			
	Model 1: Prescriptions	Model 2: Drug Cost	Model 3: Drug quantity
All CV Drugs	1 2 3 4 5***	1 2 3 4 5	1 2 3 4 5***
Antihypertensive Medications	1 2 3 4 5***	1 2 3 4 5***	1 2 3 4 5***
Antihyperlipidemic Agents	1 2 3 4 5***	1 2 3 4 5***	1 2 3 4 5*

Statistically significant differences between drug utilization in each income quintile were computed using Tukey's standardized range test. Quintiles with a common underscore are significantly different at a significance level of 0.05.

*** significant at p=.0001
** significant at p=.01
* significant at p=.05

The differences between drug costs in each quintile are rather indistinct. As suggested by the overall results of the analysis of variance, only antihypertensive and antihyperlipidemic agents differ by individual quintiles. But again, the differences emerge between clusters of quintiles rather than each individual quintile. Per quintile utilization as defined by drug quantity also reveals a similar pattern. While there are statistically significant differences between the first three, and last two quintiles when considering all cardiovascular medications, or the first, middle and last quintiles when considering the antihypertensive agents, a robust pattern is not evidenced. Thus while an overall gradient by income can be demonstrated by the data, the minute distinctions between income quintiles cannot. In other words, those in the poorer quintiles do differ significantly from those in the most affluent quintiles, but there is not a smooth income gradient.

These patterns become clearer, perhaps, when the data are disaggregated by age group. In fact, they behave in a manner similar to that found for both the gastrointestinal and central nervous system drug groups. In this drug group, however any differences between income quintiles are virtually restricted to the youngest age group only, or those between 65 and 74 years of age. Thus cardiovascular drugs do not exhibit a clear monotonic gradient to the same degree as, for example, displayed in the gastrointestinal or central nervous system therapeutic drug groups. With the exception of prescriptions per income quintile for all cardiovascular medications, which show a gradient between the first two, middle and poorest two quintiles, most other models simply differentiate between the extreme poles of the continuum. Such is the case with prescriptions for antihypertensive medications in this youngest age group, as with drug quantity for all cardiovascular drugs and antihypertensive medications. These models were also the only ones which were significant at the level p=.0001. A weaker relationship emerges for both drug quantity and prescriptions for antihyperlipidemic agents, as well as for drug costs associated with antihypertensive and antihyperlipidemic medications (Table 8.4). It should be noted that as age increases, the utilization of antihyperlipidemic agents decreases sharply; in the oldest age group antihyperlipidemic agents represent only a very small proportion of prescriptions, drug quantity and ingredient costs. Average utilization by cardiovascular drug type and age group is provided in Appendix VII.

Table 8.4

Between Group Differences in Drug Utilization by Income Quintile by Age Group: Cardiovascular Drugs	65-74 Years	75-84 years	85 Years and Over
Prescriptions			
All CV Drugs	1 2 3 4 5***	1 2 3 4 5	1 2 3 4 5
Antihypertensive Medications	1 2 3 4 5***	1 2 3 4 5	1 2 3 4 5
Antihyperlipidemic Agents	1 2 3 4 5**	1 2 3 4 5	1 2 3 4 5
Drug Cost			
All CV Drugs	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Antihypertensive Medications	1 2 3 4 5**	1 2 3 4 5	1 2 3 4 5
Antihyperlipidemic Agents	1 2 3 4 5*	1 2 3 4 5	1 2 3 4 5
Drug Quantity			
All CV Drugs	1 2 3 4 5***	1 2 3 4 5*	1 2 3 4 5
Antihypertensive Medications	1 2 3 4 5***	1 2 3 4 5*	1 2 3 4 5
Antihyperlipidemic Agents	1 2 3 4 5*	1 2 3 4 5	1 2 3 4 5

Statistically significant differences between drug utilization in each income quintile were computed using Tukey's standardized range test. Quintiles with a common underscore are not significantly different at a significance level of 0.05.

*** significant at p=.0001
** significant at p=.01
* significant at p=.05

Regression Models of Cardiovascular Drug Utilization

In order to assess the effect of utilization in the context of other demographic and health care utilization variables, they were regressed against utilization variables including number of prescriptions, drug costs and drug quantity for each individual. As could be expected for such a large sample size, all regressions yielded highly significant results (Table 8.5). The relative strength of these associations can be seen by comparing the standardized regression coefficients of each.

Table 8.5

Simple Regressions of Cardiovascular Drug Use by Income Quintile

	Model 1: Prescriptions	Model2: Drug Costs	Model 3: Drug quantity
Socio-Demographic variables			
Gender (Male)	.039***	.049***	.050***
Age	.060***	-.057***	.019***
Income Quintile	.017***	-.003	.019***
Utilization variables			
Hospitalizations	.138***	.060***	.077***
Hospitalizations w. CV procedure	.211***	.127***	.141***
Hospital days	.088***	-.009***	.008***
Hospital days w. CV procedure	.131***	.069***	.083***
CV Procedures	.128***	.078***	.082***
Physician billings			
General Practitioner	.175***	.093***	.093***
Specialist (Cardiovascular)	.056***	.034***	.035***
Total	.189***	.118***	.112***
Number of Physicians			
General Practitioner	.097***	.040***	.047***
Specialist (Cardiovascular)	.070***	.045***	.043***
Total	.166***	.108***	.101***
Number of Physician Services			
General Practitioner	.156***	.067***	.077***
Specialist (Cardiovascular)	.053***	.031***	.033***
Total	.176***	.100***	.101***
Home Care Visits			
Homemaker	.097***	.010***	.041***
Occupational Therapist	.013***	-.009**	-.003
Physiotherapist	.007*	-.007*	-.003
Nurse	.052***	.003	.019***
Total	.101***	.010***	.042***

Table values represent standardized regression coefficients (beta) computed for each individual regression analysis. *** significant at p=.0001; ** significant at p=.01; **significant at p=.05

The strongest associations emerged between drug utilization and the other health care utilization variables. The highest beta values (standardized regression coefficients) are associated with hospitalizations that occurred with a cardiovascular procedure performed, followed by total and general practitioner billings to the Medical Services Plan. The number of physicians seen by each individual, as well as the number of physician services rendered, which may be regarded as another measure of physician utilization, also figured prominently, followed by home care visits. Generally, the pattern was similar whether prescriptions, drug costs or drug quantity was considered as the dependent variable. Regressing the income quintile against number of prescriptions or drug quantity resulted in the comparatively lowest regression coefficients, although they were highly significant. Conversely, the value computed for Model 2, in which drug costs are considered, was not statistically significant.

In order to assess the effect of these variables in tandem, a multiple regression analysis was carried out. The technique of all possible regressions was used. Variables were selected for inclusion if they matched a significance level of p=.0001 and if they were not highly correlated with other variables in the model. A model was derived for all cardiovascular drug prescriptions; using the same independent variables it was applied to Model 2 (drug costs) and Model 3 (drug quantity), and for both antihypertensive and antihyperlipidemic medications separately.

The final model included income, hospitalizations associated with a cardiovascular procedure, total physician billings per individual, the number of home care visits per individual, sex, age and an interaction term. The results of this analysis are summarized in Table 8.6.

Considering first the entire cardiovascular therapeutic drug group, income quintiles emerge as a significant variable for the number of prescriptions and drug quantity dispensed. Income is a significant predictor in the drug cost equation at a lower level of significant, at p=.10. The standardized correlation coefficients indicate that other factors, such as hospitalizations associated with a cardiovascular procedure, and in the case of number of prescriptions and drug costs, physician billings may contribute more the utilization of any cardiovascular medication than income. As was evidenced in the analysis of gastrointestinal and central nervous system medications, a significant interaction between age and income quintile was observed.

Table 8.6

Multivariate Regression Models of Prescription Drug Utilization: Cardiovascular Drugs

Variable	Model 1: Prescriptions Beta	Model 1: Prescriptions P	Model 2: Drug Cost Beta	Model 2: Drug Cost P	Model 3: Drug Quantity Beta	Model 3: Drug Quantity P
All CV Drugs						
Income Quintile	.108	.0001	.050	.0774	.102	.0003
Hospitalizations (CV)	.162	.0001	.099	.0001	.114	.0001
Physician Billings	.125	.0001	.084	.0001	.070	.0001
Home Care Visits	.067	.0001	.011	.0002	.025	.0001
Sex	.036	.0001	.039	.0001	.045	.0001
Age	.055	.0001	-.054	.0001	.025	.0001
Age*Income	-.108	.0002	-.050	.0887	-.091	.0020
R-Square	.07		.03		.03	
Antihypertensive						
Income Quintile	.132	.0001	.097	.0006	.127	.0001
Hospitalizations (CV)	.171	.0001	.118	.0001	.146	.0001
Physician Billings	.125	.0001	.090	.0001	.086	.0001
Home Care Visits	.076	.0001	.026	.0001	.042	.0001
Sex	.040	.0001	.050	.0001	.057	.0001
Age	.102	.0001	.026	.0001	.090	.0001
Age*Income	-.131	.0001	-.096	.0011	-.116	.0001
R-Square	.08		.04		.05	
Antihyperlipidemic						
Income Quintile	-.077	.0066	-.081	.0043	-.004	.8870
Hospitalizations (CV)	-.016	.0001	-.016	.0001	-.010	.0001
Physician Billings	.011	.0001	.006	.0195	-.002	.5126
Home Care Visits	-.025	.0001	-.027	.0001	-.016	.0001
Sex	-.012	.0001	-.013	.0001	-.004	.1346
Age	-.167	.0001	-.169	.0001	-.081	.0001
Age*Income	.074	.0114	-.079	.0073	.009	.7629
R-Square	.01		.03		.01	

The same pattern emerges with respect to antihypertensive drugs. Income is a statistically significant determinant of the number of prescriptions dispensed for antihypertensives, as well as the quantities in which they are dispensed (p=.001). Again, the number of acute care hospital admissions associated with a cardiovascular procedure is a stronger predictor of cardiovascular drug use.

Antihyperlipidemic agents do not conform to the pattern described above. Income quintiles are significantly, albeit negatively correlated, with the number of antihyperlipidemic prescriptions dispensed as well as the costs associated with them. This suggests that a greater number of prescriptions for antihyperlipidemic prescriptions, at a higher cost, are dispensed as income increases. Income quintile appears to have no statistically significant effect on the quantity of antihyperlipidemics dispensed when other health care utilization and demographic variables are entered into the analysis.

Given the strong and statistically significant interaction observed between age and income quintile, and in order to discern whether the observed relationships are maintained in the oldest group of Pharmacare subscribers, an age-stratified analysis was performed. The results for the models characterizing all cardiovascular medications are provided in Table 8.7. Income is not a significant predictor in any age group, for any of the three dependent variables (prescriptions, drug costs, drug quantity). However, hospitalizations, physician billings, home care visits, sex are significantly related to cardiovascular drug utilization. While there is a higher propensity for males to receive any cardiovascular agent in the 65 to 74 year age group, this is reversed for those individuals aged 85 years or over. In the youngest age group, and to a lesser extent in the two older age groups, age is a significant predictor of utilization despite the relatively narrow age groups that were defined.

Table 8.7

Multivariate Regression Models by Age Group: All Cardiovascular Drugs						
	65-74 Years		75-84 Years		85 Years and over	
Variable	Beta	P	Beta	p	Beta	P
Model1: Prescriptions						
Income Quintile	.079	.3473	.002	.9883	-.182	.4379
Hospitalizations (CV)	.147	.0001	.184	.0001	.156	.0001
Physician Billings	.0130	.0001	.118	.0001	.110	.0001
Home Care Visits	.062	.0001	.072	.0001	.078	.0001
Sex	.056	.0001	.022	.0001	-.012	.1510
Age	.084	.0001	.007	.4624	-.026	.1895
Age*Income	-.072	.3994	-.002	.9829	-.093	.4273
R-Square	.07		.07		.06	
Model 2: Drug Costs						
Income Quintile	.018	.8288	-.117	.3221	.278	.2559
Hospitalizations (CV)	.080	.0001	.121	.0001	.130	.0001
Physician Billings	.083	.0016	.080	.0001	.073	.0001
Home Care Visits	.011	.0027	.018	.0001	.020	.0208
Sex	.057	.0001	.024	.0001	-.010	.2303
Age	.061	.0001	-.061	.0001	-.092	.0001
Age*Income	-.018	.8346	.118	.3216	-.270	.2696
R-Square	.03		.03		.03	
Model 3: Drug Quantity						
Income Quintile	.067	.4395	.036	.7613	.371	.1291
Hospitalizations (CV)	.093	.0001	.041	.0001	.147	.0001
Physician Billings	.064	.0001	.070	.0001	.071	.0001
Home Care Visits	.024	.0001	.034	.0001	.036	.0001
Sex	.052	.0001	.043	.0001	.008	.3423
Age	.070	.0001	-.014	.1408	-.043	.0285
Age*Income	-.052	.5517	.048	.6851	-.361	.1406
R-Square	.03		.04		.04	

These results are replicated when antihypertensive medications or antihyperlipidemic agents are analysed. As shown in Table 8.8, while income is not a significant predictor of antihypertensive drug use, hospitalizations, physician billings and home care visits are related to utilization in all age groups and measures of drugs dispensed. Sex is a highly significant factor for those individuals under 85 years of age; again, there is a higher propensity for males to receive antihypertensive drugs than females.

Table 8.8

Multivariate Regression Models by Age Group: Antihypertensive Drugs						
	65-74 Years		75-84 Years		85 Years and over	
Variable	Beta	P	Beta	p	Beta	P
Model1: Prescriptions						
Income Quintile	.116	.1662	.018	.8754	.185	.4446
Hospitalizations (CV)	.160	.0001	.190	.0001	.157	.0001
Physician Billings	.130	.0001	.117	.0001	.110	.0001
Home Care Visits	.077	.0001	.079	.0001	.079	.0001
Sex	.063	.001	.025	.0001	-.011	.1700
Age	.106	.0001	.028	.0035	-.023	.2448
Age*Income	-.106	.2102	-.019	.8698	-190	.4338
R-Square	.08		.08		.06	.2941
Model 2: Drug Costs						
Income Quintile	.108	.2657	-.127	.2809	.289	.2378
Hospitalizations (CV)	.105	.0001	.135	.0001	.135	.0001
Physician Billings	.091	.0001	.082	.0001	.075	.0001
Home Care Visits	.035	.0001	.031	.0001	.021	.0151
Sex	.074	.0001	.031	.0001	-.190	.2941
Age	.097	.0001	-.027	.0052	-.086	.0001
Age*Income	-.104	.2277	.127	.2824	-.281	.2507
R-Square	.04		.04		.04	
Model 3: Drug Quantity						
Income Quintile	.081	.3417	.098	.4041	.371	.1290
Hospitalizations (CV)	.134	.0001	.162	.0001	.150	.0001
Physician Billings	.089	.0001	.074	.0001	.071	.0001
Home Care Visits	.053	.0001	.046	.0001	.037	.0001
Sex	.074	.0001	.049	.0001	.010	.2544
Age	.108	.0001	.008	.3777	-.041	.0382
Age*Income	-.064	.4561	.106	.3671	-.362	.1396
R-Square	.06		.05		.04	

The factors associated with the use of antihyperlipidemic agents by age group are shown in Table 8.9. As observed with respect to total cardiovascular drug use, income quintile is not a significant predictive factor. In the youngest age group, antihyperlipidemic drug use was strongly associated with hospitalizations with a cardiovascular procedure, physician billings, home care visits and age when either the number of prescriptions or drug costs were considered. Also, females were more likely to receive more prescriptions for antihyperlipidemic agents, and at greater cost, than males.

Table 8.9

Multivariate Regression Models by Age Group: Antihyperlipidemic Drugs

	65-74 Years		75-84 Years		85 Years and over	
Variable	Beta	P	Beta	p	Beta	P
Model1: Prescriptions						
Income Quintile	-.092	.2934	-.079	.5096	.030	.9031
Hospitalizations (CV)	-.020	.0001	-.012	.0045	-.017	.0507
Physician Billings	.016	.0001	.014	.0072	.001	.8976
Home Care Visits	-.036	.0001	-.027	.0001	-.001	.9340
Sex	-.013	.0001	-.010	.0125	-.007	.4323
Age	-.046	.0001	-.100	.0001	-.039	.0545
Age*Income	-.085	.3323	-.079	.5094	-.031	.9012
R-Square	.004		.01		.002	
Model 2: Drug Costs						
Income Quintile	-.142	.1044	-.004	.9715	-.044	.8606
Hospitalizations (CV)	-.020	.0001	-.013	.0020	-.016	.0623
Physician Billings	.009	.0100	.010	.0176	-.003	.7521
Home Care Visits	-.037	.0001	-.032	.0001	-.005	.6044
Sex	-.014	.0001	-.014	.0007	-.010	.2644
Age	-.043	.0001	-.101	.0001	-051	.0144
Age*Income	.136	.1230	-.03	.9807	.005	.8579
R-Square	.01		.01		.01	
Model 3: Drug Quantity						
Income Quintile	.009	.9178	.115	.3382	.234	.9248
Hospitalizations (CV)	-.012	.0007	-.010	.0273	-.008	.3681
Physician Billings	-.003	.4408	.006	.1560	.009	.3362
Home Care Visits	-.022	.0001	-.018	.0001	-.005	.5904
Sex	.005	.1637	-.002	.6019	-.011	.2068
Age	-.016	.0461	-.048	.0001	-.020	.3295
Age*Income	-.006	.9473	-.105	.3849	-.018	.9438
R-Square	.001		.001		.001	

Interestingly, if age is omitted from the model, income quintile does emerge as a significant predictor of total cardiovascular drug use as well as the user of antihypertensive medication (measured by number of prescriptions and drug quantity) for individuals between the ages of 65 and 74. Clearly, age is a significant factor in the number, cost and quantity of cardiovascular drugs dispensed, and one that is also related to income. Area income affects utilization differently over the ages of individuals included in this analysis. In the youngest age group, i.e. those aged between 65 and 74 years of age, cardiovascular drug utilization generally increases with age. Conversely, in the oldest old, cardiovascular drug utilization decreases with age. The use of antihyperlipidemic agents does not follow this pattern, however. The use of these drugs decreases with age in both the youngest and oldest elderly.

Summary

These results indicate that although income is not a strong predictor of cardiovascular drug use in the elderly, it still emerges as a significant factor. However, income was shown to exhibit a strong interaction with age. In summary, cardiovascular drug utilization does indeed vary significantly according to income quintiles when all users of cardiovascular drugs are considered, except in terms of drug costs associated with all cardiovascular drugs considered. Income was not a statistically significant factor in drug utilization when the analysis was stratified by age. Hospitalizations involving a cardiovascular procedure, physician billings as well as home care visits are important determinants of cardiovascular drug use. The implications of these results, along with the results rendered from the analysis of gastrointestinal and central nervous system drugs, will be discussed in the following chapter.

Chapter Nine

Discussion

The principal objective of this study was to describe patterns of medication use for all prescribed drugs as well as those in three specific therapeutic drug classes. These include gastrointestinal, central nervous system and cardiovascular drugs. The results of this study confirm the presence of an inverse relationship between income and patterns of prescription drug use by the elderly in British Columbia. Those individuals in the least affluent socioeconomic strata, measured as area-based income quintiles, also had the highest per capita prescription drug use. For example, in 1995, those in the lowest income quintile were dispensed 23 percent more prescriptions for central nervous system medications, and 26 percent more units of these drugs. Drug costs in the lowest income quintile for gastrointestinal drugs exceeded those in the most affluent quintile by 18 percent.

This corroborates the results of previous studies in Canada (Metge, 1999), the Netherlands (van der Meer, van den Boss and Mackenbach, 1996; Scotland (Scott, Schiel and King, 1996) and Brazil (Miralles and Kimberlin, 1988), which showed a general inverse relationship between drug use and socioeconomic status. On the other hand, these results contrast sharply with other data pertaining specifically to the elderly from the United States (Stuart et al., 1991; Stuart and Grana, 1998), which demonstrated the opposite effect. These discrepancies may be due to the lack of across the board prescription drug insurance for all sectors of the elderly population in the United States.

The results also show that these patterns persist when utilization per user, rather than utilization per capita, is considered. In other words, if the use of prescription drugs only among those individuals who were prescribed at least one drug in that a therapeutic drug group within each of the four 12 month periods under study are considered, an inverse gradient still emerges. As expected, gradients of drug utilization per capita were more pronounced and produced steeper slopes compared to those for gradients of drug utilization per user. This is not surprising, since utilization rates per user are based on only those individuals who were prescribed any medication in each of the three drug groups considered here. While this does not eliminate the effect of any underlying differences in morbidity between the income quintiles, or attenuate any income-specific differences in accessing health care, this does minimize them. Presumably, all individuals compared have a demonstrated need for the medication in question. Still, individuals with the lowest incomes were dispensed up to 18 percent more prescriptions for central nervous system drugs than the more affluent users of these drugs, up to 9 percent more prescriptions for gastrointestinal preparations and 5 percent more prescriptions for cardiovascular drugs. Even greater disparities were noted for the quantity of drugs prescribed between income quintiles.

This almost universally monotonic gradient that was observed with all drugs, as well as for each of the gastrointestinal, central nervous system and to a lesser extent, cardiovascular medications, is perhaps the most significant single finding of this research. These gradients resemble those found for mortality (e.g. Roos and Mustard, 1997; Wolfson et al., 1993), health status (e.g. Frohlich and Mustard, 1996) and the utilization of health care services (Roos and Mustard, 1997) in other Canadian studies. It is important to note that these patterns do not indicate a threshold effect. The observed patterns of drug utilization are not the result of meager material resources, above which the effect of income is attenuated or removed. Income was found here to be related to drug prescribing for everyone, not just the richest or the poorest. For central nervous system drugs, for example, the lowest income quintile was found to use about 1.22 times the quantity of drugs per user used by the highest income quintile, the second poorest used 1.16 times that amount, the middle quintile used 1.12, and the second most affluent 1.06 times that of the most affluent quintile in 1995. In effect, a very systematic, monotonic income differential in the amount of medications dispensed was observed in all sectors of this population.

The second study objective stated that prescription drug utilization be considered in light of physician, hospital and home care use as well as the age and sex of the recipient. Area-based income remained a statistically significant predictor of prescription drug use even after controlling for other health care utilization. A significant interaction between age and income quintile was observed for all three therapeutic drug groups, however. Despite the predicted significant effect of physician and hospital use, as well as the amount of home care used, on the amount of prescription drugs dispensed, with some exceptions, income still emerged as a significant predictor of the cost and amount of drugs dispensed, especially for gastrointestinal and central nervous system drugs.

The multivariate models did result in low predictive value. However, the purpose here was not to construct a predictive model, but to assess the independent contribution of socioeconomic status to prescribing. It is likely that the low explanatory power of the multivariate models, which is not uncommon in studies of this type (Newbold , Eyles and Birch, 1995) was due to the omission of other important variables, such as severity and duration of symptoms or ill health that predispose the need for prescription drugs[1]. In fact, it would be most disconcerting if drug utilization would *not* be tied to need. The important finding is that even in light of the other factors entered into the regression, income still emerges as a significant correlate of drug utilization in the elderly. This has important clinical and public health policy implications in its own right.

The third objective of this research was to examine patterns of prescription drug use over the six year study period. Interesting income-related patterns of utilization emerged over time. The differences in per capita use rates (which consider the total population in the denominator), between income quintiles varied between 1989 and 1995. While in 1989 the least affluent were dispensed 25 percent more gastrointestinal prescriptions than the most affluent, this gap had decreased to 18 percent by 1995.

When rates per user, or drug use in only those persons using a drug within each therapeutic drug

---

[1] Some portion of the variation could also be due to variations in practice patterns, such as "high" versus "low " prescribers.

class, were considered, there was remarkable stability in utilization over the five income quintiles over time. The income disparities in prescription drug use increased very slightly over this period.

It is, however, interesting to note that prescription size for all drug groups and all quintiles decreased over the study period. The observation that prescription sizes decreased markedly over the study period suggests that changes in drug policy may have had some effect on prescribing. However, this is not easily explained by changes in co-payments under Plan A over time. The initial co-payment, introduced in 1987, did not change until 1994. Between 1987 and 1994, the co-payment equaled 75 percent of the dispensing fee, up to a maximum of $125. On April 1, 1994, this co-payment increased to 100%, up to a maximum paid of $200[2]. Average prescription size, on the other hand, has been steadily decreasing from 1989, i.e. well before the change in policy. Decreasing prescription size is also not explained by drug policy governing prescription size. The British Columbia Pharmacare Program did not change its coverage policy to reduce the maximum supply for short-term drugs, which include several central nervous system drugs such as sedatives, sleeping pills and barbiturates, until November 1996. Decreases in prescription size may, however, have been affected by the introduction of longer acting drugs such as once-a-day antiulcer medications, for example, that require fewer units to be dispensed over a specified time period.

The finding that income gradients for the elderly as a whole do, in fact, persist into old age in the gastrointestinal and central nervous system drug groups, was very significant, considering the ambiguity in the literature regarding the existence of socioeconomic variations in utilization among older individuals (Jeffreys, 1996). However, in most cases, statistically significant relationships between area-based household income and the use of prescription drugs persisted up to the 74 to 85 year mark in these two therapeutic drug groups, and were not statistically significant beyond that. Several possible explanations exist for the lack of a relationship between income and drug utilization among the oldest old.

First, it is certainly possible that the lack of any clear relationship between income and prescription drug utilization in the oldest old can be attributed to our inability to adequately measure socioeconomic status in this group. Average household income includes all pension and interest earnings, as well as earnings from all other sources, but does not capture capital assets (e.g. real estate holdings), or the intangible aspects of wealth such as prestige, socio-cultural beliefs about health and health care professionals or independence. In the ninth decade of life it is quite possible that pension or investment income may have diminished, and for the majority, the contribution of employment income will be negligible, if at all. However, the area-based measure of socioeconomic status used here is more likely than individual household income to capture wealth that may reflect past and accumulated assets. The average household income of the census tract area is likely to capture real estate values and other area characteristics that may reflect the assets of individuals more accurately than earned income.

Second, the prescription drug utilization rates may be skewed by a disproportionate number of individuals in the poorest income quintiles residing in nursing homes, especially in the oldest age groups, thereby distorting the use ratios between the five income quintiles which include only those individuals residing in the community. Given the available data, it was not possible to enumerate people in intermediate care facilities according to their income quintile. Accordingly, it was not possible to ascertain whether the lack of an income gradient in the oldest old was partially due to a significantly increased exodus of poorer individuals from the community into intermediate care facilities or other nursing homes. However, previous studies show that the oldest old, or those over 85 years of age, are 7.3 times more likely to reside in institutions than those in the 65 to 74 year age group. At the same time, less affluent individuals also display a significantly higher propensity to enter institutions (Carriere and Pelletier, 1995), as do those with lower levels of education (Pelletier, 1992). This implies individuals who become institutionalized

---

[2] At the same time, many large in-store pharmacies in British Columbia eliminated their dispensing fees altogether.

may be disproportionately distributed across income and age groups. For other age groups, however, and for the elderly population as a whole, it is not likely that this would affect the results in a significant fashion. If anything, this effect would create a conservative bias by disproportionately removing the sickest and frailest individuals from the poorest income quintiles.

It is also possible that the results are conservatively biased if the *very* poorest individuals have little or no contact with the health care system. The very poorest sectors of population may not access the health care system at all due to economic or other related circumstances (Feinstein, 1993; Poland, 1998), despite the relatively higher levels of morbidity that are associated with low socioeconomic status.

In a similar vein, it is reasonable to question how the results for the oldest old were affected by the higher mortality rates in this age group. An income gradient may not appear in the oldest old since the utilization of health care services associated with the last year of life is markedly higher in this group. It is known that prescription drug use rates for elderly living in the community in the 12 months prior to death are substantially higher compared to earlier use rates (Stuart and Coulson, 1993). It is not known, however, to what extent this would have affected the gradient in the oldest age group in this study, or whether a gradient would emerge if these individuals were excluded from the analysis.

But perhaps the most likely explanation for the lack of a clear gradient for those in the 85 years and over age group lies in the concept of age, in the case of the oldest elderly, as a leveler. The available evidence certainly suggests that this may be true. Declining health status, measured by the number of chronic and acute conditions, as well as overall functional status, may supercede the effects of socioeconomic status on the utilization of prescription medications. A levelling of *differences* in overall health status after 85 years of age has been reported in the literature (Arber and Cooper, 1999). At the same time, as individuals age, their *range* of symptoms and *number* of chronic conditions grows increasingly disparate, creating a broader dispersion around the mean compared to groups of younger individuals (Dressel, Minkler and Yen, 1997). For chronic conditions, at least, there is evidence suggesting that once conditions reach a more serious and persistent stage, the effect of education or occupation tends to disappear, and all individuals tend to seek medical help for their conditions with equal frequency (Alberts et all, 1998). It is also possible that this reflects the relatively small role socioeconomic status has been shown to play in the prevalence of chronic, as opposed to acute, disease (Kington and Smith, 1997). If chronic conditions dominate morbidity in the oldest old, this too may obfuscate the socioeconomic gradient in drug utilization that is evident in this study for those between the ages of 65 and 74 years.

Why a Gradient?

The data presented here raise interesting questions regarding the underlying causes of the observed income gradients in prescription drug utilization. What proportion of this gradient can be explained by the underlying differences in morbidity, and how much is due to differential treatment within and by the health care system? Variations in treatment by physicians, or in patient characteristics according to socioeconomic position may play a role in determining the gradients observed here.

Are persons treated according to their socioeconomic status, independently of income-related differences in health status? The literature suggests that they are. Systematic differences in the screening, diagnostic testing and the prescribing of medications by socioeconomic status have been uncovered. While increased testing by general practitioners has been associated with higher socioeconomic status, at least in adult populations under 65 years of age, the reverse is true for prescribing. For those 65 years and over, low income patients have been found to be three times as likely to be prescribed medications, a pattern that was also influenced, albeit to a lesser extent, by the number of chronic conditions observed in this group (Scott, Shiell and King, 1996). The literature does show that the choice of treatments may also be affected by socioeconomic status (e.g. Hirth et al., 1996; Norredam et al., 1998).

Patient behaviours that vary by socioeconomic status may also affect diagnosis and prescribing. Differences in knowledge, skills and resources with which to navigate the health care system effectively and negotiate appropriate treatment and prescribing may vary by socioeconomic position (Feinstein, 1993). This may be because better educated and more affluent individuals are able to state their treatment and diagnostic preferences more assertively (Waitzkin, 1984). Treatment preferences as well as health-related beliefs and attitudes may vary by socioeconomic status (Hartley et al., 1987; Sharp et al., 1983), which may shape the type and quantity of drugs prescribed.

For example, less educated individuals have been found to put more faith in physicians and are more prone to seek them out when symptoms present (Sharp et al., 1983). One Canadian study of over 42,000 adults has shown that visits to physicians for self-limiting upper respiratory tract infections were more common among individuals with low levels of education compared to those with at least a high school diploma (McIsaac, Levine and Goel, 1998). Furthermore, as patients become more informed, they are less likely to demand many common surgical procedures, such as tonsillectomy or cholecystectomy (Dominighetti et al., 1993), although it is not known whether this finding could be generalized to prescription drug use.

Patients may thus take on the role of an active consumer or passive patient. This choice is determined by the context of the medical encounter, influenced in turn by economic, educational and social backgrounds. Individuals of lower socioeconomic status have been found to be less likely to challenge physicians, suggest treatment alternatives or request justification for the choice of treatment (Lupton, 1997).

Research has demonstrated that sociolinguistic differences associated with patients' education and occupational class, as well as doctors' socioeconomic characteristics, may influence the patient-physician encounter (Waitzkin, 1985). In turn, this may influence drug prescribing. More highly educated patients received more information from physicians. Higher occupational status was associated with more time devoted to patient-physician discourse, more involved explanations of diagnosis and treatment, and more consistent responses to queries. In general, the enhanced communication between physicians and more educated or more affluent patients is well documented, either due to the extent and level of technical explanation as well as interpersonal communication offered by physicians, or the level of understanding on the part of patients. Although the desire for information does not appear to differ by social class, socioeconomic status may affect one's ability to procure this information (Hall, Roter and Katz, 1988; Pendleton and Bochner, 1980).

Social differences related to knowledge concerning the availability of treatment alternatives, or perceptions of control over one's own health may be important to this dynamic as well. This may result in delayed access to care for persons in the lower income quintiles, resulting in more aggressive treatment when the individual does interface with the health care system (Billings, Anderson and Newman, 1996).

Of course, it is possible that the indirect effects of one's position in the social hierarchy on individual physiological and psychological response, which consequently translates into higher morbidity, may be solely responsible for the increase in the use of prescription drugs with decreasing income. This would indicate an appropriate response of the health care system to socially determined differences in health status between relative income groups.

Different mechanisms, different drugs

The data presented in previous chapters show that the differences in utilization by income quintile are not identical for each of the three therapeutic drug classes examined. The disparities in use by income categories are notably wider for gastrointestinal and central nervous system medications in comparison with cardiovascular drugs. When utilization rates per user that include only those persons with at least one prescription in a therapeutic drug class, were considered, central nervous system drugs showed the widest income gradients. This suggests that different mechanisms may underlie social variations in the prescribing of different types of drugs.

Central nervous system preparations have been associated with poor health overall, chronic conditions as well as psychological distress (Antonov and Isacson, 1998; Brown et al., 1995; Isacson, 1997; Johnson and McFarland, 1993; Pariente, Lepine and Lellouch, 1992). These, as well as gastrointestinal, drugs represent a diverse range of medications, which may be used for a variety of symptoms. Even more specific categories of drugs, such as antiemetics, analgesics or tranquilizers may be used to treat a variety of somatic as well as psychological symptoms that may also mimic those of other underlying conditions.

Medications in the *gastrointestinal and central nervous system* therapeutic drug classes represent areas of less specificity and possibly greater discretion in determining treatment options. Greater discretionary potential associated with some treatments has been associated with larger disparities in their use (Lee et al., 1998). The relationship between income, treatment prevalence and known variability of the use of specific treatments has been demonstrated in Manitoba. In that province, hospitalizations associated with high variation medical diagnoses displayed a very distinct income gradient that was not evident for surgical or low variation medical conditions (Roos and Mustard, 1997). The relatively steep income gradient for gastrointestinal and central nervous system drugs uncovered in this study may reflect the greater potential for physician discretion in their use, which could result in the disproportionately greater reliance on medications for both somatic and nonsomatic conditions in the poorer income groups.

Central nervous system drugs, as well as the gastrointestinal preparations such as anti-ulcer medications or antiemetics, may frequently be prescribed in response to nonspecific complaints and symptoms. Van der Meer et al (1996), for example, found that persons of lower socioeconomic status are much more likely to present to a medical practitioner with relatively unspecified or minor complaints. In contrast, individuals in higher socioeconomic groups may self-medicate, or to view such symptoms as self-limiting or not requiring medical attention.. However, the differences in help-seeking behaviours between socioeconomic strata may be even more fundamental than this. There is evidence suggesting that less educated persons experience more symptoms, and are more inclined to visit physicians to alleviate them (Sharp, Ross and Cockerham, 1983), a finding which is not inconsistent with other investigations of morbidity and socioeconomic status discussed in previous chapters. Lower levels of verbal technical skills coupled with an overestimation of the value of sophisticated technology and medical education leads to vague communication and poor diagnosis (Hexell and Wintersberger, 1986). As a result, nonspecific medications may be prescribed in response to rather nonspecific, perhaps not clearly articulated, symptoms.

Other authors have suggested that the widespread use of psychoactive drugs simply reflects the medicalization of essentially social problems, such as those manifested as stress-related ailments, particularly for the most vulnerable groups in the population, such as the poor, the elderly, and especially poor, elderly women (Harding, 1986).

Low socioeconomic status has been tied to lower locus of control and fatalism (Blaxter, 1997). Both have been linked to a higher propensity to seek out the advice of a physician and medication in lieu of self-care for a variety of potentially minor ailments (Alberts et al., 1998; Sharp, Ross and Cockerham, 1983; Stoller, Forster and Portugal, 1993). Those in the upper socioeconomic strata may be able to exert greater control over their own health for ailments that are not perceived to be of high risk.

While the examination of the appropriateness of the use of gastrointestinal and central nervous system medications was beyond the scope of this study, the higher rates of prescribing in the lower income quintiles do raise a number of concerns. Higher consumption does not immediately indicate inappropriate use, but the literature does suggest that higher rates of drug use are associated with an increased number of drug-related adverse reactions (Stewart et al., 1991).

Furthermore, lower income populations, such Medicaid recipients in the United States, have been reported to be at higher risk of inappropriate prescribing than their higher-income counterparts (Wilcox, Himmelstein and Woolhandler, 1994). The inappropriate use of medications may be particularly widespread in elderly populations (e.g. Bernstein, Folkman and Lazarus, 1989).

The high usage of some drugs warrants further attention. This is particularly true for psychoactive preparations, which represent approximately one half of all central nervous system drugs, and are increasingly prescribed as socioeconomic status decreases. The risks associated with the use of psychoactive drugs are well documented in the literature. There is evidence to suggest that psychotropic medications, especially minor tranquilizers, are frequently and excessively prescribed in a manner that does not correspond to a patient's diagnosis (Hohmann et al., 1991), or for non-psychiatric conditions altogether (Johnson and McFarland, 1993; Rokstad, Straand and Fugelli, 1997). The elderly may be at especially high risk of the inappropriate prescribing of psychotropic medications (Bloom et al., 1993; Lexchin, 1993; Stuck et al., 1994; Tamblyn et al., 1994). These patterns of prescribing are known to lead to iatrogenic disorders, to which the elderly may be more susceptible (Ancill et al., 1988; O'Brien and Kursch, 1987). Although many psychotropic medications should be avoided in the elderly altogether (Beers, et al., 1991), they are, in fact, quite commonly prescribed for community-dwelling elderly persons (Mas et al., 1983; Stuck et al, 1994; Wilcox, Himmelstein and Woolhandler, 1994). Benzodiazepenes and compound analgesics have been found to be most frequently prescribed for insomnia (Rokstad, Straand and Fugelli, 1997), an intervention that may not be appropriate. Furthermore, there is concern about dependence stemming from frequent and long term use of some psychotropic medications (Isacson, 1997).

Psychoactive drugs are not the only drugs affecting the central nervous system that may induce adverse effects. Users of nonsteroidal anti-inflammatory preparations, for example, are far more prone to serious gastrointestinal disorders, such as ulcers, compared to non-users, especially among the elderly (Gabriel, Jaakkimainen and Bombardier, 1991; Grymonpre et al., 1991). On recent Canadian study suggests that at least 40 percent of these preparations may not be prescribed appropriately, thereby causing gastrointestinal and other side-effects (Tamblyn et al., 1997).

The prescribing patterns for *cardiovascular* drugs, may be the product of very different mechanisms. As mentioned above, although cardiovascular drugs did show an inverse income gradient, it was notably less pronounced than for either central nervous system or gastrointestinal drugs. What is puzzling however, is that there was not a steeper and statistically significant gradient given the known gradient in morbidity and mortality for cardiovascular disease.

Several competing explanations for this finding may exist. On the one hand, it is possible that the high mortality due to cardiovascular disease may manifest most strikingly in middle age. Thus the survivors of early cardiovascular mortality (who may be disproportionately represented in lower income groups), may, in fact, be healthier than the average individuals in upper income groups, thereby attenuating any apparent socioeconomic relationship. As discussed elsewhere by Mustard and colleagues (1997), this is thought to be consistent with Fries' compression of morbidity hypothesis (Fries, 1980), which suggests that survivors tend to experience better health at older ages.

Mortality rates by specific diagnoses, age *and* socioeconomic status are not readily available for Canada. However, the analysis of death rates in urban Canada in 1986 by Wilkins, Adams and Brancker (1989), demonstrates that the greatest variability in mortality occurs in middle age, then decreases in the oldest age groups up to the age of 85 years. Mortality for those aged 45 to 54 years of age was 135 percent greater for those in the poorest income quintile compared to those in the most affluent. This trend was reversed in the oldest old, or those 85 years and over, where mortality rates were highest in the most affluent income quintile. We do know, however, that the greatest proportion of excess potential years of life lost related to income differences for those between 45 and 74 years of age in 1986 was due to diseases of the circulatory system. Thus although there is no direct evidence from these data to support the hypothesis that mortality due to cardiovascular disease occurs at earlier ages for those in the lower income quintiles, the available information does not contradict this possibility.

This view is consistent with data from Manitoba (Mustard et al., 1997). Treatment prevalence for cardiovascular diseases and cerebrovascular disorders was shown to increase with age, and is highest for those 75 years and over. But income was more closely associated with treatment prevalence for cardiovascular and cerebrovascular disorders for those in the 50-64 year group, than for those in the 65 plus group. It is possible that these gradients in cardiovascular mortality become progressively flatter with increasing age. Data from the United States indicate that the use of cardiovascular agents significantly increases with age (Lassila et al., 1996). It is not known, however, whether this occurs to an extent that the effect of socioeconomic status is eliminated.

The alternate explanation for the relatively small gradient in the use of cardiovascular drugs points to a less favorable scenario. If, in fact, cardiovascular morbidity increases with decreasing socioeconomic status even in older age, this begs the question if we are, in fact, under-treating those in the poorer income groups, or over-treating those in the higher income groups? However, there is little corroborative evidence demonstrating that this may be so.

The finding that the gap between the quantity of drugs prescribed and number of prescriptions dispensed to poorest and wealthiest women is larger than the gap between the richest and poorest men in this population is also noteworthy. These results are especially interesting in light of other results in the literature demonstrating gender differences in the surgical treatment of cardiovascular disease, which cannot be accounted for by disease severity (Dong et al., 1998) and testing (Jaglal et al., 1995). These observed differences in treatment may be clinically defensible, since overall prevalence of cardiovascular disease in women is much lower (Jaglal et al, 1995). Possible hypotheses that attempt to explain reduced mortality in females abound, including the protective effect of biology, lifestyle or social roles (Nikiforov and Mamaev, 1998). Certainly, the analysis of the contribution of gender *and* socioeconomic status in the treatment of cardiovascular disease may further clarify these questions. Are the already existing gender differences exacerbated by differences in treatment and morbidity by socioeconomic status?

But perhaps the most interesting information resulting from the analysis of the utilization of cardiovascular drugs is set in the distribution of drug costs by medication type and income quintile. A virtually flat distribution of ingredient cost rates between income quintiles emerged from the analysis. This lack of an ingredient cost gradient for age-and sex- adjusted utilization rates is puzzling, since a definite gradient does exist when prescriptions or quantity of drugs is considered. The results do, in fact, suggest that income does have a significant bearing on not only the amount, but also the type of cardiovascular agent that is prescribed.

In this study, it was found that antihypertensive medications were prescribed to those in the poorer income quintiles at a lower unit cost compared to the higher income quintiles, even though patients did not actually pay this cost. Antihyperlipidemics were not only prescribed in lesser quantity to the poorer individuals, but also at lower unit cost. The relatively less expensive vasodilators, on the other hand, were prescribed in markedly greater quantities to the least affluent users of these medications. This suggests that the more affluent may be prescribed the newer-generation antihyperlipidemics and antihypertensives more frequently than the poorer individuals in the population.

Patterns of pharmaceutical treatment of hypertension have changed markedly in the last decade. Increased costs for cardiovascular medications are largely attributable to increased prescribing of the more expensive ACE inhibitors and calcium channel blockers and concomitant decreases in the prescribing of diuretics and beta blockers between 1991 and 1993 (Penrose et al., 1996). Upon their introduction, calcium antagonists and ACE inhibitors rapidly became among the most prescribed treatments for this indication, despite their largely unknown effect on long-term reductions in mortality. The efficacy of the older beta-blockers or diuretics has been established, but superior performance in terms of morbidity and mortality have not clearly been demonstrated for ACE inhibitors and calcium channel blockers. If they are not cost effective, are not clinically more effective than existing drugs, and simply substituted for, or used in addition to, older drugs, they are not appropriately prescribed. (Lexchin, 1992). The concurrent decline in the use of diuretics and beta-blockers may lead to increased mortality or morbidity (Lexchin, 1992; Monane et al., 1995; Siegal and Lopez, 1997; Soumerai, et al., 1997; Yamashita, 1996). In addition to the concerns over appropriateness of care, these prescribing patterns also have major implications for overall drug costs because of the significantly higher cost of the newer cardiovascular agents (Bock, 1987; Siegal and Lopez, 1997). This begs the question of whether there is an increased prevalence of suboptimal prescribing of antihypertensive drugs among the more affluent.

Similarly, concern has been voiced over the appropriate use of cholesterol lowering drugs, or antihyperlipidemics (Davey Smith and Pekkanen, 1992). It is dubious whether mortality is prevented with the use of these agents. In fact, mortality from non-cardiovascular causes may be accelerated in conjunction of the use of antihyperlipidemics. Alternately, dietary interventions have been shown to result in at least moderate reductions in serum cholesterol and are also cost-effective. Because of the increases in coronary artery disease associated with the use of some types of drug therapy for lowering serum cholesterol, the efficacy of lipid lowering drugs in the elderly, in whom this diagnosis is highly prevalent, is especially controversial (Martikainen et al., 1996; Sketris et al., 1995). In British Columbia, the oldest group of elderly individuals receives very few prescriptions for antihyperlipidemics. For the younger elderly, however, the reasons underlying the relatively higher rates of prescribing of these new and expensive drugs, especially to those in the highest income groups, have not been established.

In the case of cholesterol-lowering agents, it is possible that income-related differences in prescribing are due to income-related differences in screening. In fact, low socioeconomic status has been has been associated with low rates of cholesterol screening in health adults between the ages of 20 and 74 (Davis et al., 1998).

Channeling bias may also contribute to income-related differences in the prescribing of antihyperlipidemics, and indeed, other medications (Petri and Urquhart, 1991). Channeling bias refers to the marketing of drugs with similar actions at different times and to different groups of patients. This may occur on the basis of prognosis; if older drugs have not been effective, newer and more costly drugs may be tried with some individuals. However, more detailed clinical data are needed to establish the extent to which these new, more expensive drugs are being prescribed when other, tried-and-true medications have failed and to ascertain the independent role that socioeconomic status may play in their prescribing. The literature reports that misconceptions about the efficacy and increased safety of newer drugs are common (Bucker and Schiff, 1990), but who is getting them, and why?

In summary, gastrointestinal and central nervous system drugs are disproportionately prescribed to the less affluent elderly. This may be due to a greater propensity for individuals in the lower socioeconomic quintiles to present with greater frequency and less specific conditions and symptoms, as well as the greater degree of discretion afforded to physicians regarding their use. Cardiovascular drug utilization exhibits an inverse income gradient, albeit a markedly flatter one compared to either gastrointestinal or central nervous system drugs. Early mortality and better cardiovascular health among the elderly survivors in the less affluent income quintiles may account for these patterns by reducing the morbidity gradient for cardiovascular illnesses. This scenario implies an appropriate response from health care providers and the health care system. On the other hand, these results may also indicate that poorer individuals are being undertreated for cardiovascular disease. Lastly, the high use of gastrointestinal and central nervous system drugs in the poorest income quintiles, as well as the increased use of new yet controversial cardiovascular preparations in the most affluent income quintiles, should warn of potentially inappropriate prescribing. Questions surrounding the appropriateness of these patterns of drug use alone should in no way impel policy makers to set limits on individual drug expenditures, as this may put the elderly, especially the frailer and poorer, at increasing risk of institutionalization (Soumerai, et al, 1991).

Study Limitations

Administrative databases offer a fairly cost-effective means with which to analyse trends in utilization in virtually all individuals within a given population. Linked databases offer the additional benefits of exploring the utilization of various health services in tandem. At the same time, this breadth of information may be offered at the expense of other, more detailed information.

Although detailed information concerning the type, quantity and cost of each drug dispensed is available from the database used here, certain attributes of drug utilization cannot be ascertained. First, the data provide a good measure of prescriptions dispensed, but not necessarily medications prescribed or consumed. A greater number of dispensed prescriptions does not necessarily indicate that more drugs were actually used. Several reasons may account for this. Compliance to the drug regime may be poor, for example. Drugs may be prescribed, but never dispensed, or dispensed but never used. There exists the possibility that a portion of medications purchased may have been tried, and discarded or otherwise not used due to treatment failure. This may signal that a greater number of prescriptions are dispensed within the same drug group if several medications need to be tried before an appropriate course of treatment is identified. Conversely, some individuals may use a greater quantity of one drug if they return to the physician and/or pharmacy for frequent refills. It is not known to what extent these factors would affect the outcome of this study, since there is no evidence which suggests that after a prescription is dispensed, noncompliance is more prevalent among specific ages in this population, or in some socioeconomic groups over others.

Greater utilization in a particular drug group may also indicate that some individuals use a greater number of different drugs within the same therapeutic drug group. For example, one individual may use different cardiovascular medications for hypertension, coronary heart disease and heart failure. Still, dispensing data provide a far better estimate of drug consumption than chart based prescribing data, since many prescriptions may never be filled (Beardon et al., 1993).

Second, this study lacked the ability to accurately locate either a precise diagnosis or determine the severity of the medical condition requiring medication. As stated above, the low overall predictive power of the multivariate models, although not entirely surprising, may be due, in part, to a lack of a robust measure of disease severity or comorbidity. Therefore it is possible that differences in utilization may be at least partially due to differences in disease severity between income groups. Although detailed records of hospitalizations and physician visits are available, neither of these indicates severity of any particular condition. They also do not reflect chronic or other conditions that do not require hospitalization or perhaps even the attention of a physician. On the other hand, the amount of home care provided per individual, which includes homemaker, nursing, physiotherapy or occupational therapy, may mirror, albeit imprecisely, limiting health conditions.

It is equally difficult to sort out the specific indications for which the dispensed drugs were used without further clinical clarification. This may be particularly pertinent for some central nervous system medications such as analgesics, which may be used for a broad variety of conditions, and are frequently used in conjunction with treatments for other somatic illnesses.

The examination of relatively broad therapeutic drug categories may also render the interpretation of findings somewhat problematic. One might, in fact, expect different income effects for drugs within a single therapeutic drug group. As discussed in previously, this was the case with antihyperlipidemics, which did not follow the pattern that was evidenced for the cardiovascular drug group as a whole. Similar problems may be encountered with psychoactive medications;

while antipsychotic users may be concentrated in the lower income quintiles, antidepressants may be disproportionately prescribed for, and used by individuals in the higher income quintiles.

Furthermore, although both the number of prescriptions and drug quantity are considered here, as well as price, this study was not able to capture a dose/time relationship. In other words, it was not possible to gauge either length of use, or the quantity of drugs consumed over a given period of time. However, the patterns that emerged here, for virtually the entire elderly population of British Columbia, override differences in individual usage. Therefore this may be a more cogent issue if the clinical effects of these medications were considered on an individual level.

Lastly, the reader should be aware of some changes in drug policy that occurred in British Columbia within the study period. The Reference Drug Program, a reference based pricing policy designed to promote cost-effective prescribing, was introduced in October, 1995. The policy targets specific medications and is based on guidelines drawn from the scientific literature. However, these policy changes should have only minimal, if any, effects on the results shown here. It came into effect only very late in the study period, and operated on a very limited basis until January 1997, well beyond the time frame of this study.[3] Second, the Low Cost Alternative policy was introduced in October 1994, i.e. before the fourth and final year of data included in this study. This policy sets an upper limit on the cost of some drugs if a lower-cost alternative with the same therapeutic value is available. Under this policy, individuals who choose a higher cost alternative pay the difference themselves. Indeed, the Low Cost Alternative policy certainly affected overall drug costs in certain therapeutic drug classes, but this change would have affected all income groups equally. Third, the increase in the copayment introduced in 1994, discussed above, may have had an effect on the number, size and costs of prescriptions. Although it is not possible to determine the effect of this change on the relationship between

---

[3] On January 1, 1997, the Reference-Drug Program applied to H2 antagonists (for treating upper gastrointestinal disorders), non-steroidal anti-inflammatory drugs (central nervous system drugs) and in the cardiovascular drug category, nitrates, ACE inhibitors and Calcium Channel Blockers.

income quintile and prescribing, which may also have been affected by changes in practice patterns, pharmaceutical marketing, etc, this factor should be considered.

Implications

This study has demonstrated the existence of socioeconomic gradients in the use of prescription drugs by the elderly in British Columbia. These gradients exist for all drugs, as well as specific therapeutic drug groups. These gradients persist despite controlling for other health care utilization and home care, except in the age-stratified analysis of cardiovascular agents when the interaction between age and income was taken into consideration. Furthermore, this study demonstrates divergent patterns of medication use between socioeconomic groups *within* certain therapeutic drug classes, specifically cardiovascular medications. These point to the existence of powerful and systematic social differences in the utilization of prescription drugs.

What is not yet known with certainty, however, is the extent to which these are due to socially determined differences in the type or intensity of treatment offered, or to the social distribution of somatic disease or chronic ill health among the elderly. The results of this analysis do not rule out the possibility that differences in drug utilization may be largely determined by differences in morbidity between income groups. Likewise, access to health care utilization has also been shown to vary by income, and may also exert an independent effect on prescription drug utilization. Thus the data may be subject to several interpretations. At the very least, these data once again illustrate that universal health insurance has not eliminated increased ill health among those in the poorest income quintiles, if pharmaceutical use is any indication.

Further research in this area would aid in the elucidation of many of these questions, and serve to refine our knowledge of the relationships between drug utilization, socioeconomic status and need. Like many initial exploratory studies, these results raise a plethora of wide-ranging questions that beg further exploration. This study established an important baseline, and presents an interesting challenge and impetus for further work. Studies must now be undertaken in order to explore, in greater detail, the differential patterns of prescription drug use according to social position, individual drugs and diagnoses. As implied above, subsequent work must also incorporate severity and morbidity measures to better incorporate the "need" dimension of this complex triad between health, utilization and socioeconomic status. Research must also assess the potential effects on health status arising from socially differentiated patterns of prescribing and treatment. Uncovering the answers to such questions necessitates the use of very different study designs and possibly detailed clinical data as well. At the same time, the importance of continued emphasis on the development of linked databases for this purpose is emphasized.

The enhanced understanding of the social determinants of prescription drug use would, no doubt, assist the development of health policy in an informed and effective manner. Yet even with our present level of understanding, initiatives to alleviate these inequalities, given the social and political will, might be suggested. This may occur at two levels, one at the level of health care provision, the other at trying to reduce the extent of the broader socioeconomic inequities that give rise to these patterns.

To date, feedback to practitioners concerning prescribing practices has been minimal (Sterky et al., 1991). But direct feedback including recommendations for future prescribing practice, combined with educational programs, may be one of the more successful strategies directed at modifying prescribing by physicians (Anderson and Lexchin, 1996). More generally, the surveillance of social class and mortality, especially premature mortality, to guide the development of and monitor policy and programs aimed at the reduction of these disparities has been suggested (Barnet, Armstrong and Casper, 1997).

However, the practical feasibility of such an approach is questionable. These results, along with the insight garnered from other studies exploring socioeconomic differences in the utilization of health care services, may be instructive to our general understanding of the social dynamics underlying the process of care. These general principles may apply to other areas of health care utilization as well. These patterns of prescription drug use witnessed here may have much in common with other currently controversial topics. For example, waiting times for cardiac surgery have recently been shown to be reduced for some individuals who may be more informed, able to navigate the system or hold higher prestige in the community (Alter, Basinski and Naylor, 1998). Again, clinicians, providers of care and policy-makers must address these nonclinical determinants of care.

Ultimately, however, only a more broadly-based paradigm of health and medicine that incorporates more fully the social determinants of health, and any consequent social and health policy initiatives that are spawned from such an understanding, will help to equalize socially determined differences in health outcomes. Similarly, as suggested by Sterkey et al (1991) future emphasis on drug policy must center on health, not pharmaceuticals.

Surely, the evidence supporting broad social interventions for the improvement of health is abundant, but health policy may be slow to heed it. The description of the ancient dances of death as a metaphor for the analysis of socioeconomic inequalities in health by Johan Mackenbach (1996) is illuminative of the intrinsic contraposition between the scientific evidence, on the one hand, and policy directives, on the other. In the early ages, these dances of death vividly depicted social inequalities in mortality. This social dimension is absent in the more recent medically focused versions of these dances. According to Mackenbach, there has been a similar shift to divorce socially based health inequalities from our understanding and descriptions of health and medicine.

The seeming reluctance to adopt a broad determinants of health model on the part of the medical community, albeit a reluctance that may be waning, is obviously not likely to be due to the lack of evidence of the social basis for health inequalities. The evidence alone is clearly insufficient to challenge the dominant medical paradigm. Where the underlying issues are political or economic in nature the scientific evidence is likely to be a secondary consideration (van den Heuvel, Wieringh and van den Heuvel, 1997).

This reluctance may be witnessed in the public arena to no lesser degree. Research indicates that for the most part, social inequalities are not accepted as an underlying determinant of poor health, especially among those in the lower socioeconomic groups. Instead, individual behaviours, "the duty to be healthy", personal responsibility and other microsocial phenomena are thought to form the basis for popular opinion that may not recognize the role of socioeconomic status in health and health care. The view that extreme poverty can cause ill health (i.e. the threshold view), however, is more universally accepted (Blaxter, 1997). Yet popular consensus may be required if social policies designed to reduce socioeconomic inequities are to be implemented.

Lastly, this study emphasizes that aging of the population is just one of the factors responsible for changing patterns of health care, and with it, health care costs. Increased, excess or under-use of health care resources is at least in part a product of socioeconomic factors. While cost containment has been a foremost consideration in health care, basic equity issues have taken a back seat, despite their potential contribution to the improvement of overall health and consequently, health care expenditures. Yet these two goals are not necessarily contradictory (Vagero, 1994).

In terms of declining health, aging may not be the sole culprit. Rather, socially determined phenomena other than age may mold our experiences in the latter decades of life (Dressel, Minkler and Yen, 1997) and clearly influence patterns of morbidity and mortality. Moreover, once contact in the health care system is made, there is evidence that at least with respect to prescribing behaviour, socioeconomic inequities in patterns of care are associated with at least some diagnoses and treatments. If being old is injurious to one's health, then being old and poor just increases the risk.

References

Abramson JH, Gofin R, Jabib J, Pridan H,Gofin J. (1982) Indicators of Social Class. A comparative appraisal of measures for use in epidemiological studies. *Social Science & Medicine* 16:1739-46.

Adler NE, Boyce T, Chesney MA, Cohen S, Folkman S, Kahn RL, Syme SL (1994). Socioeconomic status and health. The challenge of the gradient. *American Psychologist* January 1994:15-24.

Adler NE, Boyce T, Chesney MA, Folkman S, Syme SL (1993). Socioeconomic inequalities in health: no easy solution. *JAMA* 269(24):3140-3144.

Alberts JF, Sanderman R, Eimers JM, van den Heuvel JA (1997). Socioeconomic inequity in health care: A study of services utilization in Curaçao. *Social Science & Medicine* 45(2):213-220.

Alberts JF, Sanderman R, Gerstenbluth, I, ven den Heuvel WJA (1998). Sociocultural variations in help-seeking behavior for everyday symptoms and chronic disorders. *Health Policy* 44(1998):57-72.

Alter DA, Basinski ASH, Naylor CD (1998). A survey of provider experiences and perceptions of preferential access to cardiovascular care in Ontario, Canada. *Annals of Internal Medicine* 129(7):567-572.

Alter DA, Naylor CD< austin P, Tu JV (1999). Effects of socioeconomic status on access to invasive cardiac procedures and on mortality after acute myocardial infarction. *New England Journal of Medicine* 341(18):1359-1367.

Ancill RJ. Embury GD. MacEwan GW. Kennedy JS (1988). The use and misuse of psychotropic prescribing for elderly psychiatric patients. *Canadian Journal of Psychiatry - Revue Canadienne de Psychiatrie*. 33(7):585-589.

Anderson GM (1997). Hospital restructuring and the epidemiology of hospital utilization. Recent experience in Ontario. *Medical Care* 35(10):OS93-OS101.

Anderson GM, Grumbach K, Luft HS, Roos LL, Mustard C, Brook R (1993). Use of coronary artery bypass surgery in the United States and Canada. *JAMA* 269(13):1661-1666.

Anderson GM, Kerluke K, Pulcins IR, Hertzman C, Barer ML (1993). Trends and determinants of prescription drug expenditures in the elderly: data from the British Columbia Pharmacare Program. *Inquiry* 30(Summer 1993):199-207.

Anderson GM, Lexchin J (1996). Strategies for improving prescribing practice. *Canadian Medical Association Journal* 154(7):1013-1017.

Anderson RT, Sorlie P, Backlund E, Johnson N, Kaplan GA (1997). Mortality effects of community socioeconomic status. *Epidemiology* 8(1):42-47.

Antonov K, Isacson D (1996). Use of analgesics in Sweden - the importance of sociodemographic factors, physical fitness, health and health-related factors, and working conditions. *Social Science & Medicine* 42(11):1473-1481.

Antonov KI, Isacson DG (1998). Prescription and nonprescription analgesic use in Sweden. *Annals of Pharmacotherapy* 32(4):485-494.

Arber S (1991). Class, paid employment and family roles: Making sense of structural disadvantage, gender and health status. *Social Science & Medicine* 32(4):425-436.

Arber S (1997). Comparing inequalities in women's and men's health: Britain in the 1990s. *Social Science & Medicine* 44(6):773-787.

Arber S, Cooper H (1999). Gender differences in health in later life: the new paradox? *Social Science & Mecicine* 48(61-76.

Arber S, Rahkonen O, Lahelma E (1997). Health inequalities in early adulthood: a comparison of young men and women in Britain and Finland. *Social Science & Medicine* 41(2):163-171

Avorn J, Monette J, Lacour A, Bohn RL, Monane M, Mogun H, LeLorier J (1998). Persistence of use of lipid-lowering medications. A cross-national study. *JAMA* 280(18):1458-1462.

Babazono A, Hillman AL. (1994). A comparison of international health outcomes and health care spending. *International Journal of Technology Assessment in Health Care* 10(3):376-381.

Badgley RF (1991). Social and economic disparities under Canadian health care. *International Journal of Health Services.* 21:659-671.

Bain DJ (1977). Patient knowledge and the content of the consultation in general practice. *Medical Education* 11:347-350.

Balkrishnan R (1998). Predictors of medication adherence in the elderly. *Clinical Therapeutics* 204(4):764-771.

Barer ML, Manga P, Shillington ER, Siegel GC (1982). *Income Class and Hospital Use in Ontario.* Ontario Economic Council Occasional Paper 14. Toronto: Ontario Economic Council.

Barer ML, Evans RG, Hertzman C (1994). Avalanche or glacier. Health care and the demographic rhetoric. HPRU 94:3D Vancouver: Centre for Health Services and Policy Research.

Barker DJP, Osmond D (1987). Inequalities in health in Britain: Specific explanations in three Lancashire towns. *British Medical Journal* 294:749-752.

Barnett E, Armstrong DL, Casper ML (1997). Social class and premature mortality among men: A method for state-based surveillance. *American Journal of Public Health* 87(9):1521-1525.

Bartley M, Sacker A, Firth D, Fitzpatrick R (1999). Social position, social roles and women's health in England: changing relationships 1984-1993. *Social Science & Medicine* 48:99-115.

Baum C, Kennedy KL, Forbes MB, Jones JK (1984). Drug Use in the United States in 1981. *JAMA* 251(10):1293-1297.

Baxter J (1994). Is husband's class enough? Class location and class identify in the United States, Sweden, Norway and Australia. *American Sociological Review* 59(2):220-232.

Beardon PHG, McGilchrist MM, McKendrick AD, McDevitt DG, MacDonald TM (1993). Primary non-compliance with prescribed medication in primary care. *British Medical Journal* 307:846-848.

Beers MH Ouslander JG. Rollingher I Reuben D. Brooks J Beck JC (1991). Explicit criteria for determining inappropriate medication use in nursing home residents. *Archives of Internal Medicine.* 151(9):1825-32.

Ben-Shlomo Y, White IR, Marmot M (1996). Does the variation in the socioeconomic characteristics of an area affect mortality? *British Medical Journal* 312(7038):1013-1025.

Benson PR (1983). Factors associated with antipsychotic drug prescribing by southern psychiatrists. *Medical Care* 21:639-654.

Benzeval M, Judge K , Smaje C (1995). Beyond class, race and ethnicity: Deprivation and health in Britian. *Health Services Research* 31(1):163-177.

Berk ML, Schur CL, Mohr P (1990). Using survey data to estimate prescription drug costs. *Health Affairs* 9(3):147-156.

Bernstein LR, Folkman S, Lazarus RS (1989). Characterization of the use and misuse of medications by an elderly, ambulatory population. *Medical Care* 27(6):654-663.

Billings J, Anderson GM, Newman LS (1996). Recent findings on preventable hospitalizations. *Health Affairs* 15(3):239-249.

Bindman AB, Grumbach K, Osmond D, Komaromy M, Vranizan K, Lurie N, Billings J, Stewart A (1995). Preventable hospitalizations and access to health care. *JAMA* 274(4):305-311.

Blaxter M (1987). Evidence on inequality in health from a national survey. *The Lancet* July4, 1987:30-33.

Blaxter M (1997). Whose fault is it? People's own conceptions of the reasons for health inequalities. *Social Science & Mecicine* 44(6):747-756.

Blishen, BR, Carroll WK, Moore C (1987). The 1981 socioeconomic index for occupations in Canada. *Canadian Review of Sociology and Anthropology* 24(4):465-488.

Bloom JA, Frank JW, Shafir MS, Martiquet P (1993). Potentially undesirable prescribing and drug use among the elderly. Measurable and. Canadian Family Physician. 39:2337-2345.

Bobak M (1996). Determinants of the East-West life expectancy gap: Contribution of lifestyle and behaviour. In Hertzman C, Kelly S, Bobak M (eds.) *East-West Life Expectancy Gap in Europe. Environmental and Non-environmental Determinants.* London: Kluwer Academic Publishers.

Bobak M, Marmot M (1996). East-West health divide and potential explanations, in Hertzman C, Kelly S, Bobak M (eds). *East-West Life Expectancy Gap in Europe. Environmental and Non-environmental Determinants.* London: Kluwer Academic Publishers.

Bobak M, Pikhart H, Hertzman C, Rose R, Marmot M (1998). Socioeconomic factors, perceived control and self-reported health in Russia. A cross-sectional survey. *Social Science & Medicine* 47(2):269-279.

Bock KD (1987). Changing prescription patterns: impact on costs. *Journal of Hypetension* 5(Suppl 3):S83-S85.

Bongers IMB, van der Meer JBW, van den Bos J, Mackenbach JP (1997). Socio-economic differences in general practitioner and outpatient specialist care in the Netherlands: A matter of health insurance? *Social Science & Medicine* 44(8):1161-1168.

Bosma H, Appels A (1996). Differences in mortality between Lithuanian and Dutch middle-aged men: Results from the Kaunas-Rotterdam Intervention Study (KRIS). In Hertzman C, Kelly S, Bobak M (eds.) *East-West Life Expectancy Gap in Europe. Environmental and Non-environmental Determinants*. London: Kluwer Academic Publishers.

Bosma H, Marmot MG, Hemingway, H, Nicholson AC et al. (1997). Low job control and risk of coronary heart disease in Whitehall II (prospective cohort) study. *British Medical Journal* 314(7080):558-565.

Bosma H, Peter R, Siegrist J, Marmot M (1998). Two alternative job stress models and the risk of coronary heart disease. *American Journal of Public Health* 88(1):68-74.

Boulton M, Tuckett D, Olson C, Williams A (1986). Social class and the general practice consultation. *Sociology of Health and Illness* 8:325-331.

Brännström, I, Weinehall L, Persson LA, Wester PO, Wall S (1993). Changing social patterns of risk factors for cardiovascular disease in a Swedish community intervention program. *International Journal of Epidemiology* 22(5):1026-1036.

British Columbia Ministry of Health and Ministry Responsible for Seniors (1998). *Pharmacare Trends*. Victoria: BC Ministry of Health and Ministry Responsible for Seniors.

Brown SL, Salive ME, Guralnik JM, Pahor M, Chapman DP, Blazer D (1995). Antidepressant use in the elderly: association with demographic characteristics, health-related factors, and health care utilization. *Journal of Clinical Epidemiology* 48(3):445-453.

Brownell MD, Roos NP (1995). *Monitoring the Winnipeg Hospital System: Update Report 1993/94*. Winnipeg: Manitoba Centre for Health Policy and Evaluation.

Brunner EJ, Marmot MG, Nanchahal K, Shipley MJ, Stansfeld SA, Juneja M, Alberti KG (1997). Social inequality in coronary risk: central obesity and the metabolic syndrome. Evidence from the Whitehall II Study. *Diabetologia* 40(11):1341-1349.

Bucker TD, Schiff G (1990). Drug formularies: myths-in-formation. *Medical Care* 28(10):928-939.

Bunker, CH, Okoro FI, Markovic N, Thai N, Pippin B, Ackrell M, Kuller LH (1996). Relationship of hypertension to socioeconomic status in a west African population. *Ethnicity and Health 1(1):33-45*.

Burnley IH (1998). Inequalities in the transition of ischaemic heart disease mortality in New South Wales, Australia, 1969-1994. *Social Science & Medicine* 47(9):1209-1222.

Butler RN, Lewis MI (1991). *Aging and Mental Health*. St. Louis: Mosby.

Canadian Coalition on Medication Use and the Elderly (1990). *Drug Utilization Related Problems in Elderly Canadians. Proceedings of an Invitational Consensus Conference on Research Priorities.* Ottawa: Canadian Public Health Association.

Carlisle DM, Leake BD (1998). Differences in the effect of patients' socioeconomic status on the use of invasive cardiovascular procedures across health insurance categories. *American Journal of Public Health* 88(7):1089-1092.

Carlisle DM, Valdez RB, Shapiro MF, Brook RB (1995). Geographic variation in rates of selected surgical procedures within Los Angeles County. *Health Services Research* 30(1): 27-42.

Carlson P (1998). Self-perceived health in East and West Europe: Another European health divide. *Social Science & Medicine* 46(10):1355-1366.

Carriere Y, Pelletier L (1995). Factors underlying the institutionalization of elderly persons in Canada. *The Journals of Gerontology* Series B, 50(3):S164-S173.

Census of Canada, 1991 (1993). *Statistics Canada Data Documentation for the Profile Series - Part B.* Ottawa: Supply and Services Canada.

Centre for Health Services and Policy Research and British Columbia Ministry of Health (1996). *Access policy for Research Uses of Linked Health Data.* HIDU 96:1. Vancouver: Centre for Health Services and Policy Research, The University of British Columbia.

Chamberlayne, R, Green B, Barer ML, Hertzman C, Lawrence WJ and Sheps SB (1998). Creating a population-based linked health database: A new resource for health services research. *Canadian Journal of Public Health* 89(4):270-73.

Chambless LE Shahar E, Sharrett AR, Heiss G, Wihnberg L, Paton CC, Sorlie P, Toole JF (1996). Association of transient ischemic attack/stroke symptoms assessed by standardized questionnaire and algorithm with cerebrovascular risk factors and carotid artery wall thickness. The ARIC Study, 1987-1989. *American Journal of Epidemiology* 144(9):857-866.

Chandola T (1998). Social inequality in coronary heart disease: A comparison of occupational classifications. *Social Science & Medicine* 47(4):525-533.

Charlton JRH, Hartley RM, Silver R, Holand WW (1983). Geographical variation in mortality from conditions amenable to medical intervention in England and Wales. *Lancet* ii:691-696.

Cockeram WC (1997). The social determinants of the decline of life expectancy in Russia and Eastern Europe: a lifestyle explanation. *Journal of Health and Social Behaviour* 38(June):117-130.

Connolly VM, Kesson CM (1996). Socioeconomic status and clustering of cardiovascular disease risk factors in diabetic patients. *Diabetes Care* 19(5):419-422.

Cooper, JW (1999). Adverse drug reaction-related hospitalizations of nursing facility patients: a 4 year study. *Southern Medical Journal* 92(5):584-90.

Cooperstock R, Parnell P (1982). Research on psychotropic drug use - a review of findings and methods. *Social Science & Medicine* 16:1179-1186.

Crystal S (1986). Measuring income and inequality among the elderly. *The Gerontologist* 26(1):56-59.

Crystal S, Shea D (1990). Cumulative advantage, cumulative disadvantage and inequality among elderly people. *The Gerontologist* 30(4):437-443.

Culler SD, Parchman ML, Przybylski M (1998). Factors related to potentially preventable hospitalizations among the elderly. *Medical Care* 36(6):804-817.

Curtis, SE. 1990. Use of survey data and small area statistics to assess the link between individual mortality and neighbourhood deprivation. *Journal of Epidemiology and Community Health.* 49:62-68.

Dahl E (1994). Social inequalities in ill-health: the significance of occupational status, education and income - results from a Norwegian survey. *Sociology of Health & Illness* 16(4):644-667.

Dahl E, Birkelund GE (1997). Health inequalities in later life in a social democratic welfare state. *Social Science & Medicine* 44(6):871-881.

Davey Smith, G (1996). Income inequality and mortality: Why are they related? *British Medical Journal* 312(7037):987-999.

Davey Smith G, Bartley M, Blane D (1990). The Black Report on socio-economic inequalities in health 10 years on. *British Medical Journal* 301:371-377.

Davey Smith G, Leon D, Shipley MJ, Rose G (1991). Socio-economic differentials in cancer among men. *International Journal of Epidemiology* 20:339-345.

Davey Smith G, Hart C, Blane D, Gillis C, Hawthorne V (1997). Lifetime socioeconomic position and mortality: Prospective observational study. *British Medical Journal* 314(7080):547-552.

Davey Smith G, Matthias E (1996). Commentary: Understanding it all - health, meta-theories, and mortality trends. *British Medical Journal* 313(7072):1584-1585.

Davey Smith G, Neaton JD, Wentworth D, Stamler R, Stamler J (1998). Mortality differences between black and white men in the USA: contribution of income and other risk factors among men screened for MRFIT. *The Lancet* 351(9107):934-939.

Davey Smith G, Neaton JD, Wentworth D et al., (1996a). Socioeconomic differentials in mortality risk among men screened for the Multiple Risk Intervention Trial I: White men. *American Journal of Public Health* 86(4):486-496.

Davey Smith G, Pekkanen J (1992). Should there be a moratorium on the use of cholesterol lowering drugs? *British Medical Journal* 304:431-434.

Davey Smith G, Wentworth D, Neaton JD et al., (1996b). Socioeconomic differentials in mortality risk among men screened for the Multiple Risk Intervention Trial II: Black men. *American Journal of Public Health* 86(4):497-511.

Davis SK, Ahn DK, Fortmann SP, Farquhar JW (1998). Determinants of cholesterol screening and treatment patterns. Insights for decision-makers. *American Journal of Preventive Medicine* 15(3):178-186.

Davis SK, Winkleby MA, Farquhar JW (1995). Increasing disparity in knowledge of cardiovascular disease risk factors and risk-reduction strategies by socioeconomic status: Implications for policymakers. *American Journal of Preventive Medicine* 11(5):318-323.

Department of Health and Social Security (1980). *Inequalities in Health: Report of a Research orking Group.* London: Department of Health and Social Security.

Diaz T, Chu SY, Buehler JW, Boyd D, Checko PJ, Conti L, Davidson AJ, Hermann P, Herr M, Levy A, Shields A, Sorvillo F, Mokotoff E, Whyte B, Hersh BS (1994). Socioeconomic differences among people with AIDS: Results from a multistate surveillance project. *American Journal of Preventative Medicine* 10(4):217-222.

Diderichsen F (1990). Health and social inequities in Sweden. *Social Science & Medicine* 31(3):359-387.

Diderichsen F, Janiert U (1992). Effects of economic change on male morbidity in neighbouring industrial and rural municipalities in northern Sweden. *Journal of Epidemiology and Community Health* 46:605-607.

Domenighetti G, Casabianca A, Gutzwiller F, Martinoli S (1993). Revisiting the most informed consumer of surgical services. *International Journal of Technology Assessment in Health Care* 9(4):505-513.

Dong W, Ben-Shlomo Y, Colhoun H, Chaturvedi N (1998). Gender differences in accessing cardiac surgery across England: A cross-sectional analysis of the health survey for England. *Social Science & Medicine* 47(11):1773-1780.

Dougherty G, Pless B, Wilkins R (1990). Social class and the occurrence of traffic injuries and deaths in urban children. *Canadian Journal of Public Health* 81:203-209.

Dressel P, Minkler M, Irene Y (1997). Gender, race, class and aging: advances and opportunities. *International Journal of Health Services* 27(4):579-600.

Droomers M, Schrijvers CTM, van de Mheen H, Mackenbach JP (1998). Educational differences in leisure-time physical inactivity: a descriptive and explanatory study. *Social Science & Medicine* 47(11):1665-1676.

Ecob R, Davey Smith G (1999). Income and health: what is the nature of the relationship? *Social Science & Medicine* 48:693-705.

Ecob R, Jones K (1998). Mortality variations in England and Wales between types of place: an analysis of the ONS Longitudinal Study. *Social Science & Medicine* 47(12):2055-2066.

Eggan AE (1993). The Tromsø Study: Frequency and predicting factors of analgesic drug use in a free-living population 912-56 years). *Journal of Clinical Epidemiology* 46(11):1297-1304.

Emslie C, Hunt K, Macintyre S (1999). Problematizing gender, work and health: the relationship between gender, occupational grade, working conditions and minor morbidity in full-time bank employees. *Social Science & Medicine 48:33-48.*

Erzen D, Carriere KC, Mustard C, Roos LL, Manfreda J, Anthonisen NR (1997). Income level and asthma prevalence and care patterns. *American Journal of Respiratory Critical Care Medicine* 155:1060-1065.

Evans RG (1994). Introduction, in Evans RG, Barer ML, Marmor TR (eds). *Why Are Some People Health and Others Not? The Determinants of Health of Populations.* New York:Aldine de Gruyter.

Evans RG, Hodge M, Pless IB (1994). If not genetics, then what? Biological Pathways and Population Health, in Evans RG, Barer ML, Marmor TR (eds). *Why Are Some People Health and Others Not? The Determinants of Health of Populations.* New York:Aldine de Gruyter.

Evans RG, Stoddart GL (1990). Producing health, consuming health care. *Social Science & Medicine* 31(12):1347-1363.

Everson SA, Lynch JW, Chesney MA, Kaplan GA et al., (1997). Interaction of workplace demands and cardiovascular reactivity in progression of carotid atherosclerosis: Population-based study. *British Medical Journal* 314(7080):553-558.

Fang J, Madhavan S, Boswroth W, Alderman MH (1998). Residential segregation and mortality in New York City. *Social Science & Medicine* 47(4):469-476.

Faresjöm T, Svärdsudd K, Tibblin G (1994). Social mobility and health in a prospective study of middle-aged men *Scandinavian Journal of Social Medicine* 22(2):86-89.

Feinstein JS (1993). The relationship between socioeconomic status and health: A review of the literature. *The Milbank Quarterly* 71(2):279-322.

Fejer D, Smart R (1973). The use of psychotropic drugs by adults. *Canadian Psychiatric Association Journal* 18:313-316.

Ferrie JE, Shipley MJ, Marmot MG, Stansfeld SA, Davey Smith G (1998). Health effects of anticipation of job change and non-employment: longitudinal data from the Whitehall II study. *British Medical Journal* 311(70150:1264-1269.

Ferrie JE, Shipley MJ, Marmot MG, Stansfeld SA, Davey Smith G (1998). An uncertain future: the health effects of threats to employment security in white-collar men and women. *American Journal of Public Health* 88(7):1030-1036.

Fillenbaum GG, Hanlon JT, Corder EH, Ziqubu-Page T, Wall WE, Brock D (1993). Prescription and nonprescription drug use among black and white community-residing elderly. *American Journal of Public Health.* 83(11):1577-1582.

Fleishman JA, Mor V (1993). Insurance status among people with AIDS: Relationships with sociodemographic characteristics and service use. *Inquiry* 30 (Summer 1993):180-188.

Forsdahl A (1977). Are poor living conditions in childhood and adolescence an important risk factor for arteriosclerotic heart disease? *British Journal of Preventive and Social Medicine* 31:91-95.

Fox AJ, Adelstein AM (1978). Occupational mortality: Work or way of life? *Journal of Epidemiology and Community Health 32:73-78.*

Fox AJ, Goldblatt PO, Jones DR (1985). Social class mortality differentials: artefact, selection or life circumstances? *Journal of Epidemiology and Community Health* 39:1-8.

Frank JW, Mustard JF (1994). The determinants of health from a historical perspective. *Daedalus* Fall, 1994:1-17.

Freeborn DK, Pope CR, Mullooly JP, McFarland BH (1990). Consistently high users of medical care among the elderly. *Medical Care* 28(6):527-540.

Fried LP, Kronmal RA, Newman AB, Bild De, Mittelmark MB, Polak JF, Robbins JA, Gardin JM (1998). Risk factors for 5-year mortality in older adults. The Cardiovascular Health Study. *JAMA* 279(8):585-592.

Fries JF (1980). Aging, natural death and the compression of morbidity. *New England Journal of Medicine* 330:130-135.

Frohlich N, Mustard C (1996). A regional comparison of socioeconomic and health indices in a Canadian province. *Social Science & Medicine* 42(9):1273-1281.

Fox AJ, Goldblatt PO, Jones DR (1985). Social class mortality differentials: artefact, selection or life circumstances? *Journal of Epidemiology and Community Health* 39:1-8.

Gabriel, SE, Jaakkimainen L, Bombardier C (1991). Risk for serious gastrointestinal complications related to use of nonsteroidal anti-inflammatory drugs. *Annals of Internal Medicine* 115(10):787-796.

Gissler M, Rahkonen O, Jarvelin M-R, Hemminki E (1998). Social class differences in health until the age of seven years among the Finnish 1987 birth cohort. *Social Science & Medicine* 46(12):1543-1552.

Gliksman MD, Kawachi I, Hunter D, Colditz GA, Manson JE, Stampfer MJ, Speizer FE, Willett WC, Hennekens CH (1995). Childhood socioeconomic status and risk of cardiovascular disease in middle aged US women: a prospective study. *Journal of Epidemiology & Community Health* 49(1):10-5.

Gordon NH, Crowe JP, Brumberg DJ, Berger NA (1992). *American Journal of Epidemiology* 135(6):609-618.

Gregario DI, Walsh SJ, Paturzo D (1997). The effects of occupation-based social position on mortality in a large American cohort. *American Journal of Public Health* 87(9):1472-1475.

Grembowski D, Patrick D, Diehr P, Durham M, Beresford S, Kay E, Hecht J (1993). Self-efficacy and health behaviour among older adults. *Journal of Health and Social Behaviour* 34(June):89-104.

Grootendorst PV, O'Brien BJ, Anderson GM (1997). On becoming 65 in Ontario. Effects of drug plan eligibility on use of prescription medicines. *Medical Care* 35(4):386-398.

Grymonpre RE, Sitar DS, Montgomery PR, Mitenko PA, Aoki FY (1991). Prescribing patterns for older heavy drug users living in the community. *DICP, The Annals of Pharmacotherapy* 25(1991 February):186-190.

Gulliford MC, Ariyanayagam-Baksh SM, bickram L, Picou D, Mahabir D (1997). Social environment, morbidity and use of health care among people with diabetes mellitus in Trinidad. *International Journal of Epidemiology* 26(3):620-627.

Haan M, Kaplan GA, Camacho T (1987). Poverty and Health: Prospective evidence from the Alameda County study. *American Journal of Epidemiology* 125(6):989-98.

Hall JA, Roter DL, Katz NR (1988). Meta-analysis of correlates of provider behaviour in medical encounters. *Medical Care* 26(7):657-675.

Hallqvist J, Diderichsen F, Theorell T, Reuterwall C, Ahlbom A and the SHEEP study group (1998). Is the effect of job strain on myocardial infarction risk due to interaction between high psychological demands and low decision latitude? Results from Stockholm Heart Epidemiology Program (SHEEP). *Social Science & Medicine* 46(11):1405-1415.

Hanlon JT, Schmader KE, Koronkowski MJ, Weinberger M, Landsman PB, Samsa GP, Lewis IK (1997). Adverse drug events in high-risk older outpatients. *Journal of the American Geriatrics Society*. 45(8):945-8.

Harburg E, Erfurt JC, Chapel C, Havenstein LS, Schull WJ, Schork MA (1973). Socioecological stressor areas and black-white blood pressure. *Journal of Chronic Disease* 26:595-611.

Harding J (1986). Mood modifiers and elderly women in Canada: The medicalization of poverty. In McDonnel K (ed.) *Women and the Pharmaceutical Industry*. Penang: International Organization of Consumers Unions

Harnick DJ, Cohen JL, Schechter CB, Fuster V, Smith DA (1998). Effect of practice setting on quality of lipid-lowering management in patients with coronary artery disease. *The American Journal of Cardiology* 81(12):1416-1420.

Hart CL, Davey Smith G, Blane D (1998a). Inequalities in mortality by social class measured at 3 stages of the lifecourse. *American Journal of Public Health* 88(3):471-474.

Hart CL, Davey Smith G, Blane D (1998b). Social mobility and mortality in a cohort of Scottish men. *Social Science & Medicine* 47(8):1121-1130.

Hartley RM, Epstein AM, Harris CM, McNeils BJ (1987). Differences in ambulatory test ordering in England and America. Role of doctors' beliefs and attitudes. *American Journal of Medicine* 82:513-519.

Hay DI (1988). Socioeconomic status and health status: A study of males in the Canada Health Survey. *Social Science & Medicine* 27(12):1317-1325.

Hayward MD, Pienta AM, McLaughlin DK (1997). Inequality in men's mortality: The socioeconomic status gradient and geographic context. *Journal of Health and Social Behaviour* 38:313-330.

Hemingway H, Nicholson A, Stafford M, Roberts R, Marmot M (1997a). The impact of socioeconomic status on health functioning as assessed by the SF-36 questionnaire: The Whitehall II study. *American Journal of Public Health* 87(9):1484-1490.

Hemingway H, Shipley MJ, Stansfeld S, Marmot M (1997b). Sickness absence from back pain, psychosocial work characteristics and employment grade among office workers. *Scandinavian Journal of Work, Environment & Health* 23(2):121-129,

Hertzman C (1994). The lifelong impact of childhood experiences: A population health perspective. *Daedalus* 123(4):167-180.

Hertzman C, Frank J, Evans RG. (1994) Heterogeneities in health status. in Evans RG, Barer ML and Marmor TR (editors) *Why are some people health and others not?* New York: Aldine de Gruyer.

Hertzman C, Wiens M (1996). Child development and long-term outcomes: A population health perspective and summary of successful interventions. *Social Science & Medicine* 43(7):1083-1095.

Hexel PC, Wintersberger H (1986). Inequalities in health: strategies. *Social Science & Medicine* 22(2):151-160.

Hirdes JP, Forbes WF (1992). The importance of social relationships, socioeconomic status and health practices with respect to mortality among health Ontario males. *Journal of Clinical Epidemiology* 45(2):175-182.

Hirsch RP, Riegelman RK (1992). *Statistical First Aid. Interpretation of Health Research Data.* Boston: Blackwell Scientific Publications.

Hirth RA, Turenne MN, Woods JD, Young EW, Port FK, Pauly MK, Held PH (1996). Predictors of type of vascular access in hemodialyis patients. *JAMA* 276(169):1303-1308.

Hofer TP, Wolfe RA, Tedeschi PJ, McMahon LF, Griffith JR (1998). Use of community versus individual socioeconomic data in predicting variation in hospital use. *Health Services Research* 33(2):243-259.

Hohmann AA, Larson DB, Thompson JW, Beardsley RS (1991). Psychotropic medication prescription in U.S. ambulatory medical care. *DCIP, The Annals of Pharmacotherapy* 25:85-89.

Holme I, Helgeland A, Hjermann I, Leren P, Lund-Larsen PG (1977). Coronary risk factors in various occupational groups: The Oslo study. *British Journal of Preventive and Social Medicine* 31:96:100.

Homan RK, Korenbrot CC (1998). Explaining variation in birth outcomes of Medicaid-eligible women with variation in the adequacy of prenatal support services. *Medical Care* 36(2):190-201.

House JS, Landis KR, Umberson D (1988). Social relationships and health. *Science* 241:540-544.

House JS, Kessler RC, Herzog AR et al. (1990). Age, socioeconomic status and health. *Millbank Quarterly* 68(3):383-411.

Hurd MD (1990). Research on the elderly: Economic status, retirement and consumption and saving. *Journal of Economic Literature* 28:565-637.

Ickovics JR, Viscoli CM, Horwitz RI (1997). Functional recovery after myocardial infarction in men: The independent effects of social class. *Annals of Internal Medicine* 127:518-525.

Isacson D (1997). Long-term benzodiazepene use: factors of importance and the development of individual use patterns over time - a 13-year follow-up in a Swedish community. *Social Science & Medicine* 44(12):1871-1880.

Isacson D, Haglund B (1988). Psychotropic drug use in a Swedish community - the importance of demographic and socioeconomic factors. *Social Science & Medicine* 26(4):477-483.

Iversen L, Andersen O, Andersand PK, Christoffersen K, Keiding N (1987). Unemployment and mortality in Denmark, 1970-1980. *British Medical Journal* 295:879-884.

Jaglal SB, Slaughter PM, Baigrie RS, Morgan C, Naylor CD (1995). Good judgement or sex bias in the referral of patients for the diagnosis of coronary artery disease? An exploratory study. *Canadian Medical Association Journal* 152:873-880.

James R, Young TK, Mustard CA, Blanchard J (1997). The health of Canadians with diabetes. *Health Reports* 9(3):47-52.

Jefferys M (1996). Social inequalities in health - do they diminish with age? *American Journal of Public Health* 86(4):474.

Jerrett M, Eyles J, Cole D (1998). Socioeconomic and environmental covariates of premature mortality in Ontario. *Social Science & Medicine* 47(1):33-49.

Johnson RE, McFarland BH (1993). Antipsychotic drug exposure in a health maintenance organization. *Medical Care* 31(5):432-444.

Jones N, Purdie G (1993). The effect of user charges on the dispensing of prescription medicines: a survey of prescription charge payment in the Wellington region. *New Zealand Medical Journal* 106(225-226.

Joseph AE, Hollett RG (1993). On the use of socio-demographic indicators in local health planning: A Canadian non-metropolitan perspective. *Social Science & Medicine* 37(6):813-822.

Judge K, Mulligan J, Benzeval M (1998a). Income inequality and population health. *Social Science & Medicine* 46(4-5):567-579.

Judge K, Mulligan J, Benzeval M (1998b). Reply to Richard Wilkinson. *Social Science & Medicine* 47(7):983-985.

Jyhla M (1994). Ten-year change in the use of medical drugs among the elderly - a longitudinal study and cohort comparison. *Journal of Clinical Epidemiology* 47(1):66-79.

Kaasik T, Andersson R, Hörte L-G (1998). The effects of political and economic transitions on health and safety in Estonia; An Estonian-Swedish comparative study. *Social Science & Medicine* 47(10):1589-1599.

Kaplan GA (1985). Twenty years of health in Alameda County: The human population laboratory analysis. Paper presented at the Ann. Meet. Society for Prospective Medicine, San Francisco.

Kaplan GA (1996). People and places; Contrasting perspectives on the association between social class and health. *International Journal of Health Services* 26(3):507-519.

Kaplan GA, Pamuk ER, Lynch JW, Cohen RD, Balfour JL (1996). Inequality in income and mortality in the United States: analysis of mortality and potential pathways. *British Medical Journal* 312(7038):999-1013.

Karasek RA, Theorell T (1990). *Healthy Work: Stress, Productivity and the Construction of Working Life*. New York: Oxford University Press.

Karjalainen S, Pukkala E (1990). Social class as a prognostic factor in breast cancer survival. *Cancer* 66:819-826.

Katz PP (1998). Education and self-care activities among persons with rheumatoid arthritis. *Social Science & Medicine* 46(8):1057-1066.

Katz SJ, Hofer TP (1994). Socioeconomic disparities in preventive care persist despite universal coverage. Breast and cervical cancer screening in Ontario and the United States. *JAMA* 272(7):530-435.

Katz SJ, Hofer TP, Manning WG (1996). Physician use in Ontario and the United States: The impact of socioeconomic status and health status. *American Journal of Public Health* 86(4):520-527.

Kawachi I, Kennedy BP, Lochner K, Prothrow-Smith D (1997). Social capital, income inequality and mortality. *American Journal of Public Health* 87(9):1491-1498.

Kennedy BP, Kawachi I, Prothrow-Stith D (1996). Income distribution and mortality: cross-sectional ecological study of the Robin Hood index in the United States. *British Medical Journal* 312(7038):1004-1007.

Kephart G, Salazar Thomas V, MacLean DR (1998). Socioeconomic differences in the use of physician services in Nova Scotia. *American Journal of Public Health* 88(5):800-803.

Keskimaki I, Salinto M, Aro S (1995). Socioeconomic equity in Finnish hospital care in relation to need. *Social Science & Medicine* 41(3):425-431.

King De, Lahiri K (1994). Socioeconomic factors and the odds of vaginal birth after cesarean delivery. *JAMA* 272(7):524-529.

Kington RS, Smith JP (1997). Socioeconomic status and racial and ethnic differences in functional status associated with chronic diseases. *American Journal of Public Health* 87(5):805-810.

Kleinbaum DG, Kupper LL (1978). Applied Regression Analysis and Other Multivariable Methods. North Scituate, MA: Duxbury Press.

Kogevinas M, Marmot MG, Fox AJ, Goldblatt PO (1991). Socioeconomic differences in cancer survival. *Journal of Epidemiology and Community Health* 45:216-219.

Koskinen, SVP, Martelin TP, Valkonen T (1996). Socioeconomic differences in mortality among diabetic people in Finland: five year follow up. *British Medical Journal* 313(7063):975-978.

Koupilova I, Bobak M, Holcik J, Pikhart H, Leon DA (1998). Increasing social variation in birth outcomes in the Czech Republic after 1989. *American Journal of Public Health* 88(9):1343-1347.

Knutsson A, Goine H (1998). Occupation and unemployment rates as predictors of long term sickness absence in two Swedish counties. *Social Science & Medicine* 47(1):25-31.

Krieger, N. (1991). Women and social class: A methodological study comparing individual, household, and census measures as predictors of black/white differences in reproductive history. *Journal of Epidemiology and Community Health* 45:35-42.

Krieger, N. (1992). Overcoming the absence of socioeconomic data in medical records: Validation and application of a census-based methodology. *American Journal of Public Health* 82(5):703-710.

Krieger N and Fee E. (1994). Social class: The missing link in U.S. health data. *International Journal of Health Services* 24(1):25-44.

Kristenson M, Orth-Gomer K, Kuchinskiene Z (1998). Different patterns of psychosocial strain; A possible explanation for the differences in ischemic heart disease mortality between Sweden and Lithuania. In Hertzman C, Kelly S, Bobak M (eds.) *East-West Life Expectancy Gap in Europe. Environmental and Non-environmental Determinants*. London: Kluwer Academic Publishers.

Kuh D, Stirling S (1995). Socioeconomic variation in admission for diseases of female genital system and breast in a national cohort aged 15-43. *British Medical Journal* 311(30 September):840-843.

Kunst AE, Groenhog F, Mackenbach JP and The EU Working Group on Socioeconomic Inequalities in Health (1998). Mortality by occupational class among men 30-64 years in 11 European countries. *Social Science & Medicine* 46(11):1459-1476.

Lahelma E, Manderbacka K, Rahkonen O, Karisto A (1994). Comparisons of inequalities in health: Evidence from national surveys in Finland, Norway and Sweden. *Social Science & Medicine* 38(4):517-524.

Lahelma E, Rahkonen O, Huuhka M (1997). Changes in the social patterning of health? The case of Finland 1986-1994. *Social Science & Medicine* 44(6):789-799.

Lantz PM, House JS, Lepkowski JM, Williams DR, Mero RP, Chen J (1998). Socioeconomic factors, health behaviours and mortality. Results from a nationally representative prospective study of US adults. *JAMA* 279(21):1703-1708.

Lasila HC, Stoehr GP, Ganguli M, Seaberg EC, Gilby JE, Belle SH, Echement DA (1996). Use of prescription medications in an elderly rural population; the MoVIES Project. *Annals of Pharmacotherapy* 30(6):589-595.

LaTour J, Lopez V, Rodriguez M, Nolasco A, Alvarez-Dardet C (1991). Inequalities in health in intensive care patients. *Journal of Clinical Epidemiology* 44(9):889-894.

LaVange L, Silverman H (1989). Outpatient prescription drug utilization and expenditure patterns of non-institutionalized aged Medicare beneficiaries. Washington DC: US Health Care Financing Administration. National Medical Care Utillization and Expenditure Survey, Series B, Descriptive Report 12. DHHS publication 86-20212.

Leclere FB, Rogers RG, Peters K (1998). Neighbourhood social context and racial differences in women's heart disease mortality. *Journal of Health and Social Behaviour* 39:91-107.

Lee AJ, Baker CS, Gehlbach S, Hosmer DW, Reti M (1998). Do black elderly Medicare patients receive fewer services? An analysis of procedure use for selected patient conditions. *Medical Care Research and Review* 55(3):314-333.

Leon DA, Shkolnikov VM (1998). Social stress and the Russian mortality crisis. *JAMA* 279(10):790-791.

Lexchin J (1992). Prescribing and drug costs in the province of Ontario. *International Journal of Health Services* 22(3):461-487.

Lexchin J (1993). Why are we still poisoning the elderly so often? *Canadian Family Physician* 39:2298-2300.

Lexchin J (1996). Income class and pharmaceutical expenditure in Canada: 1964-1990. *Canadian Journal of Public Health* 87(1):46-50.

Libertos P, Link BG, Kelsey J. (1988). The measurement of social class in epidemiology. *Epidemiologic Reviews* 10:87-121.

Liu K, Cedres LB, Stamler J, Dyer A, Stamler R, Nanas S, Berkson DM, Paul O, Lepper M, Lindberg HA, Marquardt J, Stevens E, Schoenberger JA, Shekelle RB, Collette P, Shekelle S, Garside D (1982). Relationship of education to major risk factors and death from coronary heart disease, cardiovascular diseases and all causes. Findings of three Chicago epidemiologic studies. *Circulation* 66(6):1308-1314.

Logue EE, Jarjoura D (1990). Modelling heart disease mortality with census tract rates and social class mixtures. *Social Science and Medicine* 31:545-550.

Lomas J (1998). Social capital and health: implications for public health and epidemiology. *Social Science & Medicine* 47(9):1181-1188.

Lundberg O (1993). The impact of childhood living conditions on illness and mortality in adulthood. *Social Science & Medicine* 36(8):1047-1052.

Lundberg O (1997). Childhood conditions, sense of coherence, social class and adult ill health: exloring their theoretical and empirical relations. *Social Science & Medicine* 44(6):821-831.

Lundberg L, Johannesson M, Isacson DGL, Borgquist L (1998). Effects of user charges on the use of prescription medicines in different socio-economic groups. *Health Policy* 22:123-134.

Lupton D (1997). Consumerism, reflexivity and the medical encounter. *Social Science & Medicine* 45(3):373-381.

Lynch JW, Everson SA, Kaplan GA, Salonen R, Salonen JT (1998). Does low socioeconomic status potentiate the effects of heightened cardiovascular responses to stress on the progression of carotid atherosclerosis? *American Journal of Public Health* 88(3):389-394.

Lynch JW, Kaplan GA, Cohen RD, Kauhanen J, Wilson TW, Smith NL, Salonen JT (1994). Childhood and adult socioeconomic status as predictors of mortality in Finland. *Lancet* 343:524-527,

Lynch JW, Kaplan GA, Cohen RD, Tuomilehto J, Salonen JT (1996). Do cardiovascular risk factors explain the relation between socioeconomic status, risk of all-cause mortality, cardiovascular mortality, and acute myocardial infarction? *American Journal of Epidemiology* 144(10):934-942.

Lynch JW, Kaplan GA, Pamuk ER, Cohen RD, Heck KE, Balfour JL, Yen IH (1998). Income inequality and mortality in metropolitan areas of the United States. *American Journal of Public Health* 88(7):1074-1080.

Lynch JW, Kaplan GA, Salonen JT (1997). Why do poor people behave poorly? Variation in adult health behaviours and psychosocial characteristics by stages of the socioeconomic lifecourse. *Social Science & Medicine* 44(6):809-819.

Lynch JW, Kaplan GA, Shema SJ (1997). Cumulative impact of sustained economic hardship on physical, cognitive, psychological and social functioning. *The New England Journal of Medicine* 337(26):1889-1895.

Macintyre S (1997). The Black Report and beyond what are the issues? *Social Science & Medicine* 44(6):723-745.

Macintyre S, Maciver S, Sooman A (1993). Area, class and health: Should we be focussing on places or people? *Journal of Social Policy* 22(2):213-234.

Macintyre S, West P (1991). Lack of class variation in health in adolescence: an artefact of an occupational measure of social class? *Social Science & Medicine* 32(4):395-402.

Mackenbach JP (1993). The contribution of medical care to mortality decline: McKeown revisted. Paper presented at the 11th Honda Foundation Discoveries Symposium, Toronto, October, 1993.

Mackenbach JP (1996). Dances of death, occupational mortality statistics, and social critique. *British Medical Journal* 313(7072):1587-1591.

Mackenbach JP, Bouvier-Colle MH, Jougla E (1990). "Avoidable" mortality and health services: a review of aggregate data studies. *Journal of Epidemiology and Community Health* 44:106-111.

Mackenbach JP, Kunst AE (1997). Meauring the magnitude of socio-economic inequalities in health: an overview of available measures illustrated with two examples from Europe. *Social Science & Medicine* 44(6):757-771.

Maclure A, Stewart GT (1984). Admission of children to hospitals in Glasgow: relation to unemployment and other deprivation variables. *Lancet* 2(8404):682-685.

Maddox GL, Clark DO (1992). Trajectories of functional impairment in later life. *Journal of Health and Social Behaviour* 33(June):114-125.

Manor O, Matthews S, Power C (1997). Comparing measures of health inequality. *Social Science & Medicine* 45(5):761-771.

Mapelli V (1993). Health needs, demand for health services and expenditure across social groups in Italy: an empirical investigation. *Social Science & Medicine* 36(8):999-1009.

Manga P, Broyles RW, Angus DE (1987). The determinants of hospital utilization under a universal public insurance program in Canada. *Medical Care* 25(7):658-670.

Manuck SB, Kaplan JR, Adams MR, Clarkson TB (1988). Studies of psychosocial influences on coronary artery atherogenesis in cynomolgus monkeys. *Health Psychology* 7(2):113-124.

Marks NF, Shinberg DS (1997). Socioeconomic differences in hysterectomy: The Wisconsin Longitudinal Study. *American Journal of Public Health* 87(9):1507-1514.

Marmot MG (1989). Socioeconomic determinants of CHD mortality. *International Journal of Epidemiology* 3(Suppl1):S196-S202.

Marmot MG (1994). Social differential in health within and between populations, in *Prosperity, health and well-being* (Proceeding of the 11[th] Honda Foundation Discoveries Symposium). Toronto: Canadian Institute for Advanced Research.

Marmot MG, Bosma H, Hemingway H, Brunner E, Stansfeld S (1997). Contribution of job control and other risk factors to social variations in coronary heart disease incidence. *The Lancet* 350(9073):235-239.

Marmot MG, Davey Smith G (1989). Why are the Japanese living longer? *British Medical Journal* 299:1547-1551.

Marmot MG, Davey Smith G, Stansfeld S, Patel C, North F, Head J,White I, Brunner E, Feeney A (1991). Health inequalities among British civil servants: the Whitehall II study. *The Lancet* 337:1387-1393.

Marmot M, Ryff CD, Bumpass LL, Shipley M, Marks NF (1997). Social inequalities in health: the next questions and converging evidence. *Social Science & Medicine* 44(6):901-910.

Marmot MG, Rose G, Shipley M, Hamilton PJS (1978). Employment grade and coronary heart disease in British civil servants. *Journal of Epidemiology and Community Health* 32:244-249.

Marmot MG, Shipley MJ, Rose G (1984). Inequalities in death-specific explanations of a general pattern? *Lancet* 1(8384):1003-1106.

Marmot M, Theorell T (1988). Social class and cardiovascular disease. The contribution of work. *International Journal of Health Services* 18(4):659-674.

Martikainen J, Klaukka T, Reunanen A, Peura S, Wahlroos H (1996). Recent trends in the consumption of lipid-lowering drugs in Finland. *Journal of Clinical Epidemiology* 49(12):1453-1457.

Mas X, Laporte J-R, Frate ME, Busquet L, Arnau JM, Ibanez L, Seculi E, ,Capella D, Arbones G (1983). Drug prescribing and use among elderly people in Spain. *Drug Intelligence and Clinical Pharmacy* 17:378-382.

Massey DS, Gross AB, Shibuya K (1994). Migration, segregation and the geographic concentration of poverty. *American Sociological Review* 59(3):425-437.

Matthews S, Manor O, Power C (1999). Social inequalities in health: are there gender differences? *Social Science & Medicine* 48(49-69.

Mayer-Oakes SA, Kelman G, Beers MH, De Jong F, Matthias R, Atchison KA, Lubben JE, Scheitzer SO (1993). Benzodiazepene use in older, community-dwelling southern Californians: prevalence and clinical correlates. *The Annals of Pharmacotherapy* 27(April 1993):416-420.

McCord C, Freeman HP (1990). Excess mortality in Harlem. *New England Journal of Medicine* 322:173-177.

McDonough P, Duncan GJ. Williams D, House J (1997). Income dynamics and adult mortality in the United States, 1972 through 1989. *American Journal of Public Health* 87(9):1476-1483.

McIsaac WJ, Levine N, Goel V (1998). Visits by adults to family physicians for the common cold. *Journal of Family Practice* 47(5):366-359.

McIsaac W, Naylor D, Anderson GM, O'Brien BJ (1994). Reflections on a month in the life of the Ontario Drug Benefit Plan. *Canadian Medical Association Journal* 150(4):473-477.

McKeown T (1976). *The Role of Medicine: Dream, Mirage or Nemesis*. London: Nuffield Provincial Hospitals Trust.

McKeown T (1978). Determinants of health. *Human Nature* 1(4):57-62.

McKinlay JB and SM McKinlay (1977). The questionable contribution of medical measures to the decline of mortality in the United States in the twentieth century. *Milbank Memorial Fund Quarterly* Summer, 1977:405-428.

McLaughlin CG, Normolle DP, Wolfe RA, McMahon LF,Griffith JR (1989). Small area variations in hospital discharge rates. Do socioeconomic variables matter? *Medical Care* 27:507-521.

McMahon LF, Tedeschi PJ, Wolfe RA, Griffith JR, McLaughlin CG (1990). Small-area analysis of gastrointestinal disease hospital discharge variation: Are the poor at risk? *Journal of Clinical Gastroenterology* 12(2):132-139.

Meddings DR, Hertzman C, Barer ML, Evans RG, Kazanjian A, McGrail K, Sheps SB (1998). Socioeconomic status, mortality, and the development of cataract at a young age. *Social Science & Medicine* 46(11):1451-1457.

Meeks S, Murrell SA (1997). Mental illness in late life: socioeconomic conditions, psychiatric symptoms, and adjustment of long-term sufferers. *Psychology & Aging* 12(2):296-308.

Mellinger HD, Balter MB, Uhlenhuth EH (1984). Prevalence and correlates of the long-term regular use of anxiolytics. *JAMA* 251(3):375-376.

Metge C. Black C, Peterson S, Kozyrskyj AL (1999). The population's use of pharmaceuticals. *Medical Care* 37(6) Suppl:Js42-JS59.

Minister of Industry, Science and Technology (1993). *Census of Canada, 1991. Profile of Enumeration Areas - Part A 100 % Data*. Ottawa: Statistics Canada.

Miralles MA, Kimberlin CL (1998). Perceived access to care and medication use among ambulatory elderly in Rio de Janeiro, Brazil. *Social Science & Medicine* 46(3):345-355.

Mitchell JB, McCormack LA (1997). Time trends in late-stage diagnosis of cervical cancer. Differences by race/ethnicity and income. *Medical Care* 35(12):1220-1224.

Miura H, Araki Y, Haraguchi K, Arai Y, Umenai T (1997). Socioeconomic factors and dental caries in developing countries: A cross-national study. *Social Science & Medicine* 44(2):269-272.

Moeller J, Mathiowetz N (1989). Prescribed medicines: a summary of use and expenditures by Medicare beneficiaries. Rockville MD: National Center for Health Services Research and Health Technology Assessment; National Medical Expenditure Survey Research Findings 3. DHHS Publication PHS 89-3448.

Molinari C, Ahern M, Hendryx M (1998). The relationship of community quality to the health of women and men. *Social Science & Medicine* 47(8):1113-1119.

Monane M, Glynn RJ, Gurwitz JH, Bohm RL, Levin R, Avorn J (1995). Trends in medication choices for hypertension in the elderly. The decline of the thiazides. *Hypertension* 25(5):1045-1051.

Morgan M. (1983). Measuring social inequality: Occupational classifications and their alternatives. *Community Medicine* 5:115-124.

Morrison C, Woodward M, Leslie, W, Tunstall-Pedow H (1997). Effect of socioeconomic group on incidence of, management of, and survival after myocardial infarction and coronary death: Analysis of community coronary event register. *British Medical Journal* 314(7080):541-546.

Moser KA, Fox AJ, Jones DR (1984). Unemployment and mortality in the OPCS Longitudinal Study. *Lancet* 2(8415):1324-1329.

Moss N (1997). The body politic and the power of socioeconomic status. *American Journal of Public Health* 87(9): 1411-1413.

Mott DA, Kreling DH (1998). The association of insurance type with costs of dispensed drugs. *Inquiry* 35:23-35.

Muntaner C, Eaton Ww, Diala C, Kessler RC, Sorlie PD (1998). Social class, assets, organizational control and the prevalence of common groups of psychiatric disorders. *Social Science & Medicine* 47(12):2043-2053.

Muscettola G, Bollini P, Pampallona S (1991).Pattern of neuroleptic drug use in Italian mental health services. *DICP, The Annals of Pharmacotherapy* 25(March 1991):296-301.

Mustard C, Derksen S, Berthelot J, Wolfson MJ (1999). Assessing ecologic proxies for household income: a comparison of household and neighbourhood level measures in the study of population health status. *Health & Place* 5(2):151-171.

Mustard CA, Derksen S, Berthelot J-M, Wolfson M, Roos LL (1997). Age-specific education and income gradients in morbidity and mortality in a Canadian province. *Social Science & Medicine* 45(3):383-397.

Mustard C, Derksen S, Berthelot J, Wolfson MJ, Roos LL, Carriere KC (1995). Socioeconomic gradients in mortality and in the use of health care services at different stages in the life course. Winnipeg: Manitoba Centre for Health Policy and Evaluation, University of Manitoba.

Mustard CA, Frohlich N. (1995). Socioeconomic status and the health of the population. *Medical Care* 33(2):DS43-54. *Social Science & Medicine 45(3):383-397.*

Mustard C, Roos NP. (1994). The relationship of prenatal care and pregnancy complication to birthweight in Winnipeg, Canada. *American Journal of Public Health* 84(9):1450-1457.

Nam CB, Powers MG. (1983). *The Socioeconomic Approach to Status Measurement*. Houston: Cap and Gown Press.

Newachek PW (1992). Characteristic of children with high and low usage of physician services. *Medical Care* 30(1):30-42.

Newbold KB, Eyles J, Birch S (1995). Equity in health care: Methodological contributions to the analysis of hospital utilization within Canada. *Social Science & Medicine* 40(9):1181-1192.

Nikiforov SV, Mamaev VB (1998). The development of sex differences in cardiovascular disease mortality: A historical perspective. *American Journal of Public Health*. 88(9):1348-1353.

Norredam M, Groenvold M, Petersen JH, Krasnik A (1998). Effect of social class on tumour size at diagnosis and surgical treatment in Danish women with breast cancer. *Social Science & Medicine* 47(11):1659-1663.

Notzon FC, Komarov YM, Ermakov SP, Sempos CT, Marks JS, Sempos EV (1998). Causes of declining life expectancy in Russia. *JAMA* 279(10):793-800.

O'Brien JG, Kursch JE (1987). "Healthy" prescribing for the elderly. How to minimize adverse drug effects and prevent 'dementia in a bottle'. *Postgraduate Medicine* 82(6):147-156.

Olfson M, Klerman GL (1993). Trends in the prescription of psychotropic medications. The role of physician specialty. *Medical Care* 31(6):559-564.

Östberg V, Vågerö D (1991). Socio-economic differences in mortality among children. Do they persist into adulthood? *Social Science & Medicine* 32(4):403-410.

Otten FWJ, Bosma HHA (1997). The socio-economic distribution of heart diseases: Changing gradients in the Netherlands. *Social Science & Medicine* 44(9):1349-1356.

Ozminkowski RJ, White AJ, Hassol A, Murphy M (1998). What if socioeconomics made no difference? Access to a cadaver kidney transplant as an example. *Medical Care* 36(9):1398-1406.

Pajak A (1996). Contribution of smoking. In Hertzman C, Kelly S, Bobak M (eds.) *East-West Life Expectancy Gap in Europe. Environmental and Non-environmental Determinants*. London: Kluwer Academic Publishers.

Palosuo H, Uutela A, Zhuravleva I, Lakomova N (1998). Social patterning of ill health in Helsinki and Moscow. Results from a comparative survey in 1991. *Social Science & Medicine* 46(9):11121-1136.

Pappas G, Hadden WC, Kozak LJ, Fisher GF (1997). Potentially avoidable hospitalizations: Inequalities in rates between US socioeconomic groups. *American Journal of Public Health* 87(5):811-816.

Pappas G, Queen S, Hadden W, Fisher G (1993). The increasing disparity in mortality between socioeconomic groups in the United States, 1960 and 1986. *New England Journal of Medicine* 329(2):103-109.

Pappas DJP, Osmond C (1987). Inequalities in health in Britain: Specific explanations in three Lancashire towns. *New England Journal of Medicine* 329:103-109.

Pariente P, Lepine JP Lellouch J (1992). Self-reported psychotropic drug use and associated factors in a French community sample. *Psychological Medicine* 22:181-190.

Parker JD, Schoendorf KC, Kiely JL (1994). Associations between measures of socioeconomic status and low birth weight, small for gestational age, and premature delivery in the United States. *Annals of Epidemiology* 4(4):271-8.

Parks ED, Josef N (1997). A retrospective study of determinants of length of stay in a geropsychoatric state hospital. *Psychiatric Quarterly* 68(2):91-9.

Pekkanen J, Manton KG, StallardR, Nissinen A, Karvonen MJ (1992). Risk factor dynamics, mortality and life expectancy differences between eastern and western Finland: The Finnish Cohorts of the Seven Countries Study. *International Journal of Epidemiology* 21(2):408-419.

Pelletier, L (1992). Vieillir en institution ou a domicile? Les facteurs associes a l'hebergement des personnes agees. *Espace, Populations, Societes* 1:71-86.

Pendleton D, Bochner S (1980). The communication of medical information in general practice consultations as a function of a patients social class. *Social Science & Medicine* 14A:669-673.

Penrose A, Dovey S, Tilyard M (1996). Trends in antihypertensive prescribing. *New Zealand Medical Journal* 26 January 1996:4-7.

Petri H, Urquhart J (1991). Chanelling bias in the interpretation of drug effects. *Statistics in Medicine* 10:57-581.

Pincus HA, Tanielian TL, Marcus SC, Olfson M, Zarin DA, Thompson J, Zitao JM (1998). Prescribing trends in psychotropic medications. Primary care, psychiatry and other medical specialities. *JAMA* 279(7):526-531.

Pincus T, Ester R, DeWalt DA, Callahan LF (1998). Social conditions and self-management are more powerful determinants of health than access to care. *Annals of Internal Medicine* 129(5):406-411.

Pineo PC, Porter J. (1967). Occupational prestige in Canada. *Canadian Review of Sociology* 4:24-40.

Poland B, Coburn D, Robertson A, Eakin J with members of the Critical Social Science in Health Group (1998). Wealth, equity and health care: a critique of a "population health" perspective on the determinants of health. *Social Science & Medicine* 46(7):785-798.

Power C, Hertzman C, Matthews S, Manor O (1997). Social differences in health: life-cycle effects between ages 23 and 33 in the 1958 British Birth Cohort. *American Journal of Public Health* 87(9):1499-1503.

Power C, Matthews S, Orly M (1996). Inequalities in self rated health in the 1958 birth cohort: Lifetime social circumstances or social mobility? *British Medical Journal* 313(7055):449-451.

Premier's Council on Health Strategy. 1991. *Nurturing Health: A Framework on the Determinants of Health.* Toronto: Premier's Council on Health Strategy.

Preston SH, Hill ME, Drevenstedt GL (1998). Childhood conditions that predict survival to advanced ages among African Americans. *Social Science & Medicine* 47(9):1231-1246,

Rabin DL (1972). A review of prescribed and nonprescribed medicine use. *Medical Care Review* 1972:668-699.

Rahkonen O, Lahelma E, Huukhka M (1997). Past or present? Childhood living conditions and current socioeconomic status as determinants of adult health. *Social Science & Medicine* 44(3):327-336.

Rapoport D (1994). Cutting costs by targeting prescribing practices. *Canadian Medical Association Journal* 151(1):13-14.

Rodgers GB (1979). Income and inequality as determinants of mortality: an international cross-section analysis. *Population Studies* 33(2):343-358.

Rokstad K. Straand J. Fugelli P (1997). General practitioners' drug prescribing practice and diagnoses for prescribing: the More & Romsdal Prescription Study. *Journal of Clinical Epidemiology* 50(4):485-94.

Roos NP, Black C, Frohlich N, DeCoster C, Cohen M, Tataryn D, Mustard C, Toll F, Carriere KC, Burchill C, MacWilliam L and Bogdanovic B. (1993). Assessing the relationship between health care use and the health of a population: Seeking levers for policy makers. Paper presented at the 11th Honda Foundation Discoveries Symposium, Toronto, October, 1993.

Roos NP, Black C, Frohlich N, DeCoster C, Cohen M, Tataryn D, Mustard C, Toll F, Carriere KC, Burchill C, MacWilliam L, Bogdanovic B. (1995). A Population-based health information system. *Medical Care* 33:12(Supplement):DS13-20.

Roos NP, Mustard CA (1997). Variation in health and health care use by socioeconomic status in Winnipeg, Canada: Does the system work well? Yes and No. *The Milbank Quarterly* 75(1):89-111.

Roos NP and Roos LL. (1982). Surgical rate variations: Do they reflect the health or socioeconomic characteristics of the population? *Medical Care* 20:945-958.

Roos NP, Shapiro E. (1994). Monitoring the Winnipeg Hospital System: The first report 1990-1992. Winnipeg: Manitoba Centre for Health Policy and Evaluation, University of Manitoba.

Rose D (1995). *A Report on Phase 1 of the ESRC Review of the OPCS Social Classifications.* London: OPCS.

Rose G, Marmot MG (1981). Social class and coronary heart disease. *British Heart Journal* 45(1):13-19.

Rosengren A, Kristina O-G, Wedel H, Wilhelmsen L (1993). Stressful life events, social support, and mortality in men born in 1933. *British Medical Journal* 307(6912):1102-1114.

Rosner B (1990). *Fundamentals of Biostatistics*. Boston: PWS-Kent Publishing Company.

Sapolsky RM (1993). Endocrinology alfresco: Psychoendocrine studies of wild baboons. *Recent Progress in Hormone Research* 48:437-468.

Satish S, Winograd CH, Chavez C, Bloch DA (1996). Geriatric targeting criteria as predictors of survival and health care. *Journal of the American Geriatrics Society* 44(8):914-921.

Saunders CE (1987). Patient compliance in filling prescriptions after discharge from the emergency department. *American Journal of Emergency Medicine* 5(4):283-286.

Schecter MT, Hogg RS, Aylward B, Craib KJP, Le TN, Montaner JSG (1994). Higher socioeconomic status is associated with slower progression of HIV infection independent of access to health care. *Journal of Clinical Epidemiology* 47(1):59-67.

Scott A, Shiell A, King M (1996). Is general practitioner decision making associated with patient socio-economic status? *Social Science & Medicine* 42(1):35-46.

Shapiro S (1989). The role of automated record linkage in the postmarketing surveillance of drug safety: A critique. *Clin Pharmacol Ther* 46(3):371-376.

Sharp K, Ross CE, Cockerham WC (1983). Symptoms, beliefs and the use of physician services among the disadvantaged. *Journal of Health and Social Behaviour* 24:255-263.

Shkolnikov VM, Leon DA, Adamets S, Andreev E, Deev A (1998). Educational level and adult mortality in Russia: An analysis of routine data 1979 to 1994. *Social Science & Medicine* 47(3):357-369.

Siegal D, Lopez J (1997). Trends in the antihypertensive drug use in the United States. *JAMA* 278(21):1745-1748.

Sihvonen A-P, Kunst AE, Lahelma E, Valkonen T, Mackenbach JP (1998). Socioeconomic inequalities in health expectancy in Finland and Norway in the late 1980's. *Social Science & Medicine* 47(3):303-315.

Sketris IS, Kephart GC, Hicks VA, Hubbard EJ, Brown MG, Chandler RF, MacLean DR (1995). Prescribing patterns of antilipemic drugs and prevalence of hypercholesterolemia in the Nova Scotia population more than 65 years old. *The Annals of Pharmacotherapy* 29:576-581.

Smith DG (1993). The effects of copayments and generic substitution on the use and costs of prescription drugs. *Inquiry* 30(2):189-198.

Smith JP, Kington R (1997). Demographic and economic correlates of health in old age. *Demography* 34(1):159-170.

Soumerai SB, Avorn J, Ross-Degnan D et al., (1987). Payment restrictions for drugs under Medicaid: Effects on therapy, cost and equity. *New England Journal of Medicine* 317:550-552.

Soumerai SB, McLaughlin TJ, Spiegelman D, Hertzmark E, Thibault G, Goldman L (1997). Adverse outcomes of underuse of ß-blockers in elderly survivors of acute myocardial infarction. *JAMA* 277(2):115-121.

Soumerai SB, Ross-Degnan D, Avorn J, McLaughlin TJ, Choodnovskiy I (1991). Effects of Medicaid drug-payment limits on admission to hospitals and nursing homes. *The New England Journal of Medicine* 325(15):1072-1077.

Stansfeld S, Feeney A, Head J, Canner R, North F, Marmot M (1995). Sickness absence for psychiatric illness: The Whitehall II Study. *Social Science & Medicine* 40(2):189-197.

Stansfeld SA, Marmot MG (1992). Social class and minor psychiatric disorder in British Civil Servants: a validated screening survey using the General Health Questionnaire. *Psychological Medicine* 22(3):739-749.

Statistics Canada (1991). *Postal Code Conversion File. Codebook.* Ottawa: Supply and Services Canada.

Sterky G, Tomson G, Diwan VK, Sachs L (1991). Drug use and the role of patients and prescribers. *Journal of Clinical Epidemiology* 44(Supll. II):67S-72S.

Stewart RB, Moore MR, May FE, Marks RG, Hale WE (1991). A longitudinal evaluation of drug use in an ambulatory elderly population. *Journal of Clinical Epidemiology* 44(12):1353-1359.

Stoller EP,Forster LE, Portugal S (1993). Self-care responses to symptoms by older people. A health diary study of illness behaviour. *Medical Care* 31(1):24-42.

Strong PM (1990). Black on class and mortality: theory, method and history. *Journal of Public Health Medicine* 12(3/4):168-180.

Stuart B, Ahern F, Rabatin V, Johnson A (1991). Patterns of outpatient prescription drug use among Pennsylvania elderly. *Health Care Financing Review* 12(3):61-73.

Stuart B, Coulson NE (1993). Dynamic aspects of prescription drug use in an elderly population. *Health Services Research* 28(2):237-264.

Stuart B, Grana J (1998). Ability to pay and the decision to medicate. *Medical Care* 36(2):202-211.

Stuck AE, Beers MH, Steiner A, Aranow HU, Rubenstein LZ, Beck JC (1994). Inappropriate medication use in community-residing older persons. *Archives of Internal Medicine* 154(10):2195-2200.

Sundquist J, Ekedahl A, Johansson SE (1996). Sales of tranquillizers, hypnotics/sedatives and antidepressants and their relationship with underprivileged area score and mortality and suicide rates. *European Journal of Clinical Pharmacology* 51(2):105-109.

Suomi SJ (1994). Social and biological pathways that contribute to variations n health status: Evidence from primate studies, in *Prosperity, health and well-being* (Proceeding of the 11th Honda Foundation Discoveries Symposium). Toronto: Canadian Institute for Advanced Research, pp 105-112.

Suomi SJ (1996). Biological, Maternal, and life style interactions with the psychosocial environment: Primate studies. In Hertzman C, Kelly S, Bobak M (eds.) *East-West Life Expectancy Gap in Europe. Environmental and Non-environmental Determinants*. London: Kluwer Academic Publishers.

Szreter S (1988). The importance of social intervention in Britain's mortality decline c. 1850-1914: a re-interpretation of the role of public health. *Society for the Social History of Medicine* 1(1):1-37.

Tamblyn R, Berkson L, Dauphinee WD, Gayton D, Grad R, Huang A, Isaac L, McLeod P, Snell L (1997). Unnecessary prescribing of NSAIDs and the management of NSAID-related gastropathy in medical practice. *Annals of Internal Medicine* 127(6):429-438.

Tamblyn RM, McLeod PJ, Abrahamowicz M, Monette J, Gayton DC, Berkson L, Daupinee D, Grad RM, Huang AR, Isaac LM, Schnarch BS, Snell LS (1994). Questionable prescribing for elderly patients in Quebec. *Canadian Medical Association Journal* 150(1):1801-1809.

Theorell T, Tstutsumi A, Hallquist J, Reuterwallet C et al. (1998). Decision latitude, job strain and myocardial infarction: A study of working men in Stockholm. *American Journal of Public Health* 88(3):382-388.

Thomson M. 1990. Association between mortality and poverty. *British Columbia Medical Journal* 32:337-338.

Timms D (1998). Gender, social mobility and psychiatric diagnoses. *Social Science & Medicine* 46(9):1235-1247.

Tuinstra J, Groothoff JW, van den Heuvel WJA, Post D (1998). Socio-economic differences in health risk behaviour in adolescence: Do they exist? *Social Science & Medicine* 47(1):67-74.

Vägerö D (1994). Equity and efficiency in health reform. A European view. *Social Science & Medicine* 39(9):1203-1210.

Vågerö D, Lundberg O (1989). Health inequalities in Britiain and Sweden. *The Lancet* July 1, 1989:35-36.

Vågerö D, Östberg V (1989). Mortality among children and young persons in Sweden in relation to childhood socio-economic group. *Journal of Epidemiology and Community Health* 43:280-284.

Vågerö D, Persson G (1987). Cancer survival and social class in Sweden. *Journal of Epidemiology and Community Health* 41:203-209.

Valkonen T, Sihvonen A-P, Lahelma E (1997). Health expectancy by level of education in Finland. *Social Science & Medicine* 44(6):801-808.

Van den Heuvel WJA, Wieringh R, van den Heuvel LPM(1997). Utilisation of medical technology assessment in health policy. *Health Policy* 42:211-222.

Van der Meer JBW, van den Bos J, Mackenbach JP (1996). Socioeconomic differences in the utilization of health services in a Dutch population: the contribution of health status. *Health Policy* 37:1-18.

Vita AJ, Terry RB, Hubert HB, Fries JF (1998). Aging, health risks, and cumulative disability. *New England Journal of Medicine* 338(15):1035-1041.

Volinn E, Lai D, McKinney S, Loeser JD (1988). When back pain becomes disabling: a regional analysis. *Pain* 33:33-39.

Wadsworth MEJ (1997) Health inequalities in the life course perspective. *Social Science & Medicine* 44(6):859-869.

Waitzkin H (1984). Doctor-patient communication: clinical implications of social scientific research. *JAMA* 17:2441-2443.

Waitzkin H (1985). Information giving in medical care. *Journal of Health and Social Behaviour* 26(June):81-101.

Watson P (1996). Marriage and mortality in Eastern Europe. In Hertzman C, Kelly S, Bobak M (eds.) *East-West Life Expectancy Gap in Europe. Environmental and Non-environmental Determinants.* London: Kluwer Academic Publishers.

Weinreb L, Goldberg R, Perloff J (1998). Health characteristics and medical service use patterns of sheltered homeless and low-income mothers. *Journal of General Internal Medicine* 13:389-397.

Wells KB, Kamberg C, Brook R, Camp P, Rogers W (1985). Health status, sociodemographic factors, and the use of prescribed psychotropic drugs. *Medical Care* 23(11):1295-1306.

Wennberg JE. 1985. On patient need, equity, supplier-induced demand, and the need to assess the outcome of common medical practices. *Medical Care* 23:512-550.

Wennberg JE, Freeman JL, Culp WJ (1987). Are hospital services rationed in New Haven or over-utilized in Boston? *The Lancet* 23:1185-1188.

Wennberg JE, Freeman JL, Shelton RM, Bubolz TA (1989). Hospital use and mortality among Medicare beneficiaries in Boston and New Haven. *New England Journal of Medicine* 321:1169.

Wennberg JE, Gittelsohn A. (1982). Small area variations in health care delivery: A population-based health information system can guide planning and regulatory decision-making. *Science* 182: 1102-1108.

Wessling A (1987). Continuous recording of drug prescribing in Sweden 1974-1983. Methods and examples of utilization of data. *European Journal of Clinical Pharmacology 33:7-13.*

West P (1997). Health inequalities in the early years: is there equalisation in youth? *Social Science & Medicine 44(6):833-858.*

West SL, Strom BL, Freundlich B, et al. (1994). Completeness of prescription recording in outpatient medical records from a health maintenance organization. *Journal of Clinical Epidemiology* 47(2):165-171.

Wickrama KAS, Lorenz FO, Conger RD, Matthews L, Elder GH Jr. (1997). Linking occupational conditions to physical health through marital, social and intrapersonal processes. *Journal of Health and Social Behaviour* 38(December):363-375.

Wilcox SM, Himmelstein DU, Woolhandler S (1994). Inappropriate drug prescribing for the community-dwelling elderly. *JAMA* 272(4):292-317.

Wilkins R, Adams 0 (1978). *Healthfulness of Life* Montreal: Institute for Research on Public Policy.

Wilkins R, Adams O, Brancker A (1989). Changes in mortality by income in urban Canada from 1971 to 1986. *Health Reports* 1(2):137-175.

Wilkinson RG (1992). Income distribution and life expectancy. *British Medical Journal* 304:165-168.

Wilkinson RG (1996). Health and civic society in Eastern Europe before 1989. In Hertzman C, Kelly S, Bobak M (eds.) *East-West Life Expectancy Gap in Europe. Environmental and Non-environmental Determinants.* London: Kluwer Academic Publishers.

Wilkinson RG (1997a). Comment: Income, inequality and social cohesion. *American Journal of Public Health* 87(9):1504-1506.

Wilkinson RG (1997b). Health inequities: Relative or absolute material standards? *British Medical Journal* 314(7080):591-595.

Williams JM, Currie CE, Elton RA, Beattie TF (1996). Socioeconomic status and adolescent injuries. *Social Science & Medicine* 44(12):1881-1891.

Williamson JB, Boehmer U (1997). Female life expectancy, gender stratification, health status and level of economic development: A cross-national study of less developed countries. *Social Science & Medicine* 45(2):305-317.

Winkleby, MA, Jatulis DE, Frank E, Fortmann SP (1992). Socioeconomic status and health: How education, income and occupation contribute to risk factors for cardiovascular disease. *American Journal of Public Health* 82(6):816-820.

Wohlfarth T (1997). Socioeconomic inequality and psychopathology: Are socioeconomic status and social class interchangeable! *Social Science & Medicine* 45(3):399-410.

Wohlfarth T, Van den Brink W (1998). Social class and substance use disorders: The value of social class as distinct from socioeconomic status. *Social Science & Medicine* 47(1):51-58.

Wolfson M, Rowe G, Gentleman JF, Tomiak M (1993). Career earnings and death, a longitudinal analysis of older Canadian men. *Journal of Gerontology: Social Sciences* 48(4):S167-S179.

Wolinsky FD, Wan GJ, Gurney JG, Benltey DW (1998). The risk of hospitalization for ischemic stroke among older adults. *Medical Care* 36(4):449-461.

Woo J, Ho SC, Yuen YK, Lau J (1995). Drug use in an elderly Chinese population: Prevalence and associated factors. *Gerontology* 41:98-108.

Wood E, Sallar AM Schecter MT, Hogg RS (1999). Universal health care? Poor men more likely to die from "avoidable" causes in British Columbia. The Evidence Speaks Monograph Series, Monograph Number 1. Vancouver: Centre for Health Evaluation & Outcome Sciences.

Yamashita S (1996). Current controversies in calcium channel blocker therapy. *Canadian Journal of Clinical Pharmacology* 3(2):99-108.

Appendix I

ICD-9 Codes Identifying Cardiovascular and Gastrointestinal Hospital Admissions

ICD-9 Code	Diagnosis
Cardiovascular Diagnoses	
392	Rheumatic chorea with heart involvement
394-396	Diseases of mitral and aortic valves
397	Diseases of other endocardial structures
398	Other rheumatic heart disease
401-404	Hypertensive diseases
410	Acute myocardial infarction
411	Other acute and subacute forms of ischemic heart disease
412	Old myocardial infarction
413	Angina pectoris
414	Other forms of chronic ischemic heart disease
415-417	Pulmonary heart disease
420	Acute pericarditis
421	Acute and subacute endocarditis
422	Acute myocarditis
423	Other diseases of pericardium
424	Other diseases of endocardium
425	Cardiomyopathy
426	Conduction disorders
427	Cardiac dysrhythmias
428	Heart failure
429	Ill-defined descriptions and complications of heart disease
430	Subarachnoid hemorrhage
431	Intracerebral hemorrhage
432	Other and unspecified intracranial hemorrhage
433	Occlusion and stenosis of precerebral arteries
434	Occlusion of cerebral arteries
435	Transient cerebral ischemia
437	Other and ill-defined cerebrovascular disease
438	Late effects of cerebrovascular disease
440	Atherosclerosis
441	Aortic aneurysm
442	Other aneurysm
443	Other peripheral vascular disease
444	Arterial embolism and thrombosis
446-449	Other disorders of arteries, arterioles and capillaries
Gastrointestinal Diagnoses	
530	Diseases of esophagus
531	Gastric ulcer
532	Duodenal ulcer
534	Gastrojejunal ulcer
535	Gastritis and duodenitis
537	Other disorders of stomach and duodenum
574-579	Other diseases of the digestive system

Appendix II

Distribution of Utilization by Drug Type and Income Quintile: Gastrointestinal Drugs

Distribution of Prescriptions by Income Quintile and Drug Type: Gastrointestinal Drugs

	Per Cent of Number of Prescriptions per Income Quintile				
	Quintile 1 Highest Income	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Lowest Income
1989					
Antidiarrheal preparations	7.3	7.2	6.8	6.9	6.5
Antiemetics	15.8	17.2	17.0	17.4	18.3
Antiulcer Drugs	75.3	74.2	74.9	74.3	73.6
Other	1.6	1.4	1.3	1.4	1.6
Total	100.0	100.0	100.0	100.0	100.0
1991					
Antidiarrheal preparations	6.0	5.7	5.9	5.8	5.7
Antiemetics	12.8	13.3	14.2	13.6	14.6
Antiulcer Drugs	79.9	79.9	78.8	79.4	78.4
Other	1.3	1.1	1.1	1.2	1.3
Total	100.0	100.0	100.0	100.0	100.0
1993					
Antidiarrheal preparations	5.3	4.8	4.9	4.9	5.1
Antiemetics	10.0	10.2	10.3	10.0	10.8
Antiulcer Drugs	83.6	84.0	83.8	84.0	83.0
Other	1.1	1.0	1.0	1.1	1.1
Total	100.0	100.0	100.0	100.0	100.0
1995					
Antidiarrheal preparations	4.8	4.4	4.5	4.4	4.7
Antiemetics	9.1	9.0	9.2	9.7	10.2
Antiulcer Drugs	85.1	85.6	85.2	84.8	84.1
Other	1.0	1.0	1.1	1.1	1.0
Total	100.0	100.0	100.0	100.0	100.0

Distribution of Drug Cost by Income Quintile and Drug Type:

Gastrointestinal Drugs

	Per Cent of Ingredient Costs per Income Quintile				
	Quintile 1 Highest Income	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Lowest Income
1989					
Antidiarrheal preparations	4.2	4.6	4.3	4.4	4.1
Antiemetics	6.8	7.1	6.9	7.3	7.9
Antiulcer Drugs	87.3	86.7	87.2	86.6	86.4
Other	1.7	1.6	1.6	1.7	1.6
Total	100.0	100.0	100.0	100.0	100.0
1991					
Antidiarrheal preparations	3.4	3.3	3.3	3.4	3.4
Antiemetics	5.2	5.5	5.5	5.4	6.0
Antiulcer Drugs	90.0	89.8	89.9	89.9	89.2
Other	1.4	1.4	1.3	1.3	1.4
Total	100.0	100.0	100.0	100.0	100.0
1993					
Antidiarrheal preparations	2.9	2.7	2.8	2.7	3.0
Antiemetics	5.2	5.2	5.0	4.8	5.2
Antiulcer Drugs	90.4	90.6	90.9	91.1	90.4
Other	1.5	1.5	1.3	1.4	1.4
Total	100.0	100.0	100.0	100.0	100.0
1995					
Antidiarrheal preparations	2.8	2.7	2.7	2.5	2.7
Antiemetics	4.0	4.3	4.4	5.3	5.2
Antiulcer Drugs	91.3	91.0	91.1	90.4	90.4
Other	1.9	2.0	1.8	1.8	1.7
Total	100.0	100.0	100.0	100.0	100.0

Distribution of drug Quantity by Income Quintile and Drug Type

Gastrointestinal Drugs

		Per Cent of Drug Units per Income Quintile				
		Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
		Highest Income				Lowest Income
1989						
	Antidiarrheal preparations	5.0	5.6	4.6	5.0	4.3
	Antiemetics	16.5	17.2	16.9	17.3	18.7
	Antiulcer Drugs	72.0	70.9	72.6	70.4	69.8
	Other	6.5	6.3	5.9	7.3	7.2
	Total	100.0	100.0	100.0	100.0	100.0
1991						
	Antidiarrheal preparations	4.3	4.3	4.0	4.1	4.3
	Antiemetics	13.3	13.9	14.8	14.2	15.4
	Antiulcer Drugs	77.6	78.1	76.9	77.2	73.8
	Other	4.8	3.7	4.3	4.5	6.5
	Total	100.0	100.0	100.0	100.0	100.0
1993						
	Antidiarrheal preparations	3.9	3.5	3.5	3.6	3.9
	Antiemetics	10.2	10.5	11.2	10.8	12.0
	Antiulcer Drugs	81.5	82.2	81.4	82.3	80.6
	Other	4.4	3.8	3.9	3.3	3.5
	Total	100.0	100.0	100.0	100.0	100.0
1995						
	Antidiarrheal preparations	3.7	3.5	3.5	3.2	3.7
	Antiemetics	9.2	9.1	9.5	10.1	10.6
	Antiulcer Drugs	83.6	84.1	83.0	83.2	82.2
	Other	3.5	3.3	4.0	3.5	3.5
	Total	100.0	100.0	100.0	100.0	100.0

Appendix III

Distribution of Utilization by Drug Type and Income Quintile: Central Nervous System Drugs

Distribution of Prescriptions by Income Quintile and Drug Type: Central Nervous System Drugs

		Per Cent of Number of Prescriptions per Income Quintile				
		Quintile 1 Highest Income	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Lowest Income
1989						
	Analgesics	50.3	51.6	51.1	50.1	48.8
	Antidepressants/Antipsychotics	9.2	9.4	10.0	10.2	10.5
	Sedatives	37.3	36.0	35.9	36.6	37.8
	Other	3.2	3.0	3.0	3.1	3.0
	Total	100.0	100.0	100.0	100.0	100.0
1991						
	Analgesics	51.4	52.7	51.8	51.2	49.0
	Antidepressants/Antipsychotics	9.9	10.2	10.7	10.7	11.0
	Sedatives	35.3	33.7	34.3	34.7	36.8
	Other	3.4	3.4	3.2	3.4	3.2
	Total	100.0	100.0	100.0	100.0	100.0
1993						
	Analgesics	50.3	51.9	51.3	50.8	49.0
	Antidepressants/Antipsychotics	11.9	11.7	12.2	11.9	12.5
	Sedatives	33.9	32.5	32.6	33.7	34.8
	Other	3.9	3.9	3.9	3.6	3.7
	Total	100.0	100.0	100.0	100.0	100.0
1995						
	Analgesics	46.8	49.1	47.6	46.6	45.0
	Antidepressants/Antipsychotics	14.8	14.4	14.9	14.9	15.7
	Sedatives	33.9	32.4	33.1	34.2	35.0
	Other	4.5	4.2	4.4	4.3	4.3
	Total	100.0	100.0	100.0	100.0	100.0

Distribution of Drug Cost by Income Quintile and Drug Type:

Central Nervous System Drugs

		Per Cent of Ingredient Cost per Income Quintile				
		Quintile 1 Highest Income	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Lowest Income
1989						
	Analgesics	72.5	73.1	72.6	72.0	70.0
	Antidepressants/Antipsychotics	10.4	10.6	11.0	11.0	12.1
	Sedatives	14.0	13.4	13.4	14.0	14.9
	Other	3.1	2.9	3.0	3.0	3.0
	Total	100.0	100.0	100.0	100.0	100.0
1991						
	Analgesics	71.0	71.9	70.6	70.4	68.9
	Antidepressants/Antipsychotics	12.4	12.2	12.9	13.0	13.7
	Sedatives	13.2	12.5	13.2	13.4	14.1
	Other	3.4	3.4	3.3	3.2	3.3
	Total	100.0	100.0	100.0	100.0	100.0
1993						
	Analgesics	63.4	64.6	63.4	63.1	61.2
	Antidepressants/Antipsychotics	17.7	17.3	17.9	17.7	18.6
	Sedatives	14.8	14.0	14.6	15.4	16.3
	Other	4.1	4.1	4.1	3.8	3.9
	Total	100.0	100.0	100.0	100.0	100.0
1995						
	Analgesics	51.0	52.9	52.1	51.9	50.3
	Antidepressants/Antipsychotics	29.3	27.7	28.2	27.3	28.2
	Sedatives	15.1	15.0	15.3	16.5	17.2
	Other	4.6	4.4	4.4	4.3	4.3
	Total	100.0	100.0	100.0	100.0	100.0

Distribution of Drug Quantity by Income Quintile and Drug Type

Central Nervous System Drugs

		Per Cent of Drug Units per Income Quintile				
		Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
		Highest Income				Lowest Income
1989						
	Analgesics	54.7	56.3	56.7	56.3	54.6
	Antidepressants/Antipsychotics	9.7	10.0	10.4	10.4	11.2
	Sedatives	30.1	28.6	28.0	28.6	29.6
	Other	5.5	5.1	4.9	4.7	4.6
	Total	100.0	100.0	100.0	100.0	100.0
1991						
	Analgesics	55.2	56.4	56.2	56.6	54.7
	Antidepressants/Antipsychotics	10.4	10.5	11.0	10.9	11.5
	Sedatives	28.7	27.2	27.4	27.3	28.8
	Other	5.7	5.9	5.4	5.2	5.0
	Total	100.0	100.0	100.0	100.0	100.0
1993						
	Analgesics	55.2	56.5	56.5	56.9	55.1
	Antidepressants/Antipsychotics	12.1	11.8	12.2	11.8	12.6
	Sedatives	26.3	25.1	25.2	25.6	26.7
	Other	6.4	6.6	6.1	5.7	5.6
	Total	100.0	100.0	100.0	100.0	100.0
1995						
	Analgesics	50.5	53.0	51.9	51.4	50.3
	Antidepressants/Antipsychotics	14.9	14.1	14.8	14.4	15.3
	Sedatives	27.2	26.0	26.5	27.4	27.9
	Other	7.4	6.9	6.8	6.8	6.5
	Total	100.0	100.0	100.0	100.0	100.0

Appendix IV

Distribution of Utilization by Drug Type and Income Quintile: Cardiovascular Drugs

Distribution of Prescriptions by Income Quintile and Drug Type:

Cardiovascular Drugs

	Per Cent of Number of Prescriptions per Income Quintile				
	Quintile 1 Highest Income	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Lowest Income
1989					
Antihypertensive - Antianginal	77.1	76.5	76.0	76.0	75.1
Antihyperlipidemic	5.0	4.6	5.0	4.9	4.1
Vasodilators and Antianginal	17.8	18.9	18.9	19.1	20.7
Total	100.0	100.0	100.0	100.0	100.0
1991					
Antihypertensive - Antianginal	78.2	77.3	76.8	76.8	75.8
Antihyperlipidemic	7.3	6.9	6.9	7.0	6.2
Vasodilators and Antianginal	14.4	15.8	16.2	16.2	18.0
Total	100.0	100.0	100.0	100.0	100.0
1993					
Antihypertensive - Antianginal	78.1	77.6	77.1	76.7	76.4
Antihyperlipidemic	8.3	7.6	7.4	7.2	6.1
Vasodilators and Antianginal	13.6	14.8	15.5	16.1	17.5
Total	100.0	100.0	100.0	100.0	100.0
1995					
Antihypertensive - Antianginal	77.9	77.7	77.3	77.3	77.1
Antihyperlipidemic	9.6	8.9	8.7	8.1	7.2
Vasodilators and Antianginal	12.5	13.4	14.0	14.6	15.7
Total	100.0	100.0	100.0	100.0	100.0

Distribution of Drug Cost by Income Quintile and Drug Type:
Cardiovascular Drugs

		Per Cent of Ingredient Cost per Income Quintile				
		Quintile 1 Highest Income	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Lowest Income
1989						
	Antihypertensive - Antianginal	79.7	79.9	79.2	79.2	79.3
	Antihyperlipidemic	9.4	8.7	9.2	8.9	7.4
	Vasodilators and Antianginal	10.9	11.5	11.6	11.8	13.3
	Total	100.0	100.0	100.0	100.0	100.0
1991						
	Antihypertensive - Antianginal	77.6	76.9	76.5	76.3	76.0
	Antihyperlipidemic	13.8	13.5	13.6	13.5	11.9
	Vasodilators and Antianginal	8.6	9.6	9.9	10.2	12.1
	Total	100.0	100.0	100.0	100.0	100.0
1993						
	Antihypertensive - Antianginal	75.1	75.0	74.4	74.3	74.6
	Antihyperlipidemic	16.0	15.0	15.0	14.4	12.6
	Vasodilators and Antianginal	8.9	10.0	10.6	11.3	12.8
	Total	100.0	100.0	100.0	100.0	100.0
1995						
	Antihypertensive - Antianginal	73.0	73.1	73.1	73.0	73.5
	Antihyperlipidemic	18.7	17.7	17.3	16.4	14.9
	Vasodilators and Antianginal	8.3	9.2	9.6	10.6	11.6
	Total	100.0	100.0	100.0	100.0	100.0

Distribution of Drug Quantity Income Quintile and Drug Type

Cardiovascular Drugs

		Per Cent of Drug Units per Income Quintile				
		Quintile 1 Highest Income	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Lowest Income
1989						
	Antihypertensive/Antianginal	70.2	70.4	68.5	68.5	68.7
	Antihyperlipidemic	9.3	8.2	10.3	10.6	7.95
	Vasodilators and antianginal	20.5	21.4	21.2	20.9	23.3
	Total	100.0	100.0	100.0	100.0	100.0
1991						
	Antihypertensive/Antianginal	70.5	70.5	69.3	67.8	68.0
	Antihyperlipidemic	12.7	11.7	12.3	14.2	11.5
	Vasodilators and antianginal	16.8	17.8	18.4	18.0	20.5
	Total	100.0	100.0	100.0	100.0	100.0
1993						
	Antihypertensive/Antianginal	71.8	71.4	70.5	69.6	69.7
	Antihyperlipidemic	11.8	11.0	11.0	11.5	9.5
	Vasodilators and antianginal	16.4	17.6	18.5	18.9	20.8
	Total	100.0	100.0	100.0	100.0	100.0
1995						
	Antihypertensive/Antianginal	74.1	73.5	72.9	72.7	72.0
	Antihyperlipidemic	9.3	8.7	8.65	7.9	7.0
	Vasodilators and antianginal	16.6	17.8	18.5	19.5	21.0
	Total	100.0	100.0	100.0	100.0	100.0

Appendix V

Group Means by Drug Category and Age Group: Gastrointestinal Drugs

Group Means for Number of Prescriptions by Drug Category and Age Group, Gastrointestinal Drugs

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
	Highest Income				Lowest Income
65-74 Years					
All GI Drugs	3.281	3.334	3.396	3.565	3.569
Ulcer Medications	2.748	2.816	2.860	2.991	3.012
Non-Ulcer Medications	0.518	0.533	0.536	0.553	0.578
75 to 84 Years					
All GI Drugs	3.503	3.568	3.577	3.687	3.729
Ulcer Medications	2.926	2.969	2.980	3.065	3.073
Non-Ulcer Medications	0.577	0.596	0.599	0.615	0.664
85 Years and Over					
All GI Drugs	3.477	3.518	3.570	3.616	3.637
Ulcer Medications	2.850	2.893	2.921	2.943	2.968
Non-Ulcer Medications	0.584	0.649	0.668	0.669	0.673

Group Means for Ingredient Cost ($) by Drug Category and Age Group, Gastrointestinal Drugs

	Quintile 1 Highest Income	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Lowest Income
65-74 Years					
All GI Drugs	217.14	218.39	223.06	233.87	234.81
Ulcer Medications	194.78	197.84	202.25	211.94	212.08
Non-Ulcer Medications	20.55	20.81	21.94	22.36	22.74
75 to 84 Years					
All GI Drugs	229.81	233.73	235.58	238.77	248.32
Ulcer Medications	210.16	210.22	213.99	218.60	223.99
Non-Ulcer Medications	19.65	20.17	21.59	23.51	24.34
85 Years and Over					
All GI Drugs	211.79	216.86	217.80	221.44	222.90
Ulcer Medications	193.44	198.76	199.12	200.75	203.24
Non-Ulcer Medications	17.05	17.74	18.35	19.67	22.68

Group Means for Drug Quantity by Drug Category and Age Group, Gastrointestinal Drugs

	Quintile 1 Highest Income	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Lowest Income
65-74 Years					
All GI Drugs	296.4	309.6	313.4	336.8	342.7
Ulcer Medications	245.4	259.8	259.9	279.6	280.8
Non-Ulcer Medications	49.7	51.0	53.5	57.2	61.9
75 to 84 Years					
All GI Drugs	338.9	343.9	350.3	352.0	368.0
Ulcer Medications	267.5	275.9	280.6	284.9	290.5
Non-Ulcer Medications	63.3	65.4	71.4	76.1	77.5
85 Years and Over					
All GI Drugs	314.0	321.1	339.5	342.2	380.5
Ulcer Medications	251.2	259.7	269.8	271.3	316.1
Non-Ulcer Medications	61.4	62.8	64.4	69.7	70.9

Appendix VI

Group Means by Drug Category and Age Group: Central Nervous System Drugs

Group Means for Number of Prescriptions by Drug Category and Age Group, Central Nervous System Drugs

	Quintile 1 Highest Income	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Lowest Income
65-74 Years					
All CNS Drugs	4.887	5.263	5.289	5.578	6.138
Psychoactive Drugs	2.206	2.313	2.332	2.496	2.903
Analgesics	2.681	2.931	2.976	3.085	3.235
75 to 84 Years					
All CNS Drugs	5.488	5.616	5.695	5.895	5.920
Psychoactive Drugs	2.573	2.631	2.672	2.808	2.876
Analgesics	2.858	3.023	3.042	3.045	3.086
85 Years and Over					
All CNS Drugs	5.366	5.383	5.476	5.530	5.539
Psychoactive Drugs	2.653	2.669	2.682	2.744	2.856
Analgesics	2.683	2.683	2.730	2.786	2.807

Group Means for Ingredient Cost ($) by Drug Category and Age Group, Central Nervous System (CNS) Drugs

	Quintile 1 Highest Income	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Lowest Income
65-74 Years					
All CNS Drugs	111.68	118.59	120.89	124.19	130.54
Psychoactive Drugs	37.25	38.77	40.69	42.38	47.24
Analgesics	74.43	79.82	80.20	81.81	83.30
75 to 84 Years					
All CNS Drugs	116.07	117.69	119.03	120.91	122.90
Psychoactive Drugs	37.59	40.04	40.21	42.43	43.91
Analgesics	76.03	77.00	78.82	80.10	80.47
85 Years and Over					
All CNS Drugs	94.64	95.96	99.19	101.80	107.27
Psychoactive Drugs	31.95	31.65	35.32	35.57	36.00
Analgesics	59.99	63.62	64.01	66.48	71.27

Group Means for Drug Quantity by Drug Category and Age Group,
Central Nervous system (CNS) Drugs

	Quintile 1 Highest Income	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Lowest Income
65-74 Years					
All CNS Drugs	399.5	430.3	435.3	461.1	505.4
Psychoactive Drugs	156.3	163.2	166.3	173.8	203.0
Analgesics	243.2	267.0	269.1	287.3	302.4
75 to 84 Years					
All CNS Drugs	456.1	458.0	466.7	482.9	487.8
Psychoactive Drugs	169.1	175.2	177.8	184.4	193.9
Analgesics	278.3	288.9	291.5	294.0	298.5
85 Years and Over					
All CNS Drugs	414.6	422.5	424.9	425.5	426.3
Psychoactive Drugs	158.8	163.0	164.1	164.2	169.2
Analgesics	253.5	255.8	261.3	261.9	262.2

Appendix VII

Group Means by Drug Category and Age Group: Cardiovascular Drugs

Group Means for Number of Prescriptions by Drug Category and Age Group, Cardiovascular Drugs

	Quintile 1 Highest Income	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Lowest Income
65-74 Years					
All CV Drugs	5.960	5.965	6.045	6.199	6.213
Antihypertensive Drugs	5.257	5.298	5.382	5.516	5.585
Antihyperlipidemics	0.627	0.660	0.662	0.681	0.706
75 to 84 Years					
All CV Drugs	6.567	6.605	6.671	6.686	6.728
Antihypertensive Drugs	6.266	6.331	6.381	6.391	6.460
Antihyperlipidemics	0.268	0.274	0.289	0.294	0.301
85 Years and Over					
All CV Drugs	6.405	6.470	6.493	6.575	6.653
Antihypertensive Drugs	6.353	6.399	6.441	6.540	6.605
Antihyperlipidemics	0.045	0.048	0.052	0.052	0.070

Group Means for Ingredient Cost ($) by Drug Category and Age Group,
Cardiovascular (CV) Drugs

	Quintile 1 Highest Income	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Lowest Income
65-74 Years					
All CV Drugs	473.94	479.90	481.64	484.27	484.83
Antihypertensive Drugs	375.72	378.64	385.45	387.03	394.31
Antihyperlipidemics	89.94	96.15	97.74	98.18	101.21
75 to 84 Years					
All CV Drugs	450.61	455.84	457.75	458.16	458.95
Antihypertensive Drugs	412.43	415.35	416.62	419.11	421.25
Antihyperlipidemics	36.89	38.17	39.82	40.47	41.11
85 Years and Over					
All CV Drugs	344.84	346.11	352.60	358.04	361.94
Antihypertensive Drugs	338.25	339.85	347.62	351.58	357.31
Antihyperlipidemics	4.64	4.88	6.26	6.43	6.61

Group Means for Drug Quantity by Drug Category and Age Group, Cardiovascular (CV)I Drugs

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
	Highest Income				Lowest Income
65-74 Years					
All CV Drugs	763.4	770.9	774.6	807.1	811.2
Antihypertensive Drugs	637.2	647.5	652.5	668.4	693.0
Antihyperlipidemics	118.2	122.2	123.4	126.2	138.6
75 to 84 Years					
All CV Drugs	815.1	829.8	830.3	834.1	857.2
Antihypertensive Drugs	761.8	772.7	781.3	781.8	800.9
Antihyperlipidemics	48.0	52.8	53.3	56.3	57.6
85 Years and Over					
All CV Drugs	727.7	737.4	740.0	756.5	768.2
Antihypertensive Drugs	721.0	724.2	733.3	748.1	759.6
Antihyperlipidemics	6.7	6.7	8.4	8.7	13.2