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Explaining the Social Gradient in Health in Canada: Cross-sectional and Longitudinal Analyses Examining the Role of Stressors Using the National Population Health Survey

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Explaining the social gradient in health in Canada:

Cross-sectional and longitudinal analyses examining the role of stressors using the National Population Health Survey

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Ph.D. Thesis in Psychology

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Abstract

The pervasive relationship between socioeconomic status and health has been observed in virtually all Western countries, Canada notwithstanding. The relationship between higher socioeconomic status (SES) and better health has been demonstrated to be a stepwise gradient with better health at each successive level of SES, indicating that factors beyond absolute material poverty are likely to be causing this gradient. In order to attenuate social gradients in health, underlying mechanisms must be elucidated. The purpose of this thesis was to examine whether psychosocial stressors associated with lower SES explain the poorer health of poorer people. A secondary purpose of this thesis was to examine a health behaviour–mediated pathway between stressors and health. Cross-sectional analyses of the 1994-95 National Population Health Survey (NPHS), and longitudinal analyses of the 1994-95 and 1996-97 NPHS were conducted. Logistic regression analyses demonstrated that lower income was associated with a greater odds of concomitant fair/poor self-rated health, and with a greater odds of experiencing a decline in self-rated health over a two-year period. Most stressors were more prevalent among lower income groups, and with one exception, all stressors were associated with a greater odds of fair/poor self-rated health and of experiencing a decline in health status. Stressors mediated a modest proportion of the social gradient in health. In cross-sectional analyses, about a quarter of the relationship between income and health was explained for men, and from 6% to 15% for women. In longitudinal analyses, these stressors explained 16% and 10% of the relationship between the lowest and second lowest income quintiles and decline in self-rated health respectively. Furthermore, all stressors were associated with smoking behaviour, while fewer associations were observed between stressors and physical activity behaviour. Health behaviours mediated a modest proportion of the relationship between stressors and fair/poor health. The

results of this thesis provide evidence for partial mediation of the social gradient in health by psychosocial factors, namely stressors. Furthermore, stress-related health behaviours may be a secondary pathway in this relationship. Future research is warranted to further refine explanatory models of the social gradient in health, in order to identify appropriate points for intervention.

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It's amazing when a long journey comes close to an end. It is somehow exhilarating and anticlimactic both at the same time, and it's easy to forget the experience of frequent feelings of overwhelming uncertainty.

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Introduction

Scope and Structure of Thesis

Considerable research and policy attention are currently focussed on the pervasive association observed between various measures of socioeconomic status (SES) and measures of health. This relationship, which is often referred to as the social gradient in health, appears to be graded, with good health being more likely with increasing increments in SES. In the first Whitehall study, Marmot, Shipley and Rose (1984) observed a stepwise gradient of mortality according to occupational grade in British in civil servants. Twenty years later, Marmot et al. (1991) observed a similar gradient in the Whitehall II study for angina, ischemia, and chronic bronchitis. This pattern of better health in higher socioeconomic groups has been found in numerous countries including Canada (Humphries & van Doorslaer, 2000; Veenstra, 2000), Sweden (Kareholt, 2001) and the Netherlands (Stronks, van de Mheen, Looman, & Mackenbach, 1998); for diverse health indicators such as self-rated ill-health (Humphries & van Doorslaer, 2000) and depression (Miech & Shanahan, 2000); and by using various indicators of SES, such as income (Lantz et al., 1998), education (Cavelaars et al., 1998; Ross & Wu, 1995), and subjective social status (Singh-Manoux, Adler, & Marmot, 2003). That this relationship crosses borders, diseases, and is not indicator-dependent suggests an insidious underlying non-specific cause of ill-health which appears to be embedded in social structures (Adler et al., 1994).

However, simply observing such a relationship does not necessarily imply that there is a problem with this relationship – this is a question of social values. If these social inequalities in health are avoidable, unnecessary and unfair, Whitehead and Dahlgren (1991) suggest that we should then act to reduce such inequities. In the Canadian context, the social gradient in health and related inequities in health have been judged to be important to attenuate (Epp, 1986). In

order to act towards reducing disparities in health, we must first determine what mechanisms drive them. The importance of moving social gradient research from descriptive to explanatory evidence can not be overstated: without understanding what causes these disparities, interventions may be misdirected, leading to the expenditure of scarce resources with no apparent effect, or even worse, leading to the intensification of social gradients in health. For example, if the hypothesis is that access to material resources underlies the social gradient, then an appropriate intervention may be to redistribute resources, for example by income redistribution through taxation and social programs. However, if this is not the cause of the SES-health relationship, such interventions may simply lead to inequities in health being stratified among other socioeconomic characteristics, such as education or neighbourhood prestige. Thus, the identification of 'causal pathways' is an important step in determining appropriate interventions. The purpose of this thesis is to examine whether psychosocial stressors mediate part of the social gradient in health in Canada.

This thesis tests the hypothesis that differential exposure to stressors across socioeconomic groups explains part of the relationship between SES and health in Canada. It uses Canadian data from the National Population Health Survey to test this first with cross-sectional analyses, and subsequently through longitudinal analyses. A secondary objective of the thesis is to more closely examine a specific pathway between SES, stressors, and health by examining whether health behaviours mediate any of the expected relationship between stressors and health. The longitudinal National Population Health Survey is used because of its large, representative sample of Canadians and to exploit this important investment in Canadian health data.

This thesis is presented as a series of three articles, prefaced by a general introduction, and with a brief discussion linking each of the three articles, followed by a general discussion of the thesis. The first article examines the contribution of reported stressors to the cross-sectional relationship between household income and poor self-rated health. Because cross-sectional analyses can not determine the temporal relationship between SES and health, the second article reports longitudinal analyses conducted in order to examine whether stressors at baseline explain the proposed relationship between baseline household income and subsequent decline in self-rated health two years later. The final article examines whether reported stressors are related to unhealthy behaviours, and whether this relationship explains part of the expected relationship between reported stressors and poor health.

CHAPTER 1. Theoretical Context

Defining Socioeconomic Status

One of the key concepts in the social gradient in health is the individual's status or position within society. Central to the concept of status is an ordered distribution of individuals, with some having more resources (tangible and intangible), prestige and power than others. The most common theoretical frameworks for evaluating status are Marxist or Weberian frameworks (Lynch & Kaplan, 2000). A Marxist framework bases social position on the exploitative relations of production, with some individuals owning the means of production and others who are exploited to produce. This results in categories of social classes based on economic and legal relationships, including for example employers, employees, self-employed and unemployed (Krieger, Williams & Moss, 1997). A Weberian analysis focuses on "life chances" based on the distribution of resources and skills in a society (Lynch & Kaplan, 2000). Individuals with higher status have greater access to these life chances. Such an approach to socioeconomic position usually results in socioeconomic position being measured via single indicators or as an aggregate of absolute resource-based and relative prestige-based measures, namely income, education, and occupational prestige (Liberatos, Link & Kelsey, 1988), representing class, status and power respectively. Occupation is the means by which education is transformed into income. In contrast to a Marxist analysis, a Weberian framework results in an ordinal or interval measure of socioeconomic position. In North America, most research on the social gradient in health has focussed on markers of socioeconomic position such as income, education and occupational prestige, all being somewhat related yet describing a slightly diverse set of constructs.

From a psychological perspective, socioeconomic status is important because it is related to a society's and individuals' perceptions of the 'value' of an individual, and because it shapes

the individuals' patterns of living. Identification with a certain socioeconomic group can shape an individual's self concept and may be associated with psychological attributes. For example, higher perceived social status has been associated with better psychological health: lower pessimism, higher perceived control, and lower negative affectivity (Adler, Epel, Castellazzo, & Ickovicks, 2000). Indeed, animal research indicates that being higher status in and of itself seems to be associated with better physiological functioning, which may be related to perceptions of control and status (Sapolsky, 2005). As will be discussed later, psychological theories of stress may explain some of this relationship. The second psychosocial component of SES relates to individual's daily habits and pattern of living, which Bourdieu has termed "habitus" (Bourdieu, 1986; Singh-Manoux & Marmot, 2005). Indeed, SES is associated with behaviours that have a large impact on health, such as physical activity, smoking, nutritional behaviour, and obesity. The implications of habitus for the social gradient in health will also because discussed subsequently in the section on behavioural explanations of the gradient.

In research on the social gradient in health, socioeconomic status should be considered a complex latent concept that reflects an individual's position in society relative to others' and that can be measured using numerous manifest variables. One widely available and easily quantifiable indicator of SES is income, representing most directly access to material resources, and being determined largely by occupational prestige that is achieved at least in part through educational attainment. In a market economy, it is reflection of a society's value of that individual's occupational role (Davis & Moore, 1945). Whereas it is a good indicator by itself, it does not encompass all aspects of SES, nor does it directly reflect more specific aspects of social and economic standing, such as access to social networks, disposable income or wealth. Nevertheless, wide differences in health are observed between income groups (e.g. Lantz et al.,

1998). Thus, in addition to its use as a marker of SES, it is important in its own right as one dimension which generates a social gradient in health.

Defining Health

Health is at the same time a nebulous concept and one of the most important in terms of the human functioning and quality of life. Health is a positive state, which the World Health Organization (WHO) defines as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (World Health Organization, 1946). However, much if not the majority of health research examines negative states of health, such as disease and dysfunction, as opposed to the positive state that the WHO has defined. Illness, disease, mortality, injury, and disability are relatively discrete entities, whereas physical, mental and social well-being are less clearly articulated.

Research attempting to tap into a more global definition of health has employed numerous methods, such as qualitative analysis and the use of more comprehensive measures such as the SF-36 (Short Form 36) and the Health Utility Index (HUI). The SF-36 comprises 36 questions which measure a range of attributes related to health, such as physical functioning, pain, mental health and social functioning (Ware, 2000). The HUI describes the individual's overall health on eight functional attributes: vision, hearing, mobility, dexterity, cognition, emotion, and pain and discomfort. A series of yes/no questions about each attribute combined with a weight (societal preferences for various health states) for a given level of functioning is combined to provide an overall index of health status (Torrance et al., 1996). These health indices combine information about a range of attributes into a single score, at the same time making the data more manageable for analysis but also losing information. One of the drawbacks

of these measures is their length: in large surveys with many domains of content, it is not always possible to include such comprehensive measures.

In the 1980s, Mossey and Shapiro (1982) reported that a single question asking participants to rate their own health was surprisingly predictive of mortality several years later. In addition to its utility as an easy to administer and conceptually valid global evaluation of perceived health status, subsequent research on self-rated health (SRH) has also demonstrated surprisingly robust predictive ability of accepted objective indicators of health. SRH predicts future mortality at specific follow-up periods (Idler & Benyamini, 1997), long-standing illness (Manor, Matthews, & Power, 2001), and health care utilization (Hansen, Fink, Frydenberg, & Oxhoj, 2002). It is highly stable, suggesting that it is not an assessment of transient, time-limited health states. In one study, 90% of participants reporting good health at baseline reported good health at ten-year follow-up (Manor et al., 2001).

Describing the Social Gradient in Health

The social gradient in health describes the pervasive and graded association between measures of SES and health. Early evidence was generated by the British Working Group on Health Inequalities, which examined a considerable amount of evidence concerning social gradients in health in Britain and was published in the Black Report (Townsend & Davidson, 1982). The Report provided descriptive evidence of social gradients in health, outlined four general mechanisms which may cause the observed social gradients, and generated a number of recommendations for policy. Surprisingly, although commissioned by the British government, the Black Report was poorly disseminated by the government. Subsequently, the Whitehall study of British civil servants provided unequivocal longitudinal evidence of the social gradient in

health in Britain. Marmot, Rose, Shipley and Hamilton (1978) demonstrated that the relative risk of death from coronary heart disease increased in a stepwise fashion with decreasing occupational grade over a period of more than ten years. They demonstrated a similar effect for all cause mortality (Marmot et al., 1984; relative risk of CHD mortality for highest to lowest grades, respectively: 1.0, 1.6, 2.2, 2.7). In the Whitehall II study twenty years later a similar gradient was observed for ischemia, chronic bronchitis, and angina morbidity (Marmot et al., 1991). This general pattern of mortality and morbidity over a range of diseases suggested a general, non-specific cause driving the gradient of mortality. Since these early years in social gradient research, scientists have continued to demonstrate pervasive gradients across diseases, across age groups, across countries and over time using a range of indicators of socioeconomic status (for example, see Adler et al., 1994; House, Kessler, & Herzog, 1990; House et al., 1994; Ross & Wu, 1995).

The most straightforward studies of the social gradient in health focus on mortality risk in different socioeconomic strata. For the most part, death is the least subjective indicator of any in the field of social gradient research, although even then measurement errors do occur. Class bias in cause of death registration, and "promoting the dead," where a higher status occupation is recorded on the individual's death certificate than was actually the case, are possible artefactual causes of the social gradient in mortality (Elstad, 2000). In follow up to Kitagawa and Hauser's (1973) seminal work documenting a mortality gradient in the United States by educational status using the Matched Record Study of 1960, Pappas, Queen, Hadden, and Fisher (1993) examined data from the 1986 National Mortality Followback Study and the 1986 National Health Interview Study. They found that the inverse association between socioeconomic status (as measured by education) and mortality not only persisted in 1986, but was stronger than in 1960.

When examining the contribution of major diseases to such socioeconomic differences in health, Wong, Shapiro, Boscardin, and Ettner (2002) found that 12.8 potential years of life were lost (PYLL for life expectancy of 75 years) for individuals without a high school education, while only 3.6 potential years of life were lost for those with a high school or greater education. Ischemic heart disease contributed most to the differences in PYLL disparity, followed by lung cancer, stroke, congestive heart failure, pneumonia, and lung disease. The fact that all of these disease are related to smoking resulted in Wong et al. proposing that the higher level of smoking among lower educated individuals may be a major contributor to socioeconomic differences in health. However, Marmot et al. (1984) demonstrated that their social gradient in coronary heart disease mortality remained, even after taking into account risk factors including smoking. The relative risks of 1.0, 1.6, 2.2, and 2.7 for the highest to lowest occupational grades respectively were only attenuated to 1.0, 1.5, 1.7 and 2.1 after controlling for risk factors. These studies highlight the need for rigorous research looking into the underlying causes of the social gradient in health.

In addition to evidence of a clear social gradient in mortality according to various socioeconomic indicators and for a range of causes of death, evidence also demonstrates a social gradient in morbidity. Singh-Manoux et al. (2003) showed a significant trend of higher age-adjusted prevalences for angina, diabetes, respiratory illness, perceived general health, and depression with decreasing subjective social status. While occupational grade, income and education explained some of the association between subjective status and these health conditions, subjective social status maintained an independent effect for all health conditions except for angina. Hallqvist, Lundberg, and Ahlbom (1998) studied hospital discharge records and death records for all cases of myocardial infarction (MI) in the Stockholm area for 1971 to

1994 and associated this with self-reported job titles from the Swedish census. The relative risk (RR) of MI for low-level and manual male workers as compared to others was significantly elevated, for all three-year observation periods between 1971 and 1994. Furthermore, the population attributable risk (PAR: i.e. the proportion of cases in the population that would disappear if the lower employment grades had the same MI risk as the higher level employees) increased over time. In 1999, 17% of MI cases for men, and 30% for women, were attributable to lower employment grade.

Western populations as a whole have been benefiting from increasing life expectancy. However, the question of whether those additional years of life are in good health is of importance. The phenomenon of the compression of morbidity, i.e. the restriction of poor health to the final years before death, appears to be differentially distributed by socioeconomic status as well. House et al., (1990) examined education and income gradient in the Americans' Changing Lives and the National Health Interview survey, and found that cross-sectional income and education differences in chronic health conditions, functional status, and activity limitations persisted until age 75, where morbidity differences generally converged. Subsequent longitudinal analyses of the Americans' Changing Lives survey indicated that this pattern also held for declines in health and functional status over a two and a half-year period (House et al., 1994).

When examining the literature specifically related to self-ratings of health, the expected pattern emerges. Kunst et al. (2005) report on trends in self-rated health in 10 European countries from the 1980s to the 1990s, and demonstrate that education gradients in health have been stable for men and increasing slightly for women. Health gradients between extreme income quintiles have increased for both men and women, with those in the lowest group having approximately 3 times the odds of reporting less than good self-rated health than those in the highest. In terms of

the shape of the relationship between income and self-rated health, Mackenbach et al. (2005) show that there is a definite income gradient in several European countries, but that this relationship may be curvilinear at both extremes, i.e. with decreasing negative effects and the lowest end of the income spectrum, and with decreasing benefits at the highest income levels. As a whole, this body of social gradient research indicates that mortality and morbidity are differentially distributed as a function of socioeconomic status, with individuals of lower educational attainment, occupational prestige, income and even subjective social status being at a disadvantage on almost all measures of negative health outcomes.

Consistent with international findings, there is substantial descriptive evidence of the social gradient in Canada, which appears to be less equitable than in some European countries, but more equitable than in the United States (Humphries & van Doorslaer, 2000). Studies demonstrating a social gradient in mortality in Canada have been published as far back as the early 1980s. Because individual income is not recorded on Canadian death certificates, but usual address at time of death is recorded, the mean or median household income of individuals in that census tract is sometimes used as a proxy for individual income when examining national mortality data. Wigle & Mao (1980) analysed mortality by median income in 21 metropolitan census areas (comprising of 2228 neighbourhoods, as defined by census tracts) in relation to mortality rates. In 1971, the difference in life expectancy between the lowest and highest of five income quintiles was 6.2 years for males, and 2.9 years for females. This difference is quite profound considering that the increase in life expectancy for males between 1931 and 1971 was only 2.6 years. Perhaps the most comprehensive study of Canadian mortality as a function of neighbourhood income, is the study authored by Wilkins, Berthelot, and Ng (2002). Using the same method to calculate life expectancy as Wigle and Mao (1980), Wilkins et al. (2002) found

that the difference in life expectancy between the highest and lowest income quintiles had dropped to 5.0 for men, and 1.6 for women. Over the same time period, the differences in potential years of life lost between these groups decreased by 35%. However, in 1996 24% of PYLL were still related to income differences. If income related PYLL differences were abolished, the net effect would be the same as eliminating one of the top three leading causes of death (neoplasms, injuries, and circulatory diseases).

While income information at the level of census tracts is currently the primary method of linking income to the Canadian Deaths Database, several other Canadian datasets have allowed for analysis of individual and area level socioeconomic status and health outcomes. Because usual occupation is recorded on death certificates in some provinces, including British Columbia, Wood, Sallar, Schechter, and Hogg (1999) coded individuals' occupation into social levels using several classification methods, and demonstrated that males in the lowest social class in British Columbia were twice as likely to die from causes amenable to medical intervention as those in the highest social class (with the exception of Hodgkin's disease). Both the cross-sectional components of the National Population Health Survey (NPHS; for years 1994/95, 1996/97, and 1998/99) and the Canadian Community Health Survey (CCHS; biyearly starting in 2000) provide large representative samples of the Canadian population.

Tremblay, Ross and Berthelot (2002) demonstrated that individual income and less than secondary education were strongly associated with the odds of reporting fair or poor health in the 2000/01 CCHS whereas community-level indicators of prosperity and socioeconomic disadvantage did not add explanatory power to the model. In addition to providing three years of cross-sectional data, the National Population Health Survey has a longitudinal component following approximately 17,000 of the original participants, allowing for more rigorous research

linking socioeconomic status and health status indicators. In a study investigating both individual income and metropolitan area income inequality, McLeod, Lavis, Mustard, & Stoddart (2003) found that individual income had a strong association with self-reported health after four years, whereas area level income inequality did not. As household income decreased, predicted probabilities of having a higher self-rated health status decreased, even after controlling for baseline health status. These studies suggest that the relationship between area level income and mortality in Wigle and Mao (1980) and Wilkins et al. (2002) are likely due at least in part to the compositional effects of individuals' income and health relationships, as opposed to solely the contextual effects of living in a lower income neighbourhood (Duncan, Jones, & Moon, 1998).

Also using the NPHS, Mustard, Vermeulen and Lavis (2003) examined the odds of experiencing a decline in health status over a four-year period. They found that men in lower employment grades were about twice as likely to experience a drop in self-rated health by one point or more, whereas there was no significant association for women. These differential findings by gender may reflect that occupational class does not adequately capture women's socioeconomic realities. Buckley, Denton, Robb, and Spencer (2004) used the Survey of Labour and Income Dynamics (SLID) in order to examine the transition probabilities between good and poor self-rated health. Both income and education were found to be associated with a higher probability of remaining in good health status over a three-year period, in men and women age 50 and over. Few other Canadian studies have examined the social gradient in health in a longitudinal fashion, although there is a growing body of international research using the approach. This is explored in further detail in the second article of this thesis: "Do stressors explain the association between income and changes in self-rated health? A longitudinal analysis of the National Population Health Survey."

In addition to the abundant evidence of social inequalities in health in Canada, social inequalities in health have been identified as an important issue to Canadians (Beiser & Stewart, 2005; Raphael et al., 2005). In 1986, Jake Epp (the Minister of Health and Welfare at the time) identified social disparities in health as one of major unaddressed health challenges in Canada (Epp, 1986). More recently, Health Canada has identified reducing disparities as an important goal in its 2003-2004 report on Plans and Priorities (Health Canada, 2003). Considerable targeted funding through the Canadian Institutes of Health Research, the Canadian Population Health Initiative, and Health Canada has been made available to researchers. Among others, targeting funding programs in 2003 have included "Health impact of economic change" and "Analyzing and reducing health disparities." It is fortunate that investments in national health data sources, including the National Population Health Survey, provide opportunities for researchers to investigate the mechanisms underlying the social gradient in health, the results of which may be used by policy makers towards reducing social inequalities in health. While the social gradient in health has been identified as an important health equity issue, further research is warranted into understanding the mechanisms which drive this pervasive relationship in the Canadian context, in order to determine how to address these health disparities. Such research using Canadian data is not as widespread as descriptions of the social gradient in health (Raphael et al., 2005).

Explanations of the Gradient

In addition to the considerable research reviewed in the previous section which describes and provides evidence of a social gradient in health, conceptual and empirical work has focussed on explaining the mechanisms underlying this association. This research is necessarily

interdisciplinary, as it integrates theory and methodology from diverse disciplines including social, behavioural, and health sciences. Explanations of the social gradient in health generally fall into one of two categories, as shown in Figure 1, based on the presumed direction of influence between socioeconomic status and health. The first category is selection explanations, which can be subdivided into two types of selection (Macintyre, 1997). In the social selection version, an underlying characteristic selects individuals both into lower socioeconomic status and poorer health status. The second type of selection is health selection, which proposes that poorer health status results in health-related social mobility, with sicker people experiencing a "downward drift" in socioeconomic status. In contrast to selection explanations, social causation hypotheses propose that the social and economic situation of individuals in lower socioeconomic strata causes or generates processes that lead to the ill-health of these individuals (Elstad, 2000). This thesis will explore a social causation hypothesis: that the social situation of individuals generates the health compromising mechanisms driving the social gradient in health, which will be explored in detail in a subsequent section. However before moving on to a detailed explanation of social causation hypotheses, natural and health selection hypotheses will be briefly discussed.

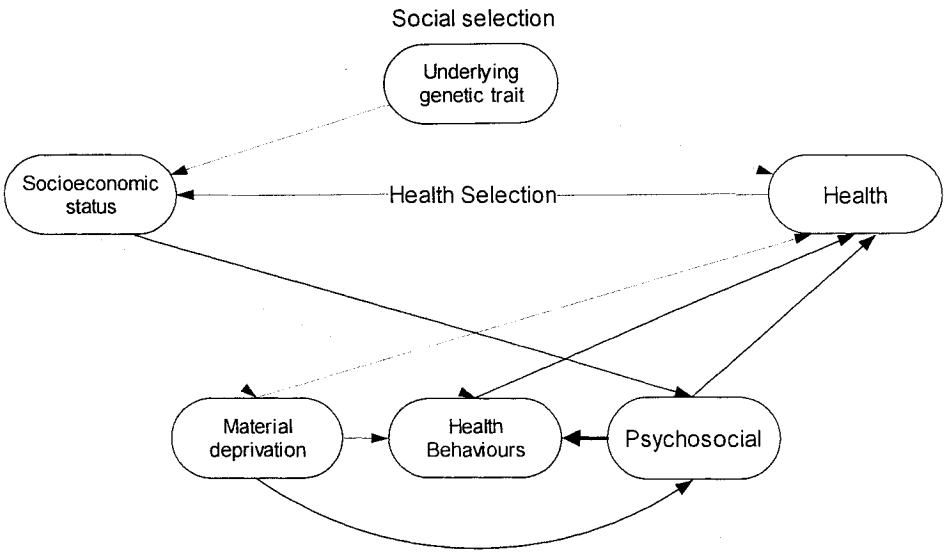

Figure 1. Conceptual model of competing and complimentary explanations of the social gradient in health.

Social and health selection

The social selection hypothesis suggests that some underlying characteristic in the individual results in that individual occupying a lower socioeconomic status and also generates poor health. If such a process is occurring, then there is nothing that can be done about social gradients in health because the cause of the relationship between socioeconomic status and health lies within individual – these gradients are unavoidable and thus not inequitable (Whitehead & Dahlgren, 1991). In fact, MacIntyre (1997) points out that there is scarce published literature presenting this view, although it has been employed as a political tool to discredit advocates promoting equity in health. Some research in the mental health field has examined social selection. For example, a study by Ritsher, Warner, Johnson and Dowrenwend (2001) examined the effects of children's and parental depression on children's occupational, educational and income attainment. However, this study found no support for social selection, whereas parental education was predictive of children's depression.

Recently, Mackenbach (2005) has reviewed hypotheses and controversies with respect to genetic contributions to health inequalities. He puts forward the hypothesis that social selection mechanisms in social gradients in health, if they are indeed contributing factors, are likely through personal attributes that have a high heritability, such as cognitive ability, personality, and bodily or mental fitness. Gottfredson (2004) suggests that Spearman's general intelligence "g", may be the underlying cause of both higher socioeconomic attainment and better health. However, the pathways suggested by Gottfredson are related to health literacy and the ability to follow through on health promoting and protective behaviours in an increasingly complex society. While these are certainly pathways that link SES with health, a large body of research that will be discussed subsequently indicates that health behaviours only explain part of the SES-

health association. Even though genetically determined traits like intelligence probably have some effect on social gradients in health, Mackenbach (2005) asserts that the majority of the SES-health relationship is likely due to environmental causes which can be attenuated through appropriate social policy. Nevertheless, research regarding the small but likely effect of genetics may be beneficial to this field of study.

More widely studied, the health selection hypothesis proposes that individuals in poorer health "drift" into lower social classes, mainly because they can not attain higher educational qualifications or fulfill the functions of higher occupational grades (Townsend & Davidson, 1982). In such a case, the direction of causality is from health to socioeconomic status. If health-related mobility were the main driving force of the social gradient in health, the point of intervention would be to improve health itself or to intervene on the mechanisms through which health problems restrain an individual in socioeconomic attainment. For example, accessibility initiatives in educational institutions and in the workplace would be an example of intervening to prevent health problems from resulting in lower socioeconomic status.

Recent research has examined the roles of health-related social mobility in driving social gradients in health. Using structural equation modelling with a longitudinal dataset spanning 10 years, Chandola, Bartley, Sacker, Jenkinson, and Marmot (2003) demonstrated that the cross-lagged paths from employment grade to health were statistically and substantively significant, whereas the paths from health to employment grade were much weaker. Analyses of the 1946 and 1958 British birth cohorts indicated that ill-health in childhood had only a small effect, if any, on adult social standing (Blane, Davey Smith, & Bartley, 1993), and Manor, Matthews and Power (2003) concluded that the effect of health selection on the social gradient in health was variable and of modest size. However, the effects of health-related selection may depend on the

nature of the sample. Elstad and Krokstad (2003) found that for continuously employed men, health inequalities were primarily due to social causation, whereas differences in health between employed and non-employed men appeared to be the result of health selection. Thus, research examining the effects of health problems on social mobility has generally indicated that although health-related social mobility exists, its effects on the social gradient in health is relatively small. In fact, health-related social mobility may even attenuate socioeconomic gradients in health, since those who experience declines in social status due to health problems still tend to have better health than average in their social class of destination (Bartley & Plewis, 1997).

In contrast to selection mechanisms which propose that either both health and socioeconomic attainment are due to some underlying genetic potential or that poorer health leads to lower SES, social causation hypotheses propose that the social environment generates conditions which lead to distal and proximal risk factors for poor health in lower SES groups. The primary mechanisms of social causation are proposed to be through the material/physical environment, lifestyle/behaviours (Townsend & Davidson, 1982), and, more recently, psychosocial explanations (Elstad, 2000). These three mechanisms will be discussed next.

Material/structural explanations

A material/structural explanation of the social gradient in health focuses on the distribution of environmental exposures and tangible resources that are driven by the social structure of society (Lynch, Davey Smith, Kaplan, & House, 2000). This explanation stems from earlier public health paradigms, in which poorer sanitation was associated with lower socioeconomic neighbourhoods and resulted in a higher incidence of disease, especially infectious disease (Berkman & Kawachi, 2000). Even in the present day, individuals in lower

socioeconomic classes are more likely to live, work, or attend school in physical environments characterised by physical and chemical hazards. For example, public schools in California with greater proportion of socioeconomically disadvantaged children are more likely to be situated close to busy roads, which increases children's exposure to air pollutants (Green, Smorodinsky, Kim, McLaughlin, & Ostro, 2004). There are also material goods associated with health that are more accessible to individuals in higher socioeconomic positions, such as a nutritious food (Travers, 1996) and perceptions of and access to facilities for recreation (Huston, Evenson, Bors, & Gizlice, 2003). However, the social gradient in health observed in the Whitehall studies refutes that material deprivation drives a considerable proportion of the social gradient in health, because the civil servants studied all had incomes adequate to provide acceptable material conditions of living, and yet clear differences between occupational classes were evident (Marmot, 1996).

Access to health care has been another major structural explanation of the social gradient in health, perhaps in part due to the influence of the biomedical paradigm which emphasises the importance of medical care for health. Thus, the inference is that differential medical care leads to differential health outcomes. While there is no doubt that medical care is an important determinant of health, and that health care (depending on the system) is differentially available and accessed, it is unlikely that health care is a major determinant of social gradients in health (Pincus, Esther, DeWalt, and Callahan, 1998). In fact, in one Canadian study, individuals living in poorer neighbourhoods were twice as likely to be hospitalized for ambulatory sensitive conditions, avoidable conditions, and conditions amenable to medical treatment, i.e. in general those conditions for which hospitalization could be avoided with appropriate medical intervention (Roos & Mustard, 1997). At the same time, surgical rates did not vary significantly

with income level of neighbourhood of residence, nor did contacts with a specialist, although contacts with a general practitioner were higher among residents of lower SES neighbourhoods. This indicates that even in countries with universal health coverage, such coverage is not universally accessible – even Canada has a social gradient in health, although gradients tend to be flatter in countries with universal health care than in countries with privatized health care such as the United States (Humphries & van Doorslaer, 2000).

A variation of the material/structural explanation is that relative deprivation is responsible for social inequalities in health. An absolute deprivation hypothesis may only explain the poorer health of individuals living in abject poverty: a relative deprivation hypothesis proposes that health may be compromised when individuals do not have the resources to engage in ordinary patterns of living, customs, and activities (Wilkinson, 1996). The mechanisms through which a relative and perceived lack of resources function are more complex and less direct than the more traditional material/structural explanations and may act through behavioural/lifestyle and psychosocial mechanisms as will be described in the next two sections.

In support of a relative deprivation explanation of health inequalities, Stronks, van de Mheen, and Mackenbach (1998) examined relative deprivation in three areas as a mediator between income and less than good health: basic amenities, such as having one hot meal a day; social activities, such as ability to have a membership in a club; and housing, such as living in a dry, damp free dwelling. These deprivation indicators explained approximately half of the relationship between income and poor health. The ability to save money, to buy new clothes on a regular basis, having friends over for dinner regularly, and taking yearly holidays were the components of the studied deprivation index that most strongly mediated the income and health relationship, indicating that it is not the material aspect of deprivation that seems to be the

putative factor in income differences in health, but rather the more psychological and behavioural components of deprivation. A similar study by the same research team examined relative deprivation and behavioural mediators of the social gradient in health, and found that about a quarter of the relationship between low education and poor health was mediated jointly by behavioural and structural factors, a third by relative deprivation independently, and about one sixth by behaviours independently (Stronks, van de Mheen, Looman, & Mackenbach, 1996). Laaksonen, Roos, Rahkonen, Martikainen and Lehalma (2005) found that material and behavioural factors mediated about half of occupational class differences in health for women, and about a third for men. However, they found that these effects were mainly independent of one another.

Behavioural/lifestyle explanations

Just as a public health paradigm generated the material/structural explanation of social inequalities in health, the emerging awareness of the importance of individual behaviours to health generated the behavioural/lifestyle explanation. During the formative period of the study of social inequalities in health, smoking, diet, and exercise were increasingly identified as important risk factors for disease and Western societies had clearly undergone the epidemiological transition from infectious to chronic diseases (Wilkinson, 1996). Indeed, health behaviours are important causes of ill-health, accounting for about 50% of the top ten leading causes of death in the United States (McGinnis & Foege, 1993). The social distribution of these behaviours demonstrates a clear social gradient, with less healthy behaviours among the socioeconomically disadvantaged. Individuals in lower socioeconomic groups are more likely to smoke (Graham, 1994; Monden, 2004), to be physically inactive (He & Baker, 2005), and to be

overweight or obese (Lantz et al., 1998; Lynch, Kaplan, & Salonen, 1997). Behavioural explanations are popular explanations of the social gradient in health, because the relationship between SES and health behaviours is well described, and also because the underlying biological mechanisms which are thought to link these behaviours to health are generally accepted.

Does empirical evidence support the role of health behaviours as a mediator of the social gradient in health? Whereas there is indeed evidence for behavioural explanations of the social gradient in health and these explanations are biologically plausible, they do not explain away the gradient. In Marmot et al.'s (1978) influential Whitehall study, about half of the increased risk of mortality in the lower employment grades could be explained by behavioural risk factors. However, even after controlling for these behavioural risk factors, the lowest employment grade still had twice the cardiovascular mortality risk as the highest. Lantz et al. (1998) report that four health behaviours (smoking, alcohol drinking, sedentary lifestyle, and body mass index) explain 12 and 17% of the increased mortality risk in the lowest and middle income groups. Stronks, et al. (1996) reported that behavioural and material factors accounted for about 30% of the increased risk of poor health among lower socioeconomic groups.

While the empirical data supports that behavioural factors indeed mediate part of the social gradient in health, the story is in fact more complicated than it appears. Two paradigms emerge when conceptualising health differences attributable to health behaviours among different socioeconomic groups (Macintyre, 1997; Townsend & Davidson, 1982). The first perspective is that of personal responsibility, where individuals are believed to be agents making freely chosen decisions that guide their emitted behaviour. This is the view put forward by earlier theorists in the area of population health, such as past Minister of Health and Welfare, Marc Lalonde (1974, p. 32), who wrote that

> Personal decisions and habits that are bad from a health point of view, create self-imposed risks. When those risks result in illness or death, the victim's lifestyle can be said to have contributed to, or caused, his own illness or death.

Such a perspective about health behaviours as a cause of the social gradient in health absolves society of the responsibility for health inequalities, because the inequalities are considered to be fair and just. That is, people who are sick from poor health behaviours "deserve" to be sick. However, this approach which emphasises individual free choice fails to account for the conditions which influence health behaviours. Another version of the health behaviour explanation of social inequalities in health takes into account those factors structured around socioeconomic status, and asks "why do poor people behave poorly?" (Lynch et al., 1997). This approach acknowledges that individual behaviours take place in socioeconomic, cultural, familial, historical and political contexts, which influence both what behaviours are possible and which behaviours are ultimately adopted from among the range of options (Lindbladh & Lytkkens, 2002).

Bourdieu, a French sociologist, proposes habitus as a compromise between self-directed agency and structurally-determined behaviour (Bourdieu, 1986). He concludes that habitus is a system of socially acquired dispositions, such as outlook and opinion, which do not determine an individual's behaviour, but simply constrain the set of class-dependent and predisposed ways of thinking about the world that an individual has accessible to him or herself. This habitus then informs practice, or behaviour. Furthermore, individuals in lower socioeconomic strata have fewer resources (social, knowledge, or economic) to facilitate change in unhealthy behaviours, thus perpetuating the concentration of unhealthy behaviours in lower strata. In fact, as behaviours are recognised to be health compromising, social patterns of behaviour see the more advantaged classes discontinuing unhealthy behaviours, and the less advantaged social classed

adopting them (or at least not discontinuing them), as was the case with smoking (Stronks, van de Mheen, Looman, & Mackenbach, 1997).

Although material/structural and behavioural explanations account for an important part of the social gradient in health, an important proportion of the variance remains unexplained. Thus, if we only focus on attenuating risks through material/structural and behavioural interventions, we may continue to observe important health inequities. Furthermore, because the pattern of risk exposures across socioeconomic groups has changed over the years but the social gradient in health has not (Wilkinson, 1996), a more general underlying mechanism is suspected, and thus Marmot's proposal of a factor or factors affecting general susceptibility across a range of diseases is important to consider (Marmot et al., 1984). Linked to Selye's concept of non-specific stress responses to a wide range of stimuli (Selye, 1956), some researchers in the area of the social gradient in health have moved towards psychosocial explanations of this phenomenon.

Psychosocial explanations

Psychosocial explanations of the social gradient in health encompass those health compromising mechanisms that arise from socially-patterned experiences resulting in perceptions and emotions which may give rise to ill-health (Elstad, 2000). In psychosocial explanations, biological mechanisms connecting the experience of lower social status to health are generally psychophysiological, mediated by psychoneuroimmune and psychneuroendocrine processes (Tarlov, 1996). In the epidemiological literature, the psychosocial explanation has traditionally been distinguished from behavioural/lifestyle explanations. However, given the multifaceted nature of behaviour and the complex web of causation in the social gradient in health, this dichotomy of behavioural/lifestyle and psychosocial explanations may be an

oversimplification. For the moment, a review of traditional views on psychosocial explanations will be articulated, followed by a discussion of how all three explanations are indeed interrelated.

The most popular psychosocial mechanisms studied relate to stress and to negative emotions, or factors which moderate these (Gallo & Matthews, 2003). There are two primary stress explanations. First, it is proposed that *differential exposure* to stressful situations (i.e. higher exposures among lower socioeconomic status groups) results in more frequent stress reactions, leading to poor health. Second, the *differential vulnerability* hypothesis (McLeod & Kessler, 1990) proposes that given a similar stressor, such a stressor would have a greater impact on the health of lower SES individuals because of a paucity of coping resources or buffering mechanisms. A related explanation is that a greater frequency of negative emotions, such as anger, hostility and depression, among lower SES groups results in poorer health (Gallo & Matthews, 1999). Finally, factors such as self-efficacy, self-esteem, social support, and perceived control are also posited as psychosocial factors which may both mediate the SES-health relationship, and moderate the effect of stressors on health. Each of these explanations will be considered in the following sections.

Stressors, stress, appraisal and coping

The primary psychosocial explanation to be discussed in this thesis is that the differential exposure to stressors of socioeconomic groups is proposed to be an important mechanism underlying the social gradient in health. Thus, an understanding of the concepts of stressors, stress and the stress process, as well as an examination of the research on differential exposure and vulnerability is necessary.

Modern stress research originated with the work of Hans Selye (1956), who studied stress as the organism's response to environmental demands placed upon it, giving rise to a stimulus-response model of stress that continues today. While the specifications of the components of the stress process vary, most theories of stress identify that some sort of stimulus, called the stressor, places demand on, challenges or threatens the organism, thus resulting in a physiological and psychological response, which is identified as the state of stress (Cohen, Kessler, & Gordon, 1995). Defining what comprises the stimulus, the stressor, is the first challenge in stress research.

The subjective phenomenological approach prevalent in contemporary North American research is represented by Lazarus and Folkman (1984), whose definition of a stressor hinges on the appraisal of an event or situation as stressful. According to their transactional model of stress, the relationship between an event, a *potential* stressor, and a state of stress is mediated by primary appraisal of an event or situation as having elements of threat, challenge and/or harm/loss, and secondary appraisal of having the resources to cope with the event. Actual coping occurs and may decrease the threat associated with the situation, resulting in a reappraisal of the situation. In the model, events stressors are only identified by the individual and a state of stress results when the potential stressor is perceived as stressful. The possible health harming component of the potential stressor is directly related to the individual's perceptions. In this model, the same event can be a stressor for one individual and not for another, and thus is an idiographic approach. However, this approach to identifying stressors results in circularity, as the stimulus can not be identified in the absence of a response.

In contrast, the normative British sociological view of Brown and Harris (1978, 1989) proposes that an event can be a stressor with potentially noxious health effects even if it is not identified as stressful by a given individual. According to Brown and Harris (1989), the key

characteristics of a stressor include threat, demand or constraint *independent* of the individual's appraisal of or reaction to the event. A benefit of this approach to studying stress is that it standardizes stimuli across individuals, and minimizes the effects of individual differences in appraisals and in coping resources. A drawback is that the researcher must define a priori what situations constitute a stressor, and thus could propose stressors that are not conceptually valid.

The chosen approaches obviously affect measurement choices. In a transactional approach, research tools generally include self-reports of stressor appraisals, often combined with reports of coping and response as well. For example, Cohen's Perceived Stress Scale measures the extent to which situations in an individual's life are appraised as stressful (Cohen, Kamarck, & Mermelstein, 1983). However, given the iterative nature of transactional models, perceptions of stressfulness necessarily change as coping efforts are successful (or not) at attenuating the perceived characteristics of the stressor (Monroe & Kelley, 1997). An approach focussed on the stimuli, or stressors, will often employ a self-report questionnaire approach, or in some cases, an investigator-driven contextual approach. One of the most important sources of error in checklist reporting is what has been called "search after meaning." Individuals experiencing mental or physical health problems often search for the "reason" for which they are sick, thus introducing a reporting bias not seen in healthy participants. There is also often overlap between the events and the health problems which are the dependent variable of interest, leading to inflated correlations (Turner & Wheaton, 1995). However, such checklist approaches are easy to use and at least attempt to remove some of the individual differences in stress appraisals.

Investigator-driven contextual approaches, such as that employed by the Life Events and Difficulties Schedule (Brown & Harris, 1978), try to circumvent some of the problems inherent in a transactional approach, as well as improving accuracy of measurement as compared to

checklist approaches. Interview approaches can elicit more information about a potential stressor than a single item on a checklist, thus better calibrating the stressor measurement. Furthermore, the context in which the stressor occurred can be captured, which could aid in determining the degree of stress-eliciting characteristics of the event (such as threat or demand). However, interview approaches are resource and time intensive, and are difficult to employ in population level studies.

In either a subjective transactional or a normative sociological approach, the reaction to a stressor, i.e. the resultant state of psychological stress, is of interest (Lemyre & Tessier, 1988). The state of stress is generally characterised by the psychological characteristics of the "feeling of being stressed," and symptoms associated with distress, anxiety and depressive affect, such as feeling restless, having difficulties sleeping, and feeling tense. This state is associated with a physiological response, most importantly the secretion of catecholamines and glucocorticoids (Lundberg & Frankenhaeuser, 1980).Yet surprisingly, few measurement tools have been developed to measure the state of stress that don't also incorporate appraisals and/or coping responses. One exception is the Psychological Stress Measure by Lemyre and Tessier (1988). Other measures of the state of stress are often more general measures of affect, such as distress scales (Stone, 1995).

The research question is the primary determinant of which model is adopted when conducting studies on stress. If the influence of the social environment on the individual is of interest, then a sociological approach like that of Brown and Harris may be most appropriate. If the interaction between the environment and the individual, and how individual factors influence psychological and physiological outcome is of interest, a transactional approach may be in order. In a comprehensive approach, which is only feasible in smaller scale studies, a combination of

approaches may be most appropriate. Because of the focus on the socioeconomic environment as the generator of adverse conditions of living in the present thesis, and because of the availability of data, the focus for this thesis will be on stressors.

Differential exposure and differential susceptibility

The first type of stress explanation in the psychosocial hypothesis focuses on stressors, and is referred to as the differential exposure hypothesis. Several classes of stressors have been articulated, including life events, chronic stressors, and work demands. Indeed, many of these stressors have shown a social distribution, with lower status individuals being exposed to a greater number of live events (Brown & Harris, 1978; Cohen, Kaplan, & Salonen, 1999; McLeod & Kessler, 1990; Stronks, Van de Mheen, Looman & Mackenbach 1998; Turner et al., 1995), chronic stressors (Stronks et al., 1998; Turner et al., 1995), and occupational stressors (Fotinatos-Ventouratos & Cooper, 1998). If it is the exposure to a stressor in and of itself that results in harmful effects on health, then given the differential exposure of socioeconomic groups to stressors, this could be a plausible explanation of the social gradient in health.

Brown and Harris (1978) demonstrated that among lower class women in England, investigator-measured chronic stressors (difficulties) and life events were more frequent and more severe. In a Canadian study, Turner, Wheaton & Lloyd (1995) observed a linear cross-sectional relationship between socioeconomic status and number of life events and chronic stressors. In longitudinal analysis of the same study sample, Turner and Turner (2005) found that individuals with lower incomes at a baseline period experience more life events at the follow-up interview, a year or more later. Examining the neighbourhood as a source of stressors, Steptoe and Feldman (2000) found that individuals living in lower income areas reported more

neighbourhood stressors, such as noise, vandalism, and disturbances by youngsters or neighbours, etc. Lower levels of social capital and of informal social control in these neighbourhoods was suggested as possible causes of these neighbourhood problems, and individuals living in these lower income neighbourhoods reported greater psychological distress and lowered ability to conduct activities of daily living.

Using a daily diary methodology, contrasting evidence has been presented by Grzywacz, Almeida, Neupert, and Ettner (2004) and Almeida, Neupert, Banks, and Serido (2005). While Grzywacz et al. (2004) found that having a *college degree or higher* education was associated with reporting a greater number of daily stressors, Almeida et al. (2005) reported that individuals with *less than high school* report a greater number of severe stressors, using both self and expert ratings of stressor severity. The latter study examined the following domains of risk: risk to future plans; finances; feelings of self-worth; perceptions of self by others; personal health and safety; and disruption of daily activities. Stressors with a high degree of risk to feelings of self-worth and risk to finances were more prevalent among individuals with lower educational attainment.

Matthews et al. (2000) used a related technique, momentary experience sampling, to examine the association between occupational prestige and stressors among middle-aged men and women. This method prompted participants at 30 minute intervals throughout the day to record mood states, activities and interpersonal interactions, among other attributes. They also responded to a questionnaire on work attributes, and participated in an interview which used a variation of Brown and Harris' Life Events and Difficulties Schedule (LEDS) to evaluate work strain. While there was no difference by occupational group in interview-measured work strain, individuals in low prestige jobs reported more conflictual interactions during the day and more

boredom. Interestingly, the relationship between work strain and negative mood was stronger for higher prestige individuals, whereas the association between momentary negative mood and higher heart rate (a physiologically less ideal state) was stronger for low prestige individuals. This implies that while work strain seems to affect higher prestige individuals in more cognitively accessible ways (through negative mood), the "silent" physiological effects of negative mood are more injurious among lower prestige individuals.

When considering stressors specific to the domain of work, the demand-control model (DCM: Karasek & Theorell, 1990) and the effort-reward imbalance model (ERI: Siegrist, 1998) are the two predominant models of work stress. The DCM suggests that jobs with a combination of high psychological demands and low control, i.e. a combination of skill utilization and decision authority, create a state of stress which is health-harming. In contrast, a sense of mastery and control, leading to feelings of self-efficacy (the belief that one is able to accomplish something that one sets out to do) is the result of a job with high demands coupled with high control (Siegrist & Marmot, 2004). Occupations that are lower on the occupational hierarchy indeed tend to have higher demands combined with lower control (Fotinatos-Ventouratos & Cooper, 1998; Marmot, Bosma, Hemingway, Brunner, & Stansfeld, 1997). The ERI model suggests that distributive justice and social reciprocity are the important facets of the work environment, in that individuals' efforts need to be balanced with rewards so that the cost/gain ratio is maintained. Siegrist proposes that jobs lacking effort-reward balance result in distress, disappointment and frustration, leading to autonomic arousal (Siegrist & Marmot, 2004). As with jobs with high demands and low control, low socioeconomic status is associated with higher effort-reward imbalance at work (Siegrist, 2002), although some studies have shown higher effort-reward imbalance with higher occupational status (Kuper, Singh-Manoux, Siegrist, &

Marmot, 2002). The health effects of high effort-reward imbalance are greater at lower employment grades, indicating a moderated mediation of the SES-health relationship by ERI.

Why might stressor exposures across numerous domains (including personal life, work, and neighbourhood among others) be more frequent among individuals of lower socioeconomic standing? Two primary approaches to answering this question are prevalent. The first is that stressors exposures are socially-patterned, arising from the inequitable distribution of experiences and resources within a society. The second is that there is something about individuals of lower socioeconomic position that contributes to the generation of stressors (i.e. random stressors arising from personal choices such as poor decision making and planning; Aneshensel, 1992). These two perspectives correspond with a sociological vs. a clinical perspective, respectively. In all likelihood, stressors arise from a combination of these two explanations; however those studying the relationship between social status and health adopting a social causation perspective rely more heavily on the first explanation. It is also arguable that individual dispositions that may generate stressors are themselves socially determined as well, such as effective proactive coping behaviours which may be learnt in early life. Aneshensel (1992) points out that the systemic, socially-patterned stressors and random, individually-generated stressors have been indiscriminately bunched together, possibly leading to an underestimation of the true degree of social patterning of certain stressors, and certainly to less accurate measurement of relationships between SES and stressors.

In terms of socially-patterned stressors, certain stressors clearly arise from low income, such as inability to pay rent or make mortgage payments; from low occupational prestige, such as the job insecurity that is common among lower prestige jobs; and from low educational attainment, such as lack of knowledge necessary to avoid risks. Wheaton (1983) has delineated

the following aspects as important stressor generators: barriers to life goal achievement; inadequate reward to investment ratio, much like Siegrist's Effort-Reward Imbalance; excessive or inadequate demands; frustration of role expectations; and resource deprivation. In fact, social ordering in and of itself may generate stressors since systemic conditions of tension may occur as a results of distributive injustice, including exclusion from full participation in society, and failure to achieve expected returns (Merton, 1938). Lower socioeconomic status results in less reliable social interactions, jeopardizes need satisfaction, goal attainment, and effective social functioning. Turner and Turner (2005) have also identified that earlier stressors tend to beget later stressors, and as such, even a small increase in risk of stressor exposure in earlier life associated with lower socioeconomic status can lead to large differences in stressor exposure in later life due to an intensification effect.

In addition to the structurally generated stressors resulting in differential stressor exposure as a function of social class, stressors may have a differential impact by socioeconomic status on the exposed individuals. This is the *differential vulnerability* hypothesis, in contrast to the *differential exposure* hypothesis presented previously, in which individuals in lower socioeconomic groups are more susceptible to negative effects from stressors. McLeod and Kessler (1990) used several datasets to examine this hypothesis, and found that the relationship between stressors in six domains and psychological distress was stronger for lower SES individuals, indicating differential vulnerability. Explanations for this vulnerability have been attributed to the greater severity of financially related stressors among lower SES individuals, or more resilient characteristics among higher SES individuals, such as effective coping strategies. McLeod and Kessler posited that because differential vulnerability was seen across stressors that were not necessarily related to finances, the latter explanation was more probably, i.e.

differential vulnerability is a function of differing buffering factors. In contrast to McLeod & Kessler's findings of differential vulnerability, Stronks et al. (1997) found that education level did not moderate the relationship between stressors and self-rated health, while Almeida et al. (2005) found that lower educational attainment heightened the relationship between daily stressors and psychological distress. However, after taking stressor appraisal into account, this relationship was attenuated by a third, indicating that at least some of differential vulnerability to stressors is attributable to appraising similar stressors as more threatening by lower socioeconomic groups.

Thus, important factors to consider in the study of stressors as a mediator of the SES-health relationship are those traditionally considered "buffering" factors, such as appraisal processes, social support, sense of control and mastery, and coping. Many of these buffering factors are developed earlier in life, and are shaped by the socioeconomic environments one grows up in. Chen, Langer, Raphaelson and Matthews (2004) examined whether socioeconomic status was associated with primary appraisals of threat and physiological responses to stress among adolescents. They report that low SES adolescents rated ambiguous situations as more threatening that higher SES adolescents, and that diastolic blood pressure and heart rate reactivity were higher among lower SES adolescents. Chen et al. hypothesise that this differential appraisal of threatening situations and differential reactivity may be a result of a less predictable and more threatening environments during childhood, leading to sustained vigilance and enhanced stress responses.

de Ridder (1995) investigated the relationship between socioeconomic status and beliefs about the impact of stressors, availability of resources and sense of control, and found that higher education was associated with a belief that stress can be positive, while lower education was

associated with a belief that stress was like a disease that had to be beaten. Using a series of fictional vignettes to examine beliefs about stressful events, de Ridder found no association between education and threat appraisals, but found that more educated individuals made more positive secondary appraisals of coping resources. Higher educated individuals tended to report a greater likelihood to engage in seeking social support and a lower likelihood to engage in threat minimization (i.e. avoidant coping) in response to a stressor. As active coping strategies have been, for the most part, associated with better psychological outcomes than avoidant coping strategies, these results support that differences in coping styles may explain some of the differential vulnerability experienced by lower SES groups (Billings & Moos, 1981).

Another potential stress moderating factor is social support, which has been hypothesised to have both a main effect on psychological well-being and a buffering effect on the relationship between stressors and well-being (House, Umberson, & Landis, 1988). In order to investigate the role of social support in the social gradient in psychological health, Turner and Marino (1994) studied the social distribution of social support. They found that occupational prestige had a positive linear relationship with perceived social support. Finally, Gallo, Bogart, Vranceanu, and Matthews (2005) also examined the perceived availability of resources for coping with stressful situations, and found that lower SES individuals reported fewer social and personal resources for coping, while higher resources were associated with higher perceived control and lower social strain. Gallo et al. conclude that lower SES individuals have a lower reserve capacity to deal with stressors, which can then lead to a downward spiral of intensification of stress. In general, the literature supports that lower individuals have not only differential exposure to stressors, but differential vulnerability to stressors, and that the mechanisms connecting the social environment to intrapersonal stress processes are well grounded in theory and empirical evidence.

Biological and behavioural pathways from stressors to health

While there is clearly evidence for a social gradient in stressors and the experience of stress, it is also important that psychosocial explanations of the social gradient in health connect these exposures with health problems through biological mechanisms. That is, the mechanisms through which stress "gets under the skin" must be plausible (Taylor, Repetti, & Seeman, 1997). Indeed, stressors have been associated with a broad range of negative health outcomes. For example, Brown and Harris (1989) have presented a series of case-control studies showing a consistently elevated risk for several different diseases of individuals exposed to life events. Belkic et al. (2000) reviewed the evidence for the association between the psychosocial work environment and cardiovascular disease, and found that six of ten cohort studies reported significant results linking job strain with incident cardiovascular disease. Similarly, Siegrist (2005) reviewed the evidence relating effort-reward imbalance to incident CVD, depression, and alcohol dependence, and concluded that these diseases are about twice as likely in individuals experiencing lack of reciprocity at work.

Both a psychophysiological and a behavioural pathway have been proposed to link stressors and the stress experience to health, with the psychophysiological pathways including both endocrine and immune system components. The psychophysiological pathway is the most commonly studied pathway, and is first mediated by the endocrine system with activation of the sympathetic-adrenal medullary (SAM) axis and the hypothalamic-pituitary-adrenal (HPA) axis. This response which prepares the body for action in response to a threat by the secretion of adrenaline is generally known as the "fight-or-flight" response (Cannon, 1929). The second system involved in the stress response is the HPA axis, which secretes the glucocorticoid cortisol. Selye called the stages of change which this response goes through in reaction to a

prolonged stressor the "General Adaptation Syndrome" (Selye, 1956). The endocrine cascade that is associated with stressors affects virtually every body system and is hypothesised to have harmful effects if activated repeatedly or for too long a period (for a review of these effects, refer to McEwen, 1998).

One of the harmful effects of the endocrine stress response is that immune functioning is disturbed in response to stressors. Corticosteroids such as cortisol have immune-suppressing effects, and many studies have associated long-term stressors with decreased immune functioning (Cacioppo et al., 1998). Cohen et al. (1998) demonstrated that individuals reporting chronic stressors but not acute (less than one month in duration) stressors were more susceptible to the common cold when challenged with the virus. This relationship followed a linear pattern with length of stressor: stressors of greater than one month, but less than six months duration yielded a two-fold risk of developing a cold after virus challenge; greater than six months but less than 24 months, a three-fold risk; and greater than 24 months, a four-fold risk. As altered immune functioning is increasingly recognised not only in infectious disease but in chronic diseases as well, evidence linking stressors to decreased immune function has relevance for a range of stress-related diseases such as cardiovascular disease (Cochran, Ewald, & Cochran, 2000).

However, stressors and stress do not only affect the neuroendocrine and immune systems: they also affect behaviours. Stressful situations elicit coping behaviours, some of which may also be included in the category of health-related behaviours. For example, smokers tend to report that they use smoking cigarettes as a way to cope with stress (Graham, 1994). Other studies have shown that individuals in high stress groups consume more high-fat foods (Weidner, Kohlmann, Dotzauer, & Burns, 1996). Some individuals use a healthy behaviour, physical activity, to cope

with stress, which should result in higher levels of physical activity associated with stressors (Weidner et al., 1996). At the same time, stressors may interfere with certain health behaviours. For example, if the time needed to cope with stressors leaves little spare time, an individual may not have the time to participate in physical activity. Or, feelings of stress may interfere with decision making processes necessary to engage in healthy behaviour. In general, stressors are proposed to be associated with negative health behaviours (Baum & Posluszny, 1999), although in certain cases stressors may elicit healthy behaviours.

The interconnectedness between stressors, health behaviours, and health necessitates that attempts to explain the social gradient in health must take into account a complex web of mechanisms. The role of health behaviours in mediating the SES-stressor-health relationship is an important factor to analyse, as it demonstrates that explanations of the social gradient in health, such as the lifestyle/behavioural explanation, really can't be examined in isolation of other explanations, such as the structural/material and psychosocial explanations. If the socioeconomic context gives rise to stressors which influence health behaviours, the adoption of and engagement in health behaviours must be considered as a link in the causal chain. In this thesis, the third and last article is devoted to exploring the links between stressors and health behaviours, in order to determine whether health behaviours associated stressors explain part of the relationship between stressors and health.

Evidence for the psychosocial explanation

Psychosocial stressors as an explanation of the social gradient in health have garnered considerable research attention. An increasing body of empirical evidence supports the role of psychosocial factors in accounting for socioeconomic differences in health. In the original

Whitehall study, Marmot et al. (1978) demonstrated that after taking into account conventional risk factors such as smoking, plasma cholesterol, blood pressure, height, obesity, and physical activity, only a quarter of the relationship between occupational grade and incident coronary heart disease was accounted for. In the Whitehall II study, accounting for traditional risk factors and job strain explained the entire social gradient in health, with job strain having the greatest contribution to CHD frequency (Marmot, Bosma, Hemingway, Brunner, & Stansfeld, 1997). The odds ratio for any CHD event for low grade employees vs. high grade employees was approximately 1.50 for men and women. Controlling for risk factors reduced these odds ratios to 1.30 in men and 1.34 in women, while controlling for work characteristics reduced these odds ratios to 1.18 for men and 1.23 for women. The fully adjusted model reduced these same odds ratios to 0.97 for men and 1.07 for women.

Stronks et al. (1997) conducted a study in which 20% of education differences in self-rated health were explained by a higher exposure to stressors among lower SES groups in the Netherlands. Controlling for neuroticism, a possible source of reporting bias that could inflate the association between stressors and poor self-rated health, reduced the explained variance which was still in the range of 10-15%. They did not find evidence for differential susceptibility to stressors between different socioeconomic groups. In a similar study comparing Finnish and American samples, Cohen, Kaplan and Salonen (1999) demonstrated that stressors explained some education and income differences in health, but that there was no evidence of a greater effect of stressors by socioeconomic level.

In contrast, Khang and Kim (2005) found that while socioeconomic differences in mortality in South Korea are similar in pattern to those seen in Western countries, no reduction in excess mortality risk associated with lower socioeconomic position was observed when taking

into account psychosocial factors such as perceived stress. This study indicated that different mechanisms may explain the social gradient in health in non-Western societies. Given that leading causes of death are different in South Korea than in European and North American countries, this is not surprising. Khang & Kim (2005) suggest that in South Korea, early environmental factors may be more closely related to leading causes of mortality (stroke, stomach cancer, and liver disease) as opposed to adulthood factors that seem to contribute to leading causes in Western countries.

The studies discussed above examine the relationship between more chronic stressors such as financial difficulties and life events, and relatively global assessments of health. In an interesting variation on the traditional study of social gradient mediation, Almeida et al. (2005) examined the relationship between SES and daily psychological and physical symptoms through daily stressors. Lower education was related to physical symptoms and psychological distress, with 30% and 20% of these respective relationships being mediated through daily stressor experiences. In general, these international studies indicate that from 10% to 30% of the social gradient in health is mediated by stressor or other psychosocial factors, across a range of socioeconomic indicators and health outcomes.

With the increase in availability of cross-sectional (CCHS) and longitudinal (NPHS) data sets, Canadian researchers have also been addressing psychosocial pathways in the social gradient in health. Ing and Reutter (2003) explored Sense of Coherence (SOC) as an explanation of SES and health relationships among Canadian women. They concluded that SOC intervenes between household income and self-rated health, explaining 14% of the relationship. McLeod et al. (2003) also used social factors and health behaviours to explain the relationship between household income and health. They found that household income was associated with poor self-

rated health, and that health behaviours and social support/social involvement explained some of this association. However, McLeod et al. did not investigate stressors as an explanatory variable. Nor did Baillis, Segall, Mahon, Chipperfield and Dunn (2001), who examined perceived control and health behaviours as mediating variables in the socioeconomic status—health relationship. A Structural Equation Model supported the mediating effects of perceived control and health behaviours on the SES—health relationship, however a hypothesised relationship linking perceived control to health through health behaviours was not supported.

Few researchers have examined stressors as a mechanism in the social gradient in health in Canada. Kosteniuk and Dickinson (2003) examined "primary" and "secondary" determinants of health using regression based path analysis. They found that income, retirement status, and age all predicted reported stressors, and that stressors was related to psychological distress and self-rated health, but not to the Health Utility Index. Furthermore, perceived control, self-esteem and social support mediated part of the relationship between household income and self-rated health, via their inverse relationship with stressors. Among women only, McDonough, Walters, and Strohschein (2002) examined the relationship between income, social roles, stressors and self-rated health. Low income adequacy was associated with a 1.24 odds of long-standing health conditions, which was reduced to 1.08 when chronic stressors were accounted for, a reduction of 67% of the excess odds. However, stressors associated with social roles, such as marital conflict among married women, were found to be largely irrelevant in the relationship between social roles and poor health. For example, working women were more likely to be free of long-standing illnesses, but job strain (only possible among the employed) was associated with a greater odds of long-standing illness. Such results suggest that certain health-protective social roles would be even more strongly associated with good health if the stressors associated with them were

attenuated. Thus, similar to evidence from other Western countries, research in the Canadian context has supported the role of psychosocial mechanisms such as sense of coherence, social support, perceived control and stressors. However, existing data sources have not been used to their fullest extent to study the contribution of stressors to the social gradient in health in Canada.

Conceptual Model

Based on the evidence reviewed above, a conceptual model of the social gradient in health based revised in light of the evidence above is presented here in Figure 2. While both social and health selection have limited theoretical and/or empirical support, they still may constitute one mechanism linking socioeconomic status and health, and thus further research may be warranted. These pathways are marked in thatched lines, to represent their possible but likely small contribution. Material deprivation, health behaviours and psychosocial mechanisms more probably mediate the social gradient in health, with substantive evidence for each of these explanations being found in the literature. These pathways are indicated by the darker lines in Figure 2. Importantly, not only does socioeconomic status generate material, behavioural and psychosocial risks, but these concepts also interact with each other. Material deprivation can lead to negative health behaviours, as occurs when the physical environment is perceived to be unsafe and thus results in lower levels of physical activity. Psychosocial risks, such as stressors and stress, also affect health behaviours which can be used as coping mechanisms, thus compounding the negative effect of psychosocial risks on health. Material deprivation itself can also lead to psychosocial risks, as happens when an unsafe neighbourhood leads to feelings of fear and increased vigilance. A partial explanatory model of the social gradient in health focussing on one psychosocial explanation is presented in this thesis, as shown in Figure 3. First, the relationship

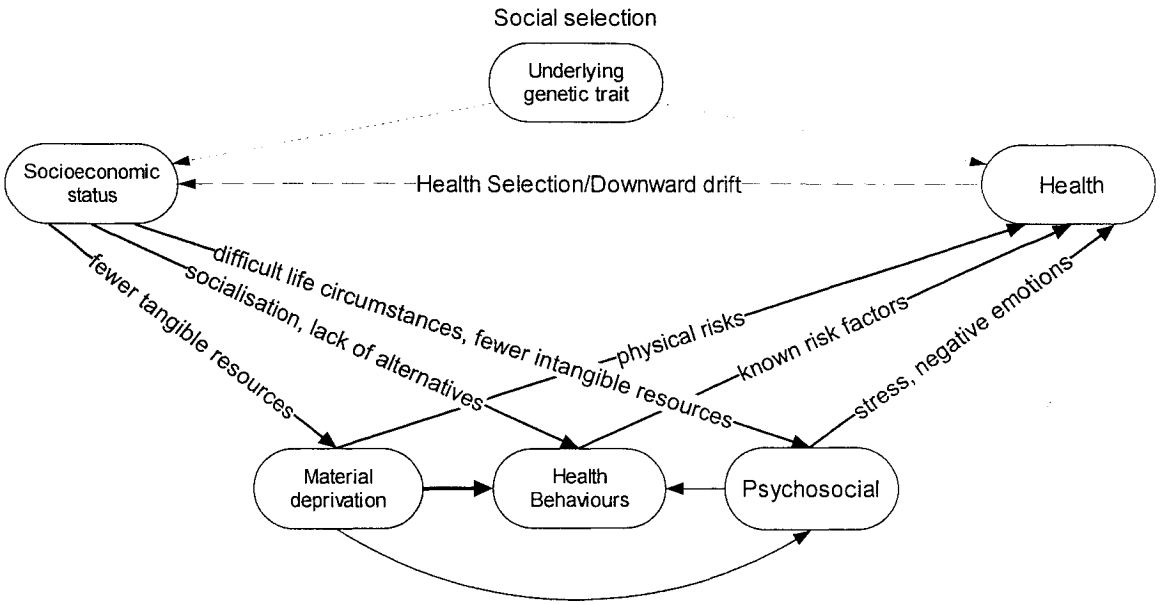

Figure 2. An expanded conceptual model of competing and complimentary explanations of the social gradient in health, incorporating what we know from the empirical literature.

between socioeconomic status and health is expected to be replicated in the Canadian context, both for concurrent and incident poor health. The relationship between household income as a marker of socioeconomic status and self-rated health is proposed to be partially mediated through stressors, a psychosocial risk. Furthermore, the relationship between stressors and self-rated health is posited to be partially mediated through health behaviours, with stressors having deleterious effects on health behaviours. While the explanatory model to be tested is not meant to be exhaustive and does not include other factors that are also important to driving social gradients in health, it is proposed to be a contribution to our understanding of one of the mechanisms potentially underlying the social gradient in health.

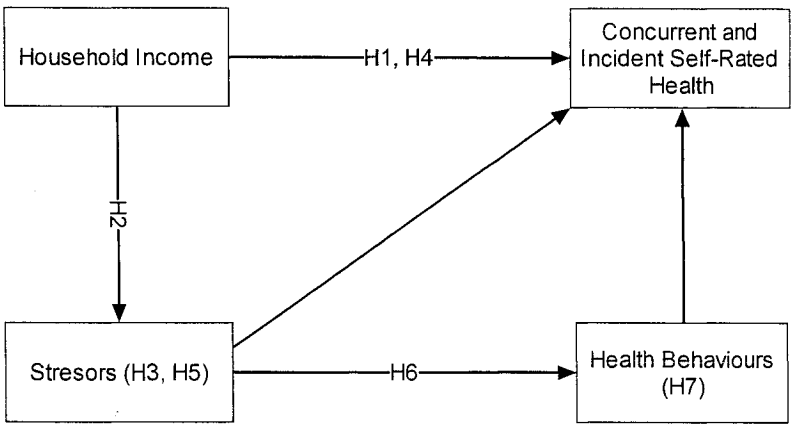

Figure 3. Hypothesised explanatory model of specific pathways in the social gradient in health to be tested in the present thesis.

Goal, Objectives and Hypotheses

The overarching goal of the thesis is to contribute to the understanding of the mechanisms through which socioeconomic position is associated with health, with a focus on psychosocial stressors as a mediator. The objectives are:

Article 1

1. To provide further evidence for the inverse association between socioeconomic position and health in Canada;

2. To demonstrate the inverse association between socioeconomic position and exposure to stressors; and

3. To establish whether stressors partially mediate the relationship between socioeconomic position and health.

Article 2

4. To demonstrate that lower socioeconomic position is associated with a greater likelihood of experiencing a decline in health status; and

5. To establish whether this association is partially mediated by stressors.

Article 3

6. To establish whether there is a positive association between stressors and smoking, and a negative association between stressors and physical activity; and

7. To establish whether the health behaviours of smoking and physical activity mediate part of the relationship between stressors and health.

It is hypothesised that:

H1) Lower socioeconomic position will be associated with a greater odds of poor/fair self-rated health.

H2) Lower socioeconomic position will be associated with greater exposure to stressors.

H3) Exposure to stressors will partially mediate the relationship between socioeconomic status and health.

H4) Lower socioeconomic position will be associated with a greater odds of experiencing a decline in health status.

H5) Exposure to stressors will partially mediate this relationship between socioeconomic position and decline in health status.

H6) Stressors will be associated with a lower likelihood of being physically active and a lower frequency of physical activity. Stressors will be associated with a greater likelihood of being a smoker, and among smokers, a greater intensity of smoking.

H7) Health behaviours will mediate part of the association between stressors and health.

CHAPTER 2. Method

The National Population Health Survey is a survey with both cross-sectional and longitudinal components initiated in 1994 by Statistics Canada in order to collect data on the health, health care utilization, and health determinants of Canadians (Statistics Canada, 1996). Data is collected every two years on a household sample of individuals. In 1994/95, 1996/97 and 1998/99 the longitudinal sample was resurveyed, as well as additional sampled individuals in order to make it possible to provide cross-sectional estimates. In 2000/01 and subsequent cycles, only the original longitudinal cohort was surveyed because cross-sectional data were being collected via the Canadian Community Health Survey (CCHS).

Data from the cross-sectional components of the NPHS are available to the academic research community by means of the Data Liberation Initiative. This Initiative makes public use microdata files (PUMF) available for research use. In contrast to the share files containing disaggregated data available on site at Statistics Canada and Remote Data Centres (RDCs), the PUMF data has been aggregated and screened in order to increase confidentiality of the data. The longitudinal NPHS files are only available through RDCs or Remote Data Access (RDA) because of the increased possibility of identification of individuals through longitudinal data (Statistics Canada, 2002). For the cross-sectional analyses in this thesis, it was sufficient to make use of the cross-sectional PUMF for the 1994/95 NPHS. However, in order to test longitudinal hypotheses, the longitudinal data from 1994/95 to 2000/01 was accessed via the Remote Data Access service. The longitudinal square master file that is available through RDA consists of all 17,276 individuals from the original 1994/95 cycle, regardless of whether they were lost to follow-up, deceased, or institutionalized in subsequent cycles.

Sample Frame

Participants for the NPHS were selected using a sample frame derived from the Labour Force Survey, except for in Quebec, were it was derived from the sample frame of the 1992/93 Enquête sociale et de santé (ESS). Individuals aged 12 and older living in households in Canadian provinces, and excluding the populations of Indian Reserves, Canadian Forces bases, and a few remote areas in Quebec and Ontario were the target population. The NPHS uses a multi-stage sampling design, in which one individual in a selected household is chosen for the longitudinal sample. Households are chosen from a multi-stage stratified sample of dwellings selected from within clusters of households which have been randomly chosen from a homogenous stratum. In 1994, the household response was 88.7%, while the selected respondent response rate was 96.1% (Statistics Canada, 1996). For the longitudinal component, the panel response rate to 2000/01 was 84.8% (Statistics Canada, 2002).

Data Collection

Data were collected using Computer Assisted Interviewing, which improves interview flow and reduces time and errors. Interviews were initiated in person except for a small number of individuals in British Columbia who were initially contacted by phone. Many interviews were finished by telephone because of the length of the interview or because the selected respondent was not available at the time of the initial contact. General information was first collected on all family members and then the selected respondent was interviewed. In the 1994/95 NPHS, proxy reporting was allowed for reasons of illness or incapacity and accounted for 4% of the information collected on selected household respondents.

Weighting

Because of the complex sample design with unequal probabilities of selection, data must be weighted in order to reflect the Canadian population. The weights calculated by Statistics Canada are scaled to represent the Canadian population resulting in an underestimation of variance because of the inflated sample size when these weights are applied. Thus, for cross-sectional analyses, weights must be rescaled to reflect the actual sample size. All analyses were conducted while using an average weight which is calculated as:

$$w^1 = (w/N)*n$$

where w = raw weight, w^1 is the average weight, n is the sample size, and N is the sum of the weights (which approximates the population size). This rescales the weights so that the average weight is one and the sum of the weights is equal to the sample size. These weights take into account unequal probabilities of selection, but not the stratification and clustering of the sample's design. Failing to account for these design effects results in artificially low variance, and increases Type I error. Thus, in order to take into account the design effects, the average weights were divided by the average design effect reported by Statistics Canada, which in the case of the 1994/95 NPHS was 1.64.

A second approach to take into account the complex survey design of the NPHS is through the bootstrap method. The bootstrap method estimates an adjusted variance in order to account for the clustering and stratified nature of the sample frame. This method can only be used through Statistics Canada Remote Data Access service, and thus was used for longitudinal analyses. The boostrapping method resamples the initial sample, by taking a simple random sample with replacement from (n – 1) clusters within n clusters of the stratum (Statistics Canada,

2002). A given number of new samples are thus created, each with a unique set of bootstrap weights, and using these weights the estimate is calculated for each sample. Precise estimates of variance can be obtained through the bootstrapping method.

Measures

The content of the NPHS surveys was designed to provide data relevant to federal and provincial ministries of health. The content was determined in order to promote an understanding of health and its determinants, health behaviours and conditions amenable to intervention, with a focus on conditions that impose a heavy burden of suffering and/or cost on individuals and the health care system (Statistics Canada, 1996). For the purposes of this thesis, the data on socioeconomic and social health determinants, health behaviours, and health status are useful. However, as with any data collected for other purposes, there are some limitations to the data and methodology when it is used for purposes that it was not originally designed for. The section below describes the data content available in the NPHS as it relates to this thesis.

Demographic variables

Demographic variables are important to consider because many health conditions are associated with demographic factors, such as the typical increased prevalence of health conditions with increasing age. Furthermore, certain demographic variables such as marital, parental, and working status are necessary because they are related to conditionally relevant stressors. Thus, the following demographic variables are used in subsequent analyses. Age is aggregated in five-year categories, from 20 to 24, to 80 and older. Marital status is dichotomised into married or common law vs. single, divorced or separated, or widowed. Working status is

dichotomised as currently employed or currently not employed. Parental status is derived from a question in the stressors module, where individuals are asked whether they have children. Those for whom stressors with children is not applicable do not have children. Thus, a dichotomised variable based on this variable was created, resulting in the identification of participants with children vs. those without children. There is a variable on household composition; however this only identifies people who are living with their children. Unfortunately, no other measure of parental status is available. Household size was a measure of the number of persons whose usual place of residence was the selected dwelling (includes children away at university).

Socioeconomic status measures

Among others, income based measures of socioeconomic status are available in the NPHS. In the PUMF, total household income from all sources is available as an aggregated variable. In order to maximize efficiency of sample size for comparisons, an ordinal household income variable was created. The lowest income quintile ranged from 0 to 19,999 CA$, the second from 20,000 to 39,999, the middle from 40,000 to 49,999, the fourth from 50,000 to 79,999 and the highest had household incomes of 80,000 CA$ and greater.

Stressor measures

A series of questions about recent life events, chronic stressors, and work stressors were included in the 1994/96 cycle of the NPHS. The recent life events and chronic stressor questions were based on the work of Wheaton (1994), while the work stressors questions were based on the work of Karasek and Theorell (1990). In all three cases, a subset of questions from original scales was chosen for inclusion in the NPHS. Recent life events and chronic stressors were

chosen through an item response theory methodology by McDowell, Boulet & Kristjansson (Statistics Canada, 1996). There is no documentation on how the subset of questions from the work stress scale was chosen.

The recent life events question related to events that the individual or his or her family or close others experienced during the past twelve months. Ten questions focussed on events such as abortion or miscarriage, financial crises, demotion at work, and experience of violence. In the 1994 PUMF, relevant responses to the recent life events questions were summed resulting in scores representing the number of events experience. This scale could range from 0 to 8, 9 or 10, depending on marital and parental status. Individuals with missing data on any of the questions pertaining to them were given a missing data value. In the longitudinal file, the life events scale was calculate differently, in order to allow for up to 25% missing data. Thus, the life event variable used was the sum of yes answers divided by the total number of questions answered, and then multiplied by the total number of questions that could be answered.

The reliability of the *life events* questions used in the NPHS was investigated by Raina, Bonnett, Waltner-Toews, Woddward, and Abernathy (1999). The scale did not exhibit high internal constancy, which is a favourable result if one considers that life events are presumed to be relatively independent of one another. Test-retest reliability (kappa) for each life event was over .80.

The chronic stressors questions covered several domains of life, including Personal stress, Financial problems, Relationship problems (for those married or partnered), Problems with children (for individuals with children), Environmental problems, and Family health problems. In the 1994/95 cross-sectional PUMF, the missing value response "don't know" was considered as "no" and not as missing data. In the cross-sectional file, because of the varying

number of questions, each of the subscales had a different range of possible scores. For example, Personal stressors scores could range from zero to five, whereas the Financial stressors scale ranged from zero to one. These scales were recoded with one representing any reported stressor in that domain, and zero representing no reported stressors. In the longitudinal file, an alternative method to calculating the stressor scales was used, in which the response "don't know" was not accepted as a negative response. In the case of the Personal stressors scale, up to one missing value was allowed, and the scale was calculated as the sum of the true answers divided by the number of true and false answers, multiplied by the number of questions that could be answered.

Wheaton (1994) has demonstrated good convergent validity of the *chronic stressors* scale with indicators of difficult social circumstances (household income and reports of prior life events which could result in chronic problems) and discriminant validity with measures of psychological distress. Analyses demonstrated that reports of chronic stressors load on a separate factor than psychological distress. A very similar life events and difficulties checklist inventory developed by Costello & Devins (1988) has shown good negative predictive values (each .97) for both life events and chronic difficulties when compared to an interview method. However, positive predictive values were low (.27 and .20 for life events and chronic difficulties) when compared to an interview method. However the interview method (the Life Events and Difficulties Schedule) only identifies the presence of *major severe events*, and may not identify less severe but nonetheless important events. The low positive predictive value may result in an underestimation of any effect of severe life events and difficulties because of the inclusion of many false-positives.

The work stress scale was based on a subset of questions from the Job Content Questionnaire. Decision latitude was measured by five questions. Psychological demands were

measured by two. Consistent with the Demand Control Model of work stress, respondents who were in both the top tertile of psychological demands and the bottom tertile of decision latitude were considered to have Work Stress. The scale has demonstrated acceptable reliability (internal consistency of subscales ranging from .68 to .85 (Karasek et al., 1998; Larocque, Brisson, & Blanchette, 1998), concordance with external ratings (Hasselhorn, Theorell, Hammar, Alfredsson, & Westerholm, 2004), and discriminant validity between different jobs (Larocque et al., 1998).

Because of the conditional nature of certain stressor variables, namely Marital Problems, problems with Children, and Work Stress, a statistical control approach was used to account for this. When faced with conditionally relevant variables, varying approaches can be used to account for them. Although it is feasible to propose that exposure to a stressor itself is the important variable, and those individuals who are in living situations where the stressor exposure can not occur are simply unexposed (e.g. being unemployed protects one from work stress), an analytic strategy not taking into account the effect of the demographic variables may result in confounding. Therefore, analyses with conditionally relevant stressors included a variable indicating the demographic status and the stressor variable was given a value of "0" for individuals to whom it was not relevant. For example, on the recoded Martial stressor scale, individuals who had missing values because they were not in a spousal relationship were given a value of zero on that scale. True missing values continued to be excluded. In all analyses with conditionally relevant stressors, the demographic variables relating to the stressor were included in the model. In effect, such an analysis poses the question, "Does being exposed to problems in one's married life confer more risk or benefit than being married in and of itself?"

Health behaviours

Data were available for both smoking and physical activity behaviours. Smoking status was determined through a question on whether the respondent smokes daily, occasionally, or not at all. Daily smokers were asked how many cigarettes they consume.

Physical activity is a more complicated measure. There were questions on leisure time physical activity, such as participation in sports and exercise for exercise's sake, questions on transportation related physical activity such as walking to work, and questions on occupational physical activity. Because of the large differences in the questions asked with respect to leisure time, transportation and occupational physical activities, it is difficult if not impossible to form an aggregate scale of these different forms of physical activity. Because these three types of physical activity are likely to be affected by different factors and have different impacts on health, only leisure time physical activity is examined in this thesis.

Leisure time physical activity was measured by the respondents identifying which forms of physical activity they engage in. If a respondent replied that they engaged in a particular behaviour, then they were asked how many times in the past three months they had engaged in that activity and how much time they spent on that activity. In order to calculate a leisure time physical activity index, energy expenditure (EE) was estimated. EE was calculated using the yearly frequency of the activity (N), average duration of the activity (D), and the MET value of the activity as follows:

$$EE\ (kcal/kg/day) = \text{Sum of } ((N * D * METS) / 365)$$

EE for all activities is summed to yield a total energy expenditure value, which is then used to create a categorical physical activity index. Active participants expended greater than 3 kcal/kg/day of energy, which is the amount of exercise that is required for cardiovascular health

benefit. Moderately active individuals expended 1.5 to 2.9 kcal/kg/day of energy, which may result in some health but little cardiovascular benefit. Finally, inactive individuals expended less than 1.5 kcal/kg/day of energy. Because the threshold of what comprises a physically active individual is high, moderately active and active participants were regrouped to a single active category.

Health measures

For this thesis, the position was adopted that health is a multidimensional concept that reflects more than a state of being free from disease and that includes an individual's subjective experience and evaluation of their own health. Self-rated health is a global indicator of perceived health status measured in each cycle of the NPHS. A single question assessing self-rated health was used, asking the respondents, "In general, would you say that your health is: poor, fair, good, very good, or excellent?" The question was recoded into a dichotomous good vs. poor health variable, with responses of excellent, very good and good being coded as 0 (good health) and responses of fair or poor being coded as 1 (poor health).

Analysis

Much of the research conducted on the social gradient in health relies on logistic regression to predict a dichotomous health outcome, or on linear regression to predict a health outcome measured on interval scale. Self-rated health can be considered only as an ordinal scale, and thus linear regression may be inappropriate. The primary goal of this thesis is to test a mediational hypothesis of the social gradient in health -- that stressors explain part of the SES-health association. In linear regression, mediation is demonstrated when: the mediator (stressors)

is associated with the predictor (SES); the mediator is associated with the outcome (poor health); and when the mediator is accounted for in the original relationship (SES-health), this association is attenuated (Baron & Kenny, 1986). In linear regression, standardised beta coefficients can be compared, because the scaling of the variables is not dependent on the other variables in the equation. However, the mediating model is not as well developed for logistic procedure. Whereas the conditions outlined by Baron and Kenny still hold true, the comparison of logistic regression coefficients is not as simple as that presented by Cohen and Cohen (1983), because there is no standardized metric of the dependent variable (a dichotomous outcome) in logistic regression. The scale in logistic regression depends on the extent of prediction of the model, which is dependent on which variables are in the model (MacKinnon & Dwyer, 1993). In most epidemiological work estimating mediating effects, the percent reduction in the excess odds is the method used to estimate mediation. This is achieved through the following:

$$\text{extent of mediation} = ((\text{odds}_1 - 1) - (\text{odds}_2 - 1))/(\text{odds}_1 - 1)$$

where odds_1 is the odds from the equation without the mediator, and odds_2 is the odds from the equation with the mediator. However, this method may result in inaccurate estimates because the scaling of odds is not linear. Thus, the more appropriate technique is to fully standardize logistic regression coefficients before mediating effects are estimated (Menard, 2002). Standardization is achieved through the following equation:

$$b^*_{YX} = (b_{YX})(s_X)/\text{SQRT}\ (s^2_{\text{predicted logit}(\hat{Y})}/R^2) = (b_{YX})(s_X)(R)/S_{\text{predicted logit}(\hat{Y})}$$

where b_{YX} = the logistic regression coefficient; s_X is the standard deviation of the dependent variable; R is the correlation between the predicted probabilities with the dependent variable; and $S_{\text{predicted logit}(\hat{Y})}$ is the variance of the predicted logit. The percentage reduction in fully standardized logistic regression coefficients is then calculated to determine the extent of mediation.

CHAPTER 3. Stressors and the Social Gradient in Health

So far, I have described the social gradient in health and reviewed explanations for it, ending with the description of a conceptual model of which certain pathways are the focus of this thesis. I have reviewed the context of the thesis in relation to the data available in the National Population Health Survey, and have presented the objectives and hypotheses for this thesis. Following is the first article of this thesis, which addresses Objectives 1, 2 and 3. This first article uses cross-sectional analysis of the National Population Health Survey to describe the social gradient in self-rated health and reported stressors in Canada as stratified across household income. Furthermore, it examines whether reported stressors are associated with poor self-rated health, and if these stressors mediate part of the household income-self-rated health relationship.

Article 1. Explaining the Social Gradient in Health in Canada:

Using the National Population Health Survey to examine the role of stressors

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Abstract

Understanding the mechanisms that explain the pervasive association between socioeconomic status and health has been identified as an important area of research. Using the 1994-1995 National Population Health Survey, this study examines whether exposure to psychosocial stressors may be one mediating mechanism of the social gradient in health. Data were obtained including indicators of socioeconomic status (SES); exposure to recent life events and chronic stressors; and self-rated health status. Results showed a clear gradient in poor self-rated health with decreasing SES. Higher exposure to stressors across several domains was also observed with decreasing SES. Exposure to stressors was further associated with poor self-rated health, above and beyond adjusting for SES. Across income adequacy groups, exposure to stressors accounted for 16% to 26% of the relationship between income group and poor self-rated health among men and for 6% to 15% among women, suggesting that exposure to psychosocial stressors may be one of the mediators underlying the higher prevalence of poor self-rated health within lower socioeconomic groups.

KEYWORDS: socioeconomic status, social gradient, stressors, stress, self-rated health

Explaining the social gradient in health in Canada:
The role of exposure to stressors in the National Population Health Survey

The social gradient in health describes the graded association observed between socioeconomic status (SES) and health status. This pervasive pattern of greater morbidity and earlier mortality associated with lower income, education, or occupational status persists for almost every disease, including heart disease, diabetes, numerous cancers, and mental illnesses (Marmot, Shipley, & Rose, 1984; Pincus, Callahan, & Burkhauser, 1987; Susser, Hopper, & Watson, 1985). Researchers have attempted to identify the causal mechanisms governing this association so that interventions can be appropriately targeted. Current explanations of the social gradient in health fall into three broad categories: material/structural, behavioral/lifestyle, and psychosocial mechanisms (Elstad, 2000). The purpose of this paper is to provide evidence for the contribution of psychosocial stressors to the social gradient in health, with consideration of the multifactorial nature of causation of patterns of health and illness.

The material/structural explanation posits that lower SES individuals are exposed to more harmful *physical* environments and have less access to health care and other material health-promoting resources (Lynch, Davey Smith, Kaplan, & House, 2000). The behavioral/lifestyle explanation suggests that lower SES individuals are less healthy as a result of poorer health-related behaviors such as smoking or poor eating habits (Lynch, Kaplan, & Salonen, 1997). However, evidence suggests that these two explanations can only explain part of the gradient (Adler et al., 1994; Evans, Barer, & Marmor, 1994) and considerable variance remains unexplained. The third paradigm is promising in explaining some of the residual variance between SES and health, and proposes that SES is associated with contextual social factors and resulting psychological processes that result in poor health through behavioral and

psychobiological mechanisms. Although these three explanations are often presented as competing hypotheses, there is considerable overlap and potential synergy between them, as the effects of one source of health liability may compound the effects of another. For example, exposure to psychosocial stressors is associated with onset of depression (Brown & Harris, 1978), and an inability to pay for the services of a psychologist could prolong the healing period, leading the individual to smoke more (Graham, 1994). Therefore, although the primary purpose of this paper is to explore the contribution of a psychosocial mechanism to the social gradient in health, this is not to the exclusion of other important pathways.

One of the proposed psychosocial mechanisms is through differential exposure to adverse life circumstances, including exposure to stressors arising from living contexts largely determined by socioeconomic status (Baum, Garofalo, & Yali, 1999; Pearlin, 1989). Stressors can be conceptualized as acute events or ongoing situations in the environment that would, *for the average person,* invoke a strong emotional reaction and that usually constitute a threat, demand, or constraint (Brown & Harris, 1978; Wheaton, 1994). Such events or situations can be regarded as stressors regardless of whether a strong emotion is indeed perceived by the individual. Several taxonomies of stressors have been articulated, including life events, chronic stressors, and work stress. Many of these stressors demonstrate a social distribution, with lower status individuals being exposed to a greater number of life events (Cohen, Kaplan, & Salonen, 1999; Gottlieb & Green, 1984; Stronks, van de Mheen, Looman, & Mackenbach, 1998; Turner, Wheaton, & Lloyd, 1995; Brown & Harris, 1978); chronic stressors (Stronks et al., 1998; Turner et al., 1995); and work stress (Karasek & Theorell, 1990; Fotinatos-Ventouratos & Cooper, 1998; Pearlin, 1989).

If exposure to stressors is to mediate the social gradient in health, then it must also be

related to poor health. Exposure to stressors and resulting psychological stress have been associated with numerous negative health outcomes, and at least two mechanisms for this have been suggested. First, changes in health-related behaviors have been associated with stressor exposure, such as increased smoking during times of stress (Baum & Posluszny, 1999; Graham, 1994). Second, direct psychophysiological effects on endocrine and immune systems are biologically plausible mechanisms (Brunner, 1997; McEwen, 1998). Exposure to a wide range of life events has been associated with greater risk for numerous diseases (Brown & Harris, 1989), and job strain has been consistently associated with a greater risk for cardiovascular disease (Schnall, Landsbergis, & Baker, 1994; Hemingway & Marmot, 1999). Indeed, these pathways between stressors and health attest to the impossibility of attributing social gradients in health to solely one explanation.

Recently, Stronks et al. (1998) demonstrated an inverse association between education and several stressors, and demonstrated that stressors contributed approximately 20% of the increased risk of poor health among the lowest educational groups in the Netherlands. Similarly, Cohen et al. (1999) reported a comparable contribution of exposure to stressors to poor health in lower income and education groups in both American and Finnish samples. These studies demonstrate that even using different indicators of socioeconomic status, a similar pattern of health gradients emerges. Socioeconomic status (SES) is a complex latent concept which refers to an individual's position in society relative to others. The relative importance of a given position is determined primarily by society's value for the function of that position, and scarcity of individuals with requisite skills to fulfill the role (Davis & Moore, 1945). One indicator of SES is income which, when obtained through employment or social transfer, reflects to a large extent the interplay of role value and scarcity of possible incumbents. Thus, occupational

prestige and education are closely related to income. In terms of functional value, income is most closely related to access to material resources. As the same time, it can act as a proxy for other important aspects of SES, such as power, status, and style of life, which, although important, are the not the focus of these analyses.

The purpose of the present study is to provide converging evidence for psychosocial mediation of the social gradient in health by testing whether a similar pattern of results is observed within a Canadian sample. The specific objectives of this study are to demonstrate inverse income gradients of self-rated poor health and exposure to stressors, and to test whether exposure to stressors can account for the increased prevalence of poor health among lower SES individuals.

Data and Methods

Data were obtained from the 1994-1995 cycle of the National Population Health Survey (NPHS; (1994-1995 NPHS Public Use Microdata Documentation, 1996) which has been described in detail by (Tambay & Caitlin, 1995). Approximately 17,000 participants were sampled using a multi-stage stratified sample of dwellings within clusters of dwellings. One participant per household was randomly selected as the targeted participant. Data were collected by Computer Assisted Interviewing. Within the 88.7% of households agreeing to participate, 96.1% of selected individuals agreed to provide detailed data, resulting in an overall response rate of 85.2 % of individuals. Reporting on selected individuals by another person (i.e. proxy reporting) accounted for 4% of the data (Statistics Canada, 1996). In order to take into account the complex survey design of the NPHS, sampling weights were calculated based on the formula provided by Statistics Canada, for men and women separately.

Participants ranging from age 20 to 80 and older were retained for our analyses (n =

15,779), including 7126 men and 8653 women. Less than 9% of participants had missing data on any of the variables included in the analyses. Participants with a complete set of data included 6351 men and 8077 women. Due to the use of weights as described above, the weighted sample size for these analyses was 4852 men and 6215 women having a complete set of data, and all reported estimates are based on weighted data.

Twenty-five percent of men and 26% of women had less than high school education, whereas 17% of men and 14% of women had a university degree or higher. Most men and women were married or living in a spousal relationship (71% and 65%, respectively). Most women were currently employed (54%), however a considerable minority had not worked within the previous 12 months (40%). A greater proportion of men were currently employed (70%), with only 22% not having worked in the previous 12 months.

Measures

Socioeconomic status.

Of the many possible indicators of socioeconomic status, in this study SES was measured by household income, grouped into five approximate income quintiles. Household income takes into account the incomes of all working adults in the household, and therefore is close to the concept of access to material resources. The lowest income quintile ranged from 0 to 19,999 CA$, the second from 20,000 to 39,999, the middle from 40,000 to 49,999, the fourth from 50,000 to 79,999 and the highest had household incomes of 80,000 CA$ and greater.

Stressors.

Three stressors scales were included in the NPHS: Chronic stressors, Recent life events and Job strain. Dichotomous variables as well as scores of the number of stressors were created as described below. The Chronic stressors scale consisted of a series of 18 questions relating to

situations that the participant reported were present in his or her life (Wheaton, 1994; Turner et al., 1995). Examples included: "A child's behavior is a source of serious concern for you"; "You would like to move but you cannot"; and "Someone in your family has an alcohol or drug problem." The Chronic stressors scale has shown good convergent validity with indicators of difficult social circumstances (e.g. reports of prior life events which could result in chronic problems) and discriminant validity with measures of psychological distress (Wheaton, 1994). The Chronic stressors questions were used to calculate dichotomous exposure scores for each domain of stressors (0 for no problems and 1 for any number of problems; variable name indicated in parentheses). Several domains of stressors are measured, including stressors related to the individual (Personal), relationship problems with a spouse (Marital), problems with children (Children), family health problems (Family health), a poor physical and social environment (Neighborhood), and financial problems (Financial).

The Job strain items were based on the Job Content Questionnaire (Karasek & Theorell, 1990) and comprised Decision Latitude (five questions reflecting Skill Discretion and Decision Authority; e.g. "Your job allows you freedom to decide how you do your job") and Psychological Demands (two questions; e.g. "Your job is very hectic"). Response choices ranged from zero to four (0 = strongly agree, 4 = strongly disagree). Individuals falling in the bottom tertile of Decision Latitude and in the top tertile of Psychological Demands were considered to be exposed to Job strain.

In this study, chronic stressors are conceptualized as adverse situations lasting for an extended period of time. Therefore, in creating an aggregate scale of chronic stressor exposures, dichotomous exposure scores on all six chronic stressor domains as well as the dichotomous Job strain exposure were summed to form a chronic stressor exposure index. This resulted in an

interval scale that represents the number of domains in which an individual reports they are exposed to a chronic stressor, and can range from 0 to 5, 6 or 7 depending on marital, parental, and employment status.

The Recent life events scale (Wheaton, 1994) was the sum of all positive responses to a series of 10 questions concerning major negative events that may have happened to the participant or his or her close others during the previous 12 months. Scores ranged from 0 to 8, 9 or 10, depending on marital and parental status. Examples of questions include: "In the past 12 months, did you or someone in your family have an unwanted pregnancy?" and "In the past 12 months, were you (or your partner) demoted at work or did either of you take a cut in pay?" This variable was also recoded into an additional dichotomous exposure variable, with 0 representing those participants with no reported life events and 1 representing all others.

Health.

Numerous perspectives, including biomedical, biopsychosocial or functional perspectives, can be adopted with respect to the operationalization of the concept of health, determining the choice of measured health indicators. We take the position that health is a multidimensional concept that reflects more than a state of being free from disease and that includes an individual's subjective experience and evaluation of their own health. Thus, self-rated health was chosen here as the single best global measured indicator of health status.

In addition to its utility as an easy to administer and conceptually valid global evaluation of perceived health status, self-rated health has also demonstrated surprisingly robust concurrent and predictive ability of accepted objective indicators of health. Self-rated health predicts future mortality (Idler & Benyami, 1997), and is associated with long-standing illness (Manor, Matthews, & Power, 2001) and health care utlization (Hansen, Fink, Frydenberg, & Oxhoj,

2002). It is highly stable, suggesting that it is not an assessment of transient, time-limited health states. In one study, 90% of participants reporting good health at baseline reported good health at the ten-year follow-up (Manor et al., 2002).

In the NPHS, a single question assessing self-rated health was used, asking the respondents, "In general, would you say that your health is: poor, fair, good, very good, or excellent?" The question was recoded into a dichotomous good vs. poor health variable, with responses of excellent, very good and good being coded as 0 (good health) and responses of fair or poor being coded as 1 (poor health).

Analyses

Logistic regression using SPSS 11.0 was used to conduct statistical analyses. Analyses were run separately for men and women in order to enable the observation of sex differences in patterns of association. The highest income quintile was used as the reference group. Logistic regression was used to test the association between SES and self-rated health, SES and stressor exposures, and stressor exposures and self-rated health. All analyses controlled for age (in ten-year groups from age 20 to 70 and over). Smoking status (daily smoker vs. all others), physical activity level (sedentary vs. all others), and the social roles of marital, parental, and employment status were also controlled when self-rated health was the dependent variable.

Age-adjusted prevalences of poor self-rated health and exposures to stressors were calculated, using the age-distribution of the sample as the standard. For Marital problems, Problems with children, and Job strain, prevalences were calculated only for participants in a spousal relationship, parents, and employed participants, respectively.

To test for mediation of the SES-health relationship by exposure to stressors, the aggregate Chronic stressor score and the aggregate Recent life events score were entered into the

logistic regression predicting poor self-rated health from income quintile after adjustment for the aforementioned factors. In order to test for mediation a relationship must be demonstrated between the predictor variable (SES) and the mediator (stressors) and between the mediator (stressors) and the outcome variable (health). Mediation is demonstrated by a reduction in the original predictor-outcome relationship when the mediator is included in the regression (Holmbeck, 1997; Baron & Kenny, 1986). Raw logistic regression coefficients from different equations can not be directly compared because the scale of the variables varies as a function of the degree of prediction, which itself varies when different variables are included in the equation. To account for this, logistic regression coefficients must first be standardized before comparing coefficients from different models as a test for mediation (MacKinnon & Dwyer, 1993). The method proposed by (Menard, 2002) was used to standardize the coefficients, using the equation:

$$b^{*}_{YX} = (b_{YX})(s_X)/\mathrm{SQRT}\ (s^2_{\text{predicted logit}(\hat{Y})}/R^2) = (b_{YX})(s_X)(R)/S_{\text{predicted logit}(\hat{Y})}$$

Results

As shown in Table 1, a clear social gradient in poor self-rated health was observed. Age-adjusted prevalence of poor self-rated health ranged from 3% to 18% among men and from 7% to 20% among women. Age-adjusted prevalences of reported stressor exposures, including *p* for the Test for Trend obtained from logistic regression analyses, are also shown in Table 1. The direction and strength of these relationships varied across stressor domains. Contrary to expectations, the prevalence of Personal stressors increased with increasing income quintile. For men, prevalence of all other stressors was inversely associated with income quintile: a significant trend across all domains indicated higher exposure among lower income quintile groups. For women, this significant trend was observed for exposure to Marital, Financial, Neighborhood,

Table 1

Age-adjusted prevalences of poor self-rated health and reported stressor exposures by income quintile, including p for Test for Trend

	Income Quintile					
	Lowest (1)	2	3	4	Highest(5)	p
Men						
Poor self-rated health	18%	11%	7%	6%	3%	<.01
Personal	54%	54%	54%	53%	60%	<.01
Marital [a]	19%	20%	19%	14%	12%	<.01
Children [b]	38%	36%	32%	27%	30%	<.05
Family health	26%	22%	16%	20%	17%	<.01
Job strain [c]	8%	9%	7%	8%	4%	<.01
Neighborhood	37%	27%	26%	25%	22%	<.01
Financial	60%	44%	36%	32%	22%	<.01
Life events	50%	36%	35%	34%	28%	<.01
Women						
Poor self-rated health	20%	13%	10%	6%	7%	<.01
Personal	63%	62%	62%	62%	65%	<.05
Marital [a]	28%	24%	22%	20%	19%	<.05
Children [b]	39%	32%	33%	33%	36%	n.s.
Family health	27%	26%	26%	24%	24%	n.s.
Job strain [c]	12%	12%	13%	11%	9%	n.s.
Neighborhood	36%	27%	22%	23%	18%	<.01
Financial	58%	39%	33%	28%	18%	<.01
Life events	50%	38%	37%	34%	36%	<.01

Note. [a] Restricted to participants in a spousal relationship (men = 3438, women = 4065); [b]Restricted to parents (men = 3316, women = 4703); [c] Restricted to employed participants (men = 3400, women = 3345).

and Life event stressors. No significant trend among women was observed for stressors associated with Children, Family health problems, or Job strain. As seen in Table 1, the social gradients in exposure to stressors were most pronounced with Financial problems and Neighborhood stressors.

Reported exposure to each stressor was associated with significant odds ratios for poor self-rated health after adjusting for age, behavioral factors, and social roles as reported in Table 2. Whereas confounding of the relationship by income quintile was a possibility, in fact adjusting for this had very little effect on the stressor-health relationship. After adjusting for income quintile only the odds ratio associated with Marital stressors among men became marginally non-significant.

As reported in Table 3, odds ratios for poor self-rated health increased progressively as income quintile decreased, even after adjusting for age and social roles. All odds ratios indicated a significant difference between the reference and comparison groups ($p<.05$), except for the second highest income quintile for both men and women. Adjusting for health behaviors resulted in attenuation of the odds ratios, with the odds ratio for the third highest income quintile in men also becoming non-significant. However, a step-wise gradient remained, with men in the lowest income quintile having an adjusted odds ratio of 3.12 and women in the lowest income quintile having an adjusted odds ratio of 3.27.

Adjusting for exposure to stressors as a test of mediation resulted in further attenuations of the odds ratios. Including stressor exposures in the model significantly improved the prediction of poor self-rated health. The last column in Table 3 presents the percentage reduction of standardized logistic regression coefficients for each income quintile group after including exposure to stressors in the logistic regression equation predicting poor self-rated health. Among

Table 2

Odds ratios for poor self-rated health according to stressor exposures adjusting for social roles and showing the effect of adjusting for income quintile (Model 2)

	Odds Ratio (95% CI)			
	Men		Women	
Stressor	Model 1	Model 2	Model 1	Model 2
Personal	1.90* (1.53, 2.37)	1.86* (1.49, 2.31)	1.99* (1.66, 2.38)	1.97* (1.64, 2.35)
Marital	1.40* (1.04, 1.87)	1.33 (0.99, 1.78)	1.93* (1.54, 2.42)	1.88* (1.49, 2.30)
Children	1.35* (1.06, 1.71)	1.32 *(1.04, 1.68)	1.82* (1.52, 2.18)	1.79* (1.50, 2.15)
Family Health	1.48* (1.18, 1.87)	1.42* (1.13, 1.80)	1.51* (1.26, 1.80)	1.52* (1.27, 1.82)
Job strain	1.86* (1.78, 2.95)	1.75* (1.11, 2.78)	1.71* (1.17, 2.50)	1.68* (1.15, 2.47)
Neighborhood	2.04* (1.62, 2.55)	1.91* (1.55, 2.43)	1.84* (1.54, 2.20)	1.76* (1.47, 2.10)
Financial	2.12* (1.17, 2.63)	1.88* (1.51, 2.35)	2.04* (1.71, 2.43)	1.84* (1.54, 2.21)
Life events	1.93* (1.55, 2.40)	1.83* (1.47, 2.28)	1.65* (1.39, 1.96)	1.59* (1.34, 1.90)

Note. *p <0.05; Model 1: Adjusted for age, social roles and health behaviors; Model 2: Adjusted for age, social roles, health behaviors, and income.

Table 3

Odds ratios of poor self-rated health according to income quintile and percentage reduction of standardized logistic regression coefficients demonstrating mediating effect of stressors

	Sample size	Odds Ratio (95%)			
Income	*n*	Model 1[a]	Model 2[b]	Model 3[c]	% reduction
		Men			
Lowest(1)	850	3.44 (2.15, 5.52)	3.12 (1.94, 5.02)	2.38 (1.47, 3.86)	26%
2	1400	2.29 (1.46, 3.60)	2.16 (1.37, 3.40)	1.88 (1.19, 2.98)	20%
3	650	1.71 (1.03, 2.86)	1.61 (.96, 2.70)	1.51 (.90, 2.54)	16%
4	1280	1.28 (.79, 2.08)	1.23 (.76, 2.00)	1.17 (.72, 1.91)	25%
Highest(5)	672	1.0	1.0	1.0	
		Women			
Lowest(1)	1558	3.50 (2.28, 5.40)	3.27 (2.12, 5.04)	2.72 (1.76, 4.22)	15%
2	1761	2.56 (1.68, 3.91)	2.43 (1.59, 3.71)	2.26 (1.47, 3.47)	8%
3	807	1.90 (1.19, 3.05)	1.82 (1.14, 2.91)	1.75 (1.09, 2.82)	6%
4	1403	1.47 (.93, 2.32)	1.48 (.94, 2.33)	1.43 (.90, 2.27)	8%
Highest(5)	686	1.0	1.0	1.0	

Note. [a] Model 1: Adjusting for age and social roles; [b] Model 2: Adjusting for age, social roles, and health behaviors; [c] Model 3: Adjusting for age, social roles, health behaviors, and all stressors.

men, the attenuation in standardized regression coefficients ranged from 16 to 26%, and among women, from 6 to 15%, suggesting partial mediation of the differences between the highest and lower socioeconomic groups by stressor exposures. Figure 4 demonstrates the reduction in the odds ratios, with the shaded portion of the bar representing the proportion of the odds ratio that was attenuated when exposure to stressors was accounted for. However, as can be seen by the residual odds ratios, a considerable association between SES and poor self-rated health persisted.

Discussion

These results provide converging evidence for the psychosocial hypothesis of the social gradient in health. Decreasing income quintile was associated with incremental increases in the prevalence of poor self-rated health as well as higher prevalences of many stressors. Exposure to each stressor was associated with significant odds ratios for poor self-rated health. Finally, partial mediation of the SES-health relationship by exposure to stressors was demonstrated by a reduction in odds ratios when stressors were accounted for in the regression equation.

The observed relationship between income quintile and self-rated health is consistent with the preponderance of results describing the social gradient in health, across Western countries and using related but distinct indicators of socioeconomic status such as income quintile, occupational prestige and education[1]. The consistent pattern of results is remarkable and emphasizes the pervasiveness of the social gradient in health. However, descriptions of the social gradient in health tell us nothing about what causes this pattern; the results of this study suggest exposure to stressors as one psychosocial pathway which may be an important contributor to SES differences in health.

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[1] We also repeated our analyses using education as the socioeconomic indicator and obtained results similar to those presented.

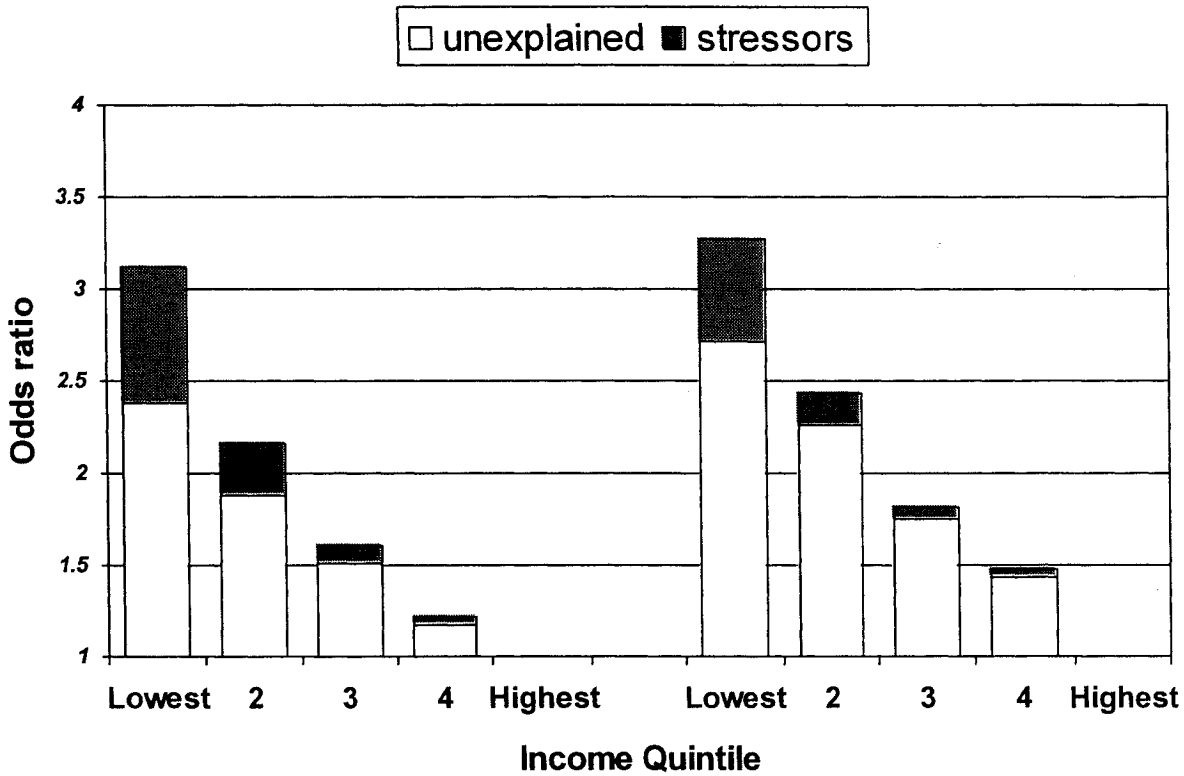

Figure 4.

Odds ratios of poor self-rated health for men and women by income quintile controlling for age, social roles and health behaviors, with the shaded area showing proportion of odds ratios explained by stressors.

With the exception of Personal stressors, we observed a significant trend of increasing prevalence of stressor exposures with decreasing income quintile for all stressors among men, and for many stressors among women. Our results concur with those of Turner et al. (1995), who reported a linear relationship between SES and number of chronic stressors, and significantly greater exposure to negative life events among lower SES individuals. In contrast, Stronks et al. (1998) found that only family health problems and poor financial conditions were associated with decreasing education, whereas relationship problems were reported more frequently with increasing education. Cohen et al. (1999) observed decreasing risk of exposure to two or more life events with increasing education or income among an American sample but not among a Finnish sample. Reasons for these differences need to be further explored, but may reflect differences in the structuring of social systems between these countries. Alternatively, inconsistent results across studies may be attributable to different methods of measuring stressor exposures.

Differences in the direction and strength of the distribution of types of stressor exposures across socioeconomic strata may be explained by the location of the stressor within the social system. Stressors which are structural in origin, such as poor neighborhood environments or financial problems, demonstrated a steeper gradient than stressors which are more closely related to the individual and his or her microsystem, such as personal stressors or marital problems. Given the use of income as an indicator of socioeconomic status, this result is consistent with the idea of income as a resource for access to material goods and therefore has the greatest association with financial and neighborhood stressors. Other choices of socioeconomic indicators may yield different saliency of gradients. For example education may be more closely related to stressors that can be avoided with appropriate knowledge or skills, whereas occupational prestige

as an SES indicator may be more related to stress at work, due to systematic variations in control as a function of power within occupations.

It has been argued that the systemic stressors of financial stressors and a poor neighborhood environment contribute to the social gradient in health through material pathways as opposed to psychosocial ones (Lynch et al., 2000). For example, financial problems could result in an inability to buy nutritious food or to pay for adequate heating. However, these stressors also confer health risk through stress mechanisms, as they indeed result in considerable psychological distress (MacFayden, MacFayden, & Prince, 1996). Furthermore, systemic stressors could generate other secondary stressors at system levels more proximal to the individual. Therefore, intervening at the level of "upstream" stressors through material/structural interventions may prevent the development of "downstream" stressors which normally require intervention at the level of the individual.

Reporting of exposure to stressors was consistently associated with higher odds ratios of poor self-rated health, even after adjusting for income quintile. Both Stronks et al. and Cohen et al. also observed increased health risk associated with increasing stressor exposure. However, given the cross-sectional nature of this study, these associations must be interpreted with caution as it is possible that poor health results in an increase in reporting stressor exposures. For example, health problems may cause an individual to incur large expenses associated with the health problem, resulting in financial problems. For this reason, longitudinal studies which examine changes in health status would provide stronger evidence supporting the hypothesized psychosocial mechanisms.

Including exposure to stressors in the model of the relationship between income quintile and poor self-rated health decreased the odds ratios across all groups; however, significant

associations persisted as did the graded nature of these relationships. This provides correlational evidence for partial mediation of income effects on health through psychosocial pathways: greater reported stressors appear to contribute to the higher prevalence of poor self-rated health among lower income groups as compared to the highest income group. Although it is not possible to statistically discriminate between mediation and confounding, because exposure to stressors are conceptualized as arising from the living contexts associated with one's socioeconomic status, and because they are plausible causes of poor health, these results should be interpreted as an instance of mediation (Rothman & Greenland, 1998). Moreover, the present analyses may have *underestimated* the contribution of stressors to the social gradient in health by adjusting for behavioral factors. Changes to health behaviors resulting from stressor exposure have been reported and are postulated to be one mechanism through which stress affects health. Therefore some of the contribution of exposure to stressors to the social gradient in health may have been removed due to this, resulting in a conservative estimate of the mediating effect of exposure to stressors.

Several limitations of this study must be highlighted. First, due to the cross-sectional nature of this study, the results should not be interpreted as causal associations. Future analyses of the NPHS dataset should examine changes in self-rated health over time as well as incident reports of disease to better establish causal sequence. Second, the self-report nature of the data raises concerns of reporting biases and shared methods variance. In the domain of stress research, considerable attention has been given to the possible confounding of self-reports of stressor exposures and of health problems by negative affectivity (Watson & Pennebaker, 1989). Furthermore, negative affectivity appears to be more common among lower SES individuals (Adler, Epel, Castellazzo, & Ickovics, 2000). However, some authors have argued that negative

affectivity has a substantive role linking stressors exposures to ill-health, and therefore adjusting for it may lead to an underestimation of actual effects (Spector, Zapf, Chen, & Frese, 2000). Use of contextual or observer-based measurement of stressors would address the possibility of reporting biases; however this is not feasible in large population-based studies. Finally, these results should be interpreted with the caveat that alternative explanations driven by unmeasured factors can not be excluded.

Given the results presented in this study, which concur with those presented by other researchers in several countries, further research into the psychosocial explanation of the social gradient in health is warranted. The important proportion of the relationship between SES and health explained by psychosocial stressors suggests that interventions that reduce the chronic stressor burden may contribute to the reduction of socioeconomic gradients in health. Interventions which target material and structural factors which give rise to these stressors may be particularly important.

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From Cross-sectional to Longitudinal Analyses: Strengthening the Evidence

The previous article clearly demonstrated a social gradient in self-rated health as distributed across household income groups. Decreasing household income was associated with an increasing prevalence of reported stressors, and reported stressors were associated with poor self-rated health. Stressors mediated the social gradient in health by about one fifth in men, and somewhat less among women (ranging from 6 to 15%).

However, these cross-sectional analyses must be interpreted with caution. Reverse causation, with health problems resulting in lower household income, can not be excluded as a possible explanation of the observed association between self-rated health and income. Thus, determining the temporal sequence between household income and self-rated health is an important step in providing evidence for a causal relationship. Other confounds are also important to consider. Being in a state of poor health could also result in a "search after meaning" effect (Brown & Harris, 1978), where individuals in poor health are more likely to remember stressors as they try to find cogent explanations of their health problems. As well, there is potential for a reporting bias leading to a higher reporting of both stressors and negative evaluations of health. These issues will be addressed in the second article in this thesis, entitled "Do stressors explain the association between income and changes in self-rated health? A longitudinal analysis of the National Population Health Survey."

The next article uses longitudinal data from the National Population Health Survey to examine whether household income at baseline predicts a decline in self-rated health status two years later. As well, whether reported stressors at baseline predict declines in health status will be addressed. Finally, whether stressors mediate part of the expected relationship between baseline income and decline in self-rated health will be examined. These analyses will address

the temporal sequencing of the income and health, and stressors and health relationship. Unfortunately, because only the first and not the second cycles of the NPHS measure stressors, we can not ascertain the ordering between household income and stressors. However, in the model being tested, accounting for the temporal sequence between income and health and stressors and health is most important.

CHAPTER 4. Stressors and the Social Gradient in Health Decline

Article 2. Do Stressors Explain the Association Between Income and Changes in Self-rated Health? A Longitudinal Analysis of the National Population Health Survey

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Abstract

Although there is considerable evidence documenting the relationship between lower socioeconomic status and poorer health, longitudinal research is needed to study mechanisms which may explain this relationship. This study investigated whether income was associated with decline in self-rated health over a two-year period, and whether stressors mediated part of this social gradient. Participants in the National Population Health Survey who rated their health as excellent, very good or good in 1994/95 were followed over two years. Analyses demonstrated that individuals in the two lowest household income quintiles had significantly greater odds of experiencing a decline in health status as compared to the highest quintile. Seven of eight reported stressors at baseline were each associated with a significantly increased odds of experiencing a decline in self-rated health. Furthermore, these stressors explained 16% and 10% of the relationship between the lowest and second lowest income quintiles and decline in self-rated health respectively. These results suggest that stressors may be one mechanism underlying the social gradient in health.

KEYWORDS: income, self-rated health, social gradient, stress, longitudinal, National Population Health Survey

A considerable body of research demonstrates the pervasiveness of the graded relationship between increasing socioeconomic status (SES) and better health status, whether using "objective" measures of income, education, or occupation based measures, or subjective measures of perceived SES (Adler & Ostrove, 1999). However, in order to act to attenuate socioeconomic differences in health, the mechanisms which drive this association must be understood. Proposed mechanisms of the social gradient in health include both health selection and social causation explanations (Elstad, 2000). In health selection, health is a factor which leads to the ability to attain education or occupational achievement, and to earn income. In contrast, social causation explanations propose that SES affects health through material, behavioural and psychosocial pathways. If this is the case, then intervention at the level of socioeconomic status itself or at points on these pathways could act to attenuate socioeconomic differences in health.

Research focussing on determining the direction of the SES-health relationship generally points to social causation explanations. For example, through analysis of the 1958 Birth Cohort longitudinal dataset, Manor, Matthews and Power (2003) concluded that although poor health was associated with being more likely to experience declines in social standing, the effect of health selection on the social gradient in health was variable and of modest size. In both the 1958 and 1946 Birth Cohorts, ill-health in childhood had little effect on adult social standing (Blane, Davey Smith, & Bartley, 1993; Power, Manor & Fox, 1991). In the aggregate, these studies suggest that while health selective mobility does occur, health selection cannot be considered a major explanation of the social gradient in health, especially not among employed individuals.

Given that social causation seems to be driving an important part of the social gradient in health, the underlying mechanisms that cause this gradient need to be identified. Major

explanations have included physical environment/material, behavioural/lifestyle, and psychosocial causes of the social gradient in health (Elstad, 2000; Townsend & Davidson, 1982). Studies examining the contribution of these mechanisms to the social gradient in health generally support the role of each of these causes, however there is little longitudinal research using nationally representative samples studying the contribution of these causes.

Lantz et al. (2001) examined socioeconomic disparities in changes in health over 7.5 years using a population survey, and concluded that health behaviours explained only a modest proportion of the increased odds of decline in health associated with lower education or income. A study examining decline in health over four years in French and UK public employees demonstrated that early childhood environment, health behaviours and job strain explained 56% and 42% of the increased odds of poor self-rated health associated with lower employment grade, in men and women respectively. In contrast, these factors explained only 27% of the increased odds of poor self-rated health by employment grade for women in the French cohort, and nothing for men (Fuhrer et al., 2002). In a study of UK civil servants, Martikainen, Stansfeld, Hemingway and Marmot (1991) reported that material problems and decision latitude explained 43% and 25% of employment grade differences in three-year changes in physical functioning for men, but did not explain employment grade differences in physical functioning change among women. In the Danish National Work Environment Cohorts study, the socioeconomic gradient in a worsening of self-reported health status over five years was largely explained by work factors (59%) and behavioural factors (17%) (Borg & Kristensen, 2002). Interestingly, while social class was an important predictor of worsening self-reported health, it was not a significant predictor of improved self-reported health. Finally, Mustard, Vermeulen and Lavis (Mustard, Vermeulen, & Lavis, 2003)(2003) demonstrated that among employed

Canadians, men in the two lowest occupational classes had approximately 1.8 the odds of experiencing a decline in health status over four years, whereas no association was observed among women. Health behaviours and psychosocial job characteristics explained only a modest proportion of the increased odds among men. Adjusting for income did not alter these findings.

Theses occupational studies add important knowledge to the literature. The variables explaining the relationship between socioeconomic position and decline in health ranged from having no explanatory power, to explaining over half of the excess odds. Generally, effects observed were more consistent among men than among women, indicating that different mechanisms may be at play for men and for women. However, in many cases the mechanisms were not studied individually, and thus it is difficult to determine where intervention efforts may be targeted. Furthermore, only the study by Lantz et al. (2001) included non-employed participants, thus this body of research has limited generalizability. There is need for longitudinal research, examining employed and non-employed individuals, and examining the contribution of specific mechanisms.

In a previous paper, we demonstrated an income gradient in self-rated health that was partially accounted for by self-reported stressors (Orpana & Lemyre, 2004). However, because the data were cross-sectional, it was not possible to ascertain the temporal ordering of the association. Did health problems precede low household income, or did low household income precede the health problems? Fortunately, longitudinal data is now available by which we can better determine the direction of this effect. The goal of the present paper is to investigate whether there is a relationship between income quintile at baseline and subsequent decline in self-rated health from good/very good/excellent to fair/poor over a two-year period, and whether

stressors reported at baseline mediate the relationship between baseline income and decline in self-rated health.

Methods

Data from 17,276 individuals in the National Population Health Survey (NPHS) longitudinal file were analysed. The NPHS is a longitudinal survey administered by Statistics Canada, with the first cycle taking place in 1994/95 and follow-up surveys every two years thereafter for twenty years. It samples individuals living in households over the age of 12 years in all provinces, excluding individuals living on Indian reserves, Canadian Forces bases, and a few remote areas. Households were chosen from a stratified multi-stage sample of dwellings selected from within clusters of households, based on the sample design of the Labour Force Survey (except for in Quebec, where the Enquête sociale et de santé sample frame was used). Data were collected by computer-assisted interviewing. For these analyses, the longitudinal square subset available by Remote Data Access was studied, consisting of 17,276 individuals who were surveyed initially in 1994. Data from the 1994/95 and 1996/97 cycles were analysed.

The response rate in the 1994/95 Cycle was reported to be 83.65% at the Canada level for the health component of the survey (Statistics Canada, 2002a). The response rate at Cycle 2 in 1996/97 was 93.6%. Participants 20 or older with complete data on the studied variables who selected good, very good, or excellent health in response to the self-reported health question in 1994/95 were included, comprising 11,447 of the original 17,276 participants. 2,178 participants were excluded, because of non-response, death or institutionalization at Cycle 2, or due to missing data on the studied variables. The final studied sample size was 9,269.

Measures

Household income.

Household income was chosen as the indicator of socioeconomic status for this study. While other indicators have been used by other researchers, we chose household income because it has a concrete meaning and is proximally related to several of the stressors investigated in this study. Household income combines the income of all working adults in a household, and was grouped into five approximate income quintiles. The lowest income quintile ranged from 0 to 19,999CA$, the second lowest from 20,000 to 39,999CA$, the middle from 40,000 to 49,999CA$, the second highest from 50,000 to 79,999CA$ and the highest had household incomes of 80,000CA$ or more.

Self-rated health.

Health is a broad concept, but here we chose to use a global assessment of self-rated health which has been shown to be predictive of future change in disability (Idler & Kasl, 1995), increasing illness (Ferraro, Farmer & Wybaniec, 1997), and hospitalization (Romelsjo, Kaplan, Cohen, Allebeck, & Andreasson, 1992) in people of all ages. A significant body of research has also shown that self-rated health is associated with of increased risk of mortality, for up to 12 years after a single report (Idler & Angel, 1990) and even after controlling for a comprehensive set of empirically measured risk factors for disease (Idler & Benyamini, 1997). Self-rated health has concurrent and predictive validity with numerous measures of health (Hansen, Fink, Frydenberg, & Oxhoj, 2002).

In the NPHS, self-rated health is assessed by a single question at each cycle, asking respondents "In general, would you say that your health is: poor, fair, good, very good, or excellent?" For these analyses, the responses were dichotomized into poor and fair vs. good, very good or excellent. Change in self-rated health between cycles was measured as new cases of fair/poor health subsequent to Cycle 1.

Stressors.

Recent life events, Chronic stressors and Job strain were each assessed in the first cycle of the NPHS. Recent life events and Chronic stressors were measured using questions developed by Turner, Wheaton & Llyod (1995). Job strain was measured using an abbreviated version of the Job Content Questionnaire (Schwartz, Pieper, & Karasek, 1988).

The Chronic stressors scale consisted of a series of 18 questions about situations that the respondent reported he or she was faced with. The Chronic stressors scale has been validated by Wheaton (1994), and demonstrates good convergent validity with indicators of difficult social circumstances and discriminant validity with measures of psychological distress (Wheaton, 1994). These questions covered numerous domains (variable names are included in parentheses), including: stressors related to the individual (Personal); relationship problems with a spouse (Marital); problems with one's children (Children); family health problems (Family health); a poor physical and social environment (Neighborhood); and financial problems (Finance). A dichotomous variable was created for each stressor domain, with 1 indicating a positive response to any question on the sub scale, and 0 indicating all negative responses to those questions. An aggregate Chronic stressors scale was created, summing the dichotomous Chronic stressor variable responses, which creates a variable representing the number of domains in which an individual reports a chronic stressor.

Recent life events were measured by asking the respondent a series of ten questions about major negative life events that had happened to the respondent or his or her close others during the previous twelve months. Questions were selected from a longer list based on the research of Turner and Wheaton (Turner et al., 1995). Scores ranged from 0 to 8, 9 or 10 depending on marital and parental status. In addition to the aggregate score, and dichotomous Life events

variable was created, with individuals reporting no life events ascribed a value of 0, and individuals reporting any life events ascribed a value of 1.

Seven questions were used to measure the concept of Job strain and are a simplified version of those used by Schwartz et al. (1988) which in turn is based on Karasek's work (Karasek, Baker, Marxer, Ahlborn, & Theorell, 1981) and the US Quality of Employment Surveys. Five questions measured Decision Latitude and two measured Psychological Demands. Individuals falling in both the top tertile of Demands and the lowest tertile of Decision Latitude were coded as experiencing Job strain.

Control variables.

All analyses controlled for age (in five-year groups from age 20 to 70 and over); sex; household size; the social roles of marital, parental, and employment status; and the health behaviours of smoking status (daily smokers vs. occasional and non-smokers) and physical activity level (sedentary vs. all others).

Analyses

Mediation is can be demonstrated when an association between a predictor and an outcome is attenuated by inclusion of the mediator in the regression model, after having shown and association between the predictor and the mediator, and between the mediator and the outcome (Baron & Kenny, 1986). The association between household income group (the predictor) and stressors (the mediator) was demonstrated through age-adjusted prevalences of reported stressor exposures according to income quintile, including p for the Test for Trend. The association between stressors and incident fair/poor health was demonstrated through logistic regression in SPSS 11.5. Then, incident cases of fair/poor health were predicted from household income group at baseline (Model 1). The highest income group was used as the reference group.

Finally, the aggregate Chronic stressor scale, the Life events scale, and the dichotomous Job strain variable were entered into the regression (Model 2).

Mediation was demonstrated by comparing fully standardised logistic regression coefficients from Models 1 and 2. The method proposed by Menard (2002) was used to standardise coefficients, as per the following formula:

$$b^*_{YX} = (b_{YX})(s_X)/\text{SQRT}\ (s^2_{\text{predicted logit}(\hat{Y})}/R^2) = (b_{YX})(s_X)(R)/S_{\text{predicted logit}(\hat{Y})}$$

Because of the complex sample design of the NPHS, variance estimates of parameters can not be calculated directly nor through the application of weights because of design effects. Therefore, the bootstrap method of estimating variance was used (Statistics Canada, 2002b). This method repeatedly subsamples the initial sample using special bootstrap weights in order to obtain more precise variance estimates. Bootstrapping was performed by Remote Data Access through the Data Liberation Initiative of Statistics Canada.

Results

From 1994 to 1996, declines in self-rated health among the entire sample were as frequent as increases: 3.9% reported a change in their self-rated health from good or better to fair or poor and 4.0% reported a change from fair or poor to good or better. Two-hundred eighty-seven respondents died and 62 were institutionalised. Although respondents in these groups who were healthy at baseline and who were subsequently institutionalised or died could be considered as having a decline in health status, we chose to exclude these individuals because they may represent different health pathways than those who remained alive and living in a household.

Women comprised 52% of the study sample. The median age group was 35-39 years. Seventeen percent of the sample had incomes less than 20,000 CA$; 27% had incomes from 20,000 to 39,999 CA$; 14% from 40,000 to 49,999CA$; 26% from 50,000 to 79,999CA$; and

13% had incomes of 80,000CA$ or more. Seventy percent of respondents reported being married, common law, or living with a partner. Sixty-six percent of respondents were working. Sixty percent of respondents were inactive, and 25% smoked daily.

As shown in Table 4, in comparison to individuals in the highest income group, individuals is the lowest and second lowest income groups had a significantly greater odds of declining self-rated health. Although the pattern of odds ratios for the middle and second highest income groups follows a stepped pattern, these odds ratios are not significantly different from one. Age was also significantly associated with a higher odds of decline in health, as was having children, and being a smoker. Being active or employed was associated with a lower odds of decline in health.

As shown in Table 5, the prevalence of reported stressors varies according to stressors type, with a high of 59% of respondents reporting Personal stress, and a low of 8% of respondents being classified as having high Job strain. Stressor prevalence also varies as a function of income: five of the 8 stressors demonstrated a significant income gradient. Personal stress, problems with Children, and Family health problems did not. Each reported stressor in 1994 was associated with a greater odds of moving from good or better to fair or poor self-rated health, except for Marital problems. Adjusting for income had little effect on these odds ratios. Job strain had the largest association, with individuals reporting Job strain in 1994 having 2.12 the odds of experiencing a decline in health as compared to those not reporting Job strain. The smallest effect was observed for Life events, with a 1.38 odds of experiencing a decline in health. The consistency of results across seven of eight diverse stressor domains suggests that a

Table 4

Odds ratios of incident poor self-rated health from 1994 to 1996, and percentage reduction of fully standardized logistic regression coefficients demonstrating mediating effect of stressors

	Model 1	Model 2	% reduction
Income			
Lowest(1)	2.76* (1.51, 5.04)	2.32* (1.25, 4.34)	16
2	2.24* (1.24, 4.05)	2.05* (1.12, 3.75)	10
3	1.54 (0.82, 2.90)	1.47 (0.77, 2.79)	10
4	1.49 (.85, 2.62)	1.43 (0.81, 2.52)	9
Highest(5)	1.0	1.0	
Age	1.16 (1.10, 1.21)	1.20 (1.15, 1.26)	
Sex			
Male	1.00	1.00	
Female	0.92 (0.72, 1.19)	0.88 (0.68, 1.13)	
Marital Status			
Not married	1.00	1.0	
Married	1.09 (0.83, 1.42)	1.01 (0.77, 1.31)	
Parental Status			
No children	1.00	1.00	
Children	1.14 (0.82, 1.56)	0.96 (0.69, 1.32)	
Employment			
Not employed	1.00	1.00	
Employed	0.71* (0.52, 0.98)	0.62* (0.45, 0.86)	
Activity Level			
Inactive	1.00	1.00	
Active	0.66* (0.51, 0.86)	0.67* (0.51, 0.87)	
Smoking Status			
Non smoker	1.00	1.00	
Smoker	1.81* (1.40, 2.34)	1.61* (1.24, 2.10)	
Work Stress	--	1.83* (1.16, 2.87)	
Chronic Stressors	--	1.33* (1.20, 1.46)	
Life Events	--	1.04* (0.93, 1.17)	

Note. *$p < 0.05$; Model 1: Adjusting for age, sex, household size, social roles, and health behaviors. Model 2: Adjusting for age, sex, household size, social roles, health behaviors, and stressors.

Table 5

Crude prevalence of reported stressors, age-adjusted prevalence of reported stressors by income quintile, and adjusted odds ratios with 95% confidence intervals for news cases of poor self-rated health according to reported stressors.

	Prevalence							
		Income quintile						Odds ratio[a]
		Lowest (1)	2	3	4	Highest(5)	p	
Personal	59%	58	58	58	57	62	n.s.	1.74* (1.36, 2.24)
Marital	14%	11	15	15	15	14	<.05	1.42* (1.00, 2.01)
Children	24%	23	26	25	23	23	n.s.	1.66* (1.25, 2.19)
Family health	20%	21	19	19	19	17	n.s.	1.57* (1.19, 2.07)
Job strain	8%	6	9	8	10	5	<.05	2.02* (1.28, 3.18)
Neighborhood	27%	35	27	24	24	20	<.01	1.61* (1.24, 2.08)
Financial	37%	58	41	34	31	21	<.01	1.61* (1.20, 2.17)
Life events	38%	48	38	37	34	34	<.01	1.47* (1.16, 1.87)

Note. *p<0.05; p = p for trend; [a]Adjusting for age, sex, household size, social roles, health behaviours and income quintile.

common mechanism may underlie these observed associations, and that this is independent of income.

As shown in Table 1, a test for mediation demonstrated a reduction in odds ratios for both groups with a significant odds ratios in Model 1. The percentage reduction in fully standardised logistic regression coefficients were 16% for the lowest income group and 10% for the second lowest income group, after including stressors in the model (Model 2). These results are demonstrated in Figure 5. This reduction in odds ratios suggests that reported stressors may be responsible for a small but important part of the observed association between income quintile and new cases of fair and poor self-rated health. Stressors explain an increasing proportion of the variance as income quintile decreases.

Neither sex-stratified analyses nor analyses restricted to non-employed participants yielded significant odds ratios for decline in self-rated health by income quintile. The smaller number of cases of decline in self-rated health may have resulted in insufficient power to observe effects after splitting the sample. However, in employed participants, the lowest and second lowest income quintiles had significantly higher odds of decline in health, with odds ratios for 3.00 (95% CI: 1.19, 7.58) and 3.04 (95% CI: 1.31, 7.10) respectively. Adding stressors to the model reduced the odds ratios to 2.82 (95% CI: 1.08, 7.39) and 2.88 (95% CI: 1.20, 6.89) for the lowest and second lowest income groups respectively.

Discussion

This study demonstrated that individuals living in households with combined incomes of under 20,000 CA$ have almost three times the odds of experiencing a decline in self-rated health over two years than individuals in the highest income quintile. Furthermore, an increased odds of declining health status was observed even among the income group ranging from 20,000 to

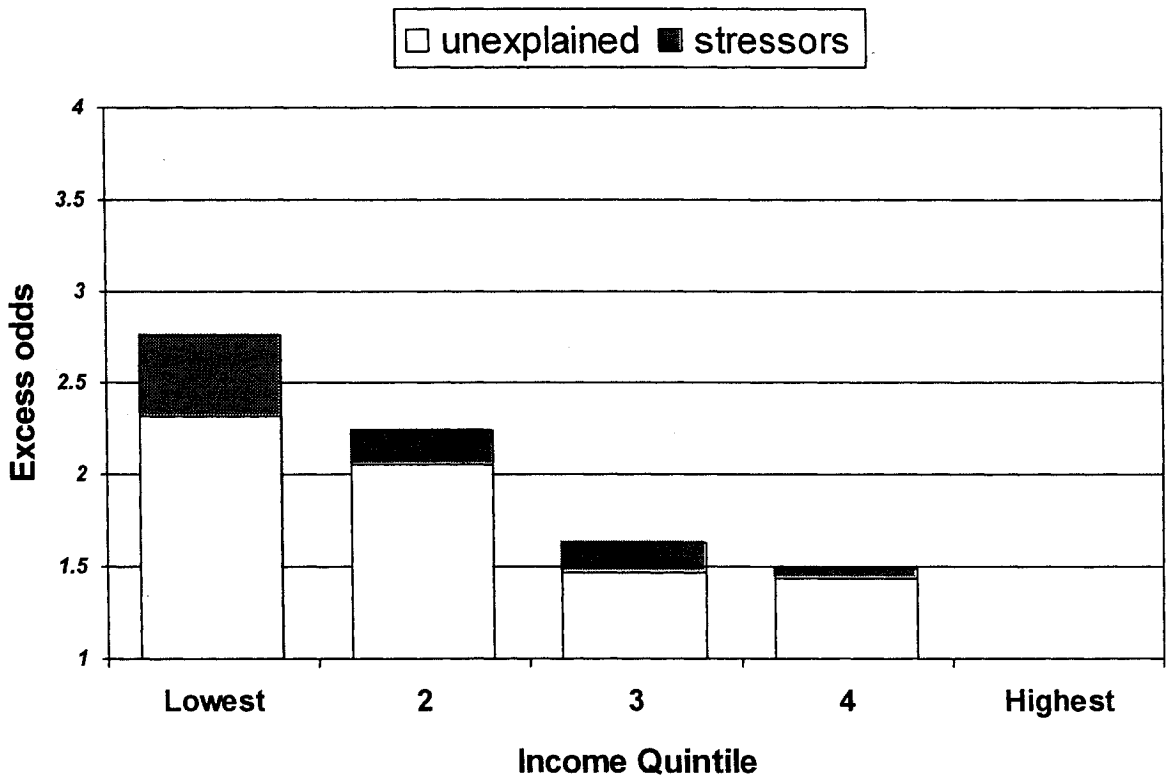

Figure 5.

Odds ratios of incident poor self-rated health by income quintiles controlling for age, social roles and health behaviours, with the shaded area showing the proportion of odds ratios explained by stressors.

40,000 CA$, suggesting that mechanisms beyond absolute poverty and material deprivation may be at work, since most incomes in this range are clearly above the point at which absolute material deprivation is of issue in Canada. Reported stressors were significant predictors of decline in self-rated health, and our study demonstrated a modest but important mediating effect of stressors on the relationship between income and health decline. Stressors explained 16% and 10% of this association for the lowest and second lowest income groups, respectively.

Unfortunately because of sample size, sex-stratified analyses and those examining the non-employed did not yield significant results, possibly due to the limited number of cases. However, among employed individuals, the pattern of results were similar to that for the entire sample, with the two lowest income groups having significantly elevated odds of decline in self-rated health. It may be fruitful to use the present analytical framework with future cycles of the NPHS after the accumulation of more cases of incident fair/poor health.

A surprisingly consistent magnitude of association between a wide range of stressors and subsequent decline in self-rated health emerged, with most stressors associated with an approximately 1.5 odds of a decline from good or better to fair or poor health. The exception was Job strain, which was associated with greater than twice the odds of a decline in self-rated health. Adjusting for income quintile had almost no effect on the magnitude of the odds ratios, underlining that the health effects of these stressors do not appear to function through the material deprivation that is associated with some of them. Because these stressors have been shown to be differentially distributed across income groups, with lower income individuals being more likely to report stressors (Orpana & Lemyre, 2004; Turner et al., 1995), stressors are a good candidate explanatory mechanism for the social gradient in health.

The magnitude of mediation by stressors in our study can not easily be compared to those reported in other studies. In contrast to the literature reviewed which examined numerous mediating factors simultaneously, we examined only a single type of mediating factor. As well, we compared fully standardised logistic regression coefficients instead of using a reduction in excess odds approach to quantifying mediation. Nevertheless, our results concur with those of other researchers, in that psychosocial mechanisms appear to mediate a modest but important part of the social gradient in health.

Reporting biases must be considered when examining the relationship between socioeconomic status, stressors and self-rated health. Humphries & van Doorslaer (2000) found that individuals in lower socioeconomic groups reported worse self-rated health given a certain Health Utility Index score than did individuals in higher socioeconomic groups, supporting that reporting biases should be taken into account when examining social gradients in self-rated health. However, in longitudinal analyses, reporting biases will affect associations only if they change over time. For example, a lower socioeconomic group would have to report their health status at baseline as being better than it actually was and then to report their actual and less favourable health status in 1996 in order for the bias to inflate gradients in incident poor health. If anything, if lower SES participants underestimate their true health at baseline, gradients have been attenuated through the exclusion of individuals reporting fair or poor health at baseline.

Another artefactual explanation of our findings stems from the way we measure decline in health. Individuals who were reported good, very good, or excellent health in 1994/95 and fair or poor health in 1996/97 were considered to have experienced a decline in health status, and this method of measuring change is frequently used by other researchers (Lantz et al., 2001). However, because lower income groups have a higher prevalence of the marginal category of

good health at baseline (with prevalences of 28%, 27%, 24%, 21% and 16% in the lowest to highest income groups respectively), a higher odds of moving to fair or poor health may be a result of there being a greater pool of individuals in lower income groups in the good health group and there being fewer categories to cross in order to be considered a case of decline in health status. We ran a logistic regression restricting the analysis to just participants reporting good health in 1994/95. Results indicated that as income quintile increased, the odds of moving from good to fair or poor health decreased. Thus we can conclude that the observed effects are not due only to the higher prevalence of good as opposed to better than good health in the lower income groups.

One of the strengths of this study is its longitudinal nature. By measuring the predictor variables before the event of interest occurs, we can be certain of the temporal sequencing of these events. In a previous article (Orpana & Lemyre, 2004), we examined the contemporaneous effects of household income on self-rated health and mediation of this by stressors. Whereas the social gradient in poor self-rated health across income at the same time was approximately of the same magnitude as the social gradient in two year decline in self-rated health, the mediating effect of stressors estimated in this longitudinal study was somewhat smaller than that observed among men in the cross-sectional study, and similar to that observed among women. The mediating effect of stressors may be smaller because the time factor has not been accounted for adequately and interpretation of these results depend on the hypothesised lag between stressors and their effect on health. Many of the stressors studied may have been present prior to 1994/95 when they were measured, and may have already acted on the individual resulting in a state of fair or poor health. Such individuals would not be identified in the present analyses, and thus the relationship between stressors and health, and the mediating effect of stressors may have been

underestimated. In a similar manner, because income and stressors are measured at the same point in time, it is possible that stressors existing prior the observation period affected income. Ideally, income would be measured prior to the occurrence and reporting of stressors, in order to have greater confidence in the direction of the observed effects.

Several recommendations stem from these analyses. First, social gradients in health observed in Canada do reflect some degree of social causation. Thus, identifying the factors which lead to a greater odds of declining health status among lower SES groups is paramount to attenuate socioeconomic differentials in health. Our study suggests that stressors may be one mechanisms contributing to poorer health among poorer people. Indeed, the odds of declining from good or better to fair or poor self-rated health among individuals reporting a stressor are higher by about 50%. Intervening to reduce stressors or to buffer their impact may affect individuals' health status, regardless of their socioeconomic status. However, since these stressors are more common among lower socioeconomic status individuals (Orpana & Lemyre, 2004), reducing these stressors will have a greater impact on the health of lower income populations. For example, adjusting workplace policies to increase decision latitude may yield benefits for the population as a whole, with a greater impact on lower SES groups.

Given its importance as a social issue, further research is necessary to better determine the mechanisms underlying the social gradient in health. Longitudinal research is perhaps the best way to identify potential mechanisms. Improvements in longitudinal research could include collecting information about stressor duration and the use of longer follow-up periods. However once potential mechanisms are supported by longitudinal research, intervention research is called for to provide stronger evidence for the causality of identified mechanisms.

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Refining the Model: A Behavioural Pathway Between Stressors and Health

These longitudinal results provide further evidence for social causation driving the social gradient in health. Health-related selection was controlled for by excluding individuals who were already in fair or poor health at baseline, and a clear, stepwise gradient of increasing odds of experiencing a decline in health status with lower socioeconomic status over a two-year period was demonstrated. Furthermore, stressors reported at baseline were associated with a decline in health status, and these stressors explained a modest proportion of the increased odds of health decline among the two lowest socioeconomic groups.

Both of the previous studies provide support for a psychosocial explanation of the social gradient in health and health decline. What is of secondary interest is identifying the mechanisms which link reported stressors with poor health, in order to provide evidence for biological plausibility. Whereas studying the psychophysiological pathways between stressors and health is beyond the scope of this thesis, the data sets analysed do contain information about health behaviours. Stress-related changes to health behaviours are proposed to be one pathway between stressors and health, and this pathway will be examined as a secondary analysis in this thesis.

In the analyses in the first two articles, health behaviours were controlled for in all regressions predicting self-rated health because of the well established association between lower SES and poorer health behaviours (Lynch et al., 1997), and between health behaviours and health status (McGinnis & Foege, 1993). However, if stressors result in poor health behaviours, controlling for the variance associated with health behaviours when examining the mediating effects of stressors on the relationship between SES and health may result in an underestimation of the effect due to stressors. Thus, the final article examines whether there is an association between reported stressors and health behaviours, and whether health behaviours mediate the

relationship between stressors and fair/poor self-rated health. Indeed, considering that competing explanations of the social gradient in health are interconnected, and certainly not independent of each other, understanding the interrelations between alternate explanations is important.

CHAPTER 5. Stressors, Health Behaviours and Health

Article 3. Linking Stressors and Health: Can Health Behaviours Explain the Association?

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Abstract

Both a direct psychophysiological and an indirect behavioural pathway have been proposed to explain the association between stress and health. However, most research on stress and health investigates the psychophysiological pathways, controlling for health behaviours instead of treating them as a mechanism of interest. The goal of this study was to investigate whether stressors were associated with smoking status and intensity, and physical activity level and frequency, and whether these health behaviours mediated the association observed between stressors and self-rated health. Data from participants age 20 and over in the National Population Health Survey were analysed. Results demonstrated that each studied stressor, except for job strain among men, was associated with a higher odds of being a smoker. Only those individuals reporting marital or financial problems were *more* likely to be inactive, although men reporting problems with children were *less* likely to be inactive. Health behaviours mediated a modest proportion of the association between stressors and poor health, ranging from no explanatory power to 14%. These results indicated that smoking status seems to be consistently associated with reported stressors, and that the health behaviours of smoking and physical activity explain a small proportion of the relationship between stressors and health. This research suggests that controlling for health behaviours when examining stressors as a determinant of health may result in an underestimation of the true effects of stressors. Future longitudinal research is called for to take into account temporal sequence and lagged effects of health behaviours on health.

Linking stressors and health: Can health behaviours explain the association?

Traditionally, the relationship between stress and health has been explained through a direct effect of neuroendocrine and neuroimmune processes. However, an important consideration when explaining the relationship between stress and health is the role of health-related behaviours. Stressors and feelings of stress have the capability to affect individuals' behaviour, including those that are health-related (Baum & Posluszny, 1999). In turn, these health-related behaviours have the potential to affect health directly, for example through the carcinogenic effects of tobacco use, as well as through altering neuroendocrine or neuroimmune functioning resulting in increased susceptibility, for example through lowered immune status due to inadequate nutrition. In research examining the effect of stressors or stress on health, health behaviours are often controlled for, and not examined as a component of the causal pathway. However, if health behaviours mediate part of the relationship between stressors and health, then controlling for health behaviours will underestimate the effect of stressors on health. Thus, the present article aims to examine the empirical association between stressors and health behaviours, and whether health behaviours mediate the relationship between SES and health.

Early research suggested that health behaviours in general (for example, as measured by a self-care index) deteriorate in response to stressors (Abood & Milton, 1988; Gottlieb & Green, 1984; Wiebe & McCallum, 1986). However, these studies examined health behaviour as a unidimensional concept, without addressing variations in this relationship as a function of specific health behaviours. The general relationship proposed is that in response to stressors, health-harming behaviours such as smoking increase and health-promoting activities such as physical activity and good nutrition decrease (Baum & Posluszny, 1999). However, a consistent body of evidence supporting this hypothesis remains to be developed.

Several different ways which stressors and stress can affect health behaviours are conceivable. For example, a) behaviours may be associated with environmental conditions resulting from exposure to the stressor itself; b) behaviours may be associated with the affective and cognitive response to stressors (the state of feeling stressed); or c) behaviours may be employed as a form of coping (Adler & Matthews, 1994; Baum & Posluszny, 1999). For example, in case a), a family crisis requiring much time to be spent at the hospital may result in diminished levels physical activity due to lack of time. In case b), feelings of stress may disturb decision making processes involved in choosing whether to exercise or not. In case c), an individual may choose to have a cigarette during a time of stress because she believes it will calm her down (Graham, 1994) or the individual may eat more high fat foods for comfort (Steptoe, Wardle, Pollard, Canaan, & Davies, 1996).

Although it is often assumed that exposure to a stressor, if anything, results in a negative change in health behaviours, it is also possible that some subset of the population actually engages in more healthful behaviour as a form of coping. For example, some people may use exercise as a form of coping with negative emotions (Steptoe et al., 1996). Therefore, it is important to take into account various reactions to stressors, some deliberate (such as jogging to relieve feelings of stress) and other not so deliberate (such as a decrease in routine exercise because of attention to more pressing matters). It is also important to note that exposure to stressors is only one of several important determinants of health behaviours, including structural, interpersonal, and individual factors. One would expect the variance in health behaviours accounted for by exposure to stressors to be significant but rather small. However, if a consistent association is found, then the cumulative effect on a large population may be quite substantial.

The literature on the association between exposure to stressors and health behaviours has primarily addressed the behaviours of alcohol use, smoking, physical activity and nutrition. Smoking and physical activity, representing a health-damaging and a health-promoting behaviour respectively, will be examined in this study. These two behaviours are relevant to a large proportion of the population and have important effects on health.

Smoking

The literature on the relationship between exposure to stressors and smoking indicates a more consistent and larger effect than the literature on stressors and physical activity. Smoking is an important risk factor for both cardiovascular disease and some cancers (Jacobs et al., 1999), and given current programs to decrease the prevalence of smoking and level of consumption of tobacco products among users, the relationship between exposure to stressors and smoking is an important contextual factor to take into account. Similar stressors to those examined in the stressors-physical activity relationship have been examined, including academic stress, job strain, life events and chronic stressors. Measures of smoking have included smoking status (smoker/non-smoker), the intensity of smoking (number of cigarettes per day), and changes in intensity of smoking.

Academic exams (Steptoe et al., 1996; West & Lennox, 1992) and the experience of war (Soskolne et al., 1996) have been associated with increases in intensity of smoking among men and women. Job demands (Hellerstedt & Jeffery, 1997) and job strain (Cohen et al., 1991; Green & Johnson, 1990) have been associated with being a smoker and higher levels of smoking among smokers. Life events have been associated with being a smoker in women but not in men (Cohen et al., 1991). Smoking has also been identified by qualitative research as a method of coping with unpleasant experiences, especially those associated with lower socioeconomic position (Graham,

1994), and has been reported as a method of both increasing and decreasing arousal levels during times of stress (West & Lennox, 1992).

Physical activity

Research on the association between exposure to stressors and physical activity behaviour has examined the effect of wide variety of stressors on frequency, duration, adoption or maintenance of physical activity. Stressors examined include academic stress, work stressors, live events, daily hassles, and chronic stressors. Academic exams (Weidner, Kohlmann, Dotzauer, & Burns, 1996), exposure to war (Soskolne, Baras, Palti, & Epstein, 1996) and job strain (Hellerstedt & Jeffery, 1997) have each been associated with a decrease in the frequency of exercise. In contrast, marital conflict has been associated with an increase in exercise behaviour in men (Cohen, Schwartz, Bromet, & Parkinson, 1991), as has unexpected job loss in some groups (Ferrie, Shipley, Marmot, Stansfeld, & Davey Smith, 1998) but not others (Fuchs & Hahn, 1992). Total number of life events experienced during in a six-month period did not affect adoption of exercise, but was associated with lower maintenance of exercise (Oman & King, 2000). Exposure to daily hassles has been associated with no change in physical activity (Steptoe, Lipsey, & Wardle, 1998), a decrease in duration but not frequency of exercise (Stetson, Rahn, Dubbert, Wilner, & Mercury, 1997), and a decrease in frequency of exercise (Evans & Nies, 1997). On the whole, research associating exposure to stressors with physical activity behaviour points to a small, yet inconsistent, negative relationship. There are also some specific stressors such as marital conflict and job loss that seem to be associated with an increase in physical activity. However, given the small number of studies that have addressed this relationship, it is important to conduct further research.

The purpose of this study is to identify whether individuals who report stressors are more or less likely to be smokers and more or less likely to be physically inactive. Second, this study will investigate whether smokers who report stressors have a higher intensity of smoking, and whether individuals who report stressors have a greater frequency of physical activity participation. Finally, whether these health behaviours explain part of the relationship between stressors and health will be explored.

Methods

Data source

Data from the Public Use Microdata File (PUMF) of the National Population Health Survey (NPHS) 1994/95 were analysed (Statistics Canada, 1996). These data were obtained through the Data Liberation Initiative of Statistics Canada. The NPHS surveyed a stratified random sample of individuals age 12 and over living in households in the ten provinces, and excluding individuals on Canadian Armed Forces bases, Indian Reserves, and some remote areas of Ontario and Quebec, with a total sample size of 17,626. The household response rate was 88.7% and the selected individual response rate was 96.1%. Participants age 20 and over were retained for analysis, resulting in a sample size of 15,779.

Measures

Health behaviours

Individuals who reported that they smoked daily were categorized as smokers. Smoking intensity was measured as the reported number of cigarettes smoked per day, among smokers.

The physical activity index and physical activity frequency were calculated based on a series of questions about leisure time physical activity. The physical activity index was derived by Statistics Canada from leisure time energy expenditure calculated based on participation in a

given activity, the duration of participation, monthly frequency of participation, and the MET (a measure of metabolic energy cost) for that activity. Active and moderately active individuals averaged 1.5 or more kcal/kg/day of energy expenditure and inactive individuals averaged less than 1.5 kcal/kg/day.

Monthly frequency of physical activity lasting over 15 minutes was a derived variable which measures the number of times participants engaged in leisure-time physical activity lasting more than 15 minutes in the past month. The questions referred to a three-month period, thus the total frequency was divided by three by Statistics Canada to reflect a one-month period. A value of zero represented no physical activity lasting over 15 minutes.

Stressors

Data on chronic stressors, recent life events and work stress were available. The recent life events and chronic stressors questions were based on the work of Wheaton (1994). The chronic stressors questions covered the following domains: Personal stress, Financial problems, Marital problems, Problems with one's children, Neighbourhood problems, and Family health problems. Because a varying number of questions were asked with respect to each of these domains, a dichotomous indicator variable was created for each domain indicating whether the individual reported any stressors in that domain or none. Individuals, for whom the stressor was not applicable, for example individuals without children in the case of Problems with children, were given score of zero. A similar approach was taken to the measurement of Life events. Individuals reporting any life events (based on a series of ten questions) were given a score of one, and those individuals reporting no life events were given a score of zero. The Job strain scale was based on the work of Karasek (Karasek, Baker, Marxer, Ahlbom, & Theorell, 1981), and comprised five questions about decision latitude and two questions about psychological

demands. Individuals having scores in the bottom tertile of decision latitude and the top tertile of psychological demands were considered to be experiencing job strain. The unemployed and individuals not in the work force were given a score of zero on the Job strain indicator.

Health

Health was measured through a single self-rated health question, in which respondents were asked "In general, would you say your health is: excellent, very good, good, fair or poor?" This variable was dichotomised into a good or better vs. fair or poor variable.

Control variables

Demographic control variables included age in five-year groups, sex, marital status, parental status, employment status, and household income group. In analyses related to physical activity, a restriction of activity flag was used to account for physical activity limitations which may preclude the individual from otherwise engaging in physical activity. This flag was derived from any affirmative response to a series of questions enquiring about restriction of activity in various domains of life, including in one's leisure activities.

Analyses

Logistic regression analyses stratified by sex were used to predict being a smoker or being physically inactive from each domain of reported stressors, controlling for age, income group, and marital, parental, and employment status, and income group. Analyses examining physical activity behaviours also controlled for restriction of activities. Similarly, health behaviours were used to predict fair or poor self-rated health via logistic regression analyses. Differences in the intensity of smoking (among smokers) and monthly frequency of physical activity between individuals reporting a given stressor and those who didn't were tested using hierarchical analysis of covariance (ANCOVA). Outliers three or more standard deviations from

the mean on the dependent variable were excluded from the analyses. When evaluating the role of Marital problems, Problems with children, or Job strain, analyses were restricted to include only individuals who were living with a partner, parents, or the employed respectively. The effects of age, sex, income group, marital, parental and employment status were accounted for before testing for the main effects of the stressor. The interaction effect between sex and stressor was also tested.

In order to evaluate whether the studied health behaviours of smoking and physical inactivity may explain part of the relationship between stressors and health (Orpana & Lemyre, 2004), we used hierarchical logistic regression, entering a stressor and covariates on the first step and the health behaviours on the second step. Both the categorical health behaviour variable and the intensity of the health behaviour were entered. A reduction in the fully standardised logistic regression coefficients from one step to the next suggests that the health behaviours account for part of the relationship between stressors and health. The method of fully standardising logistic regression coefficients proposed by Menard (2002) was used and has been reported elsewhere (Orpana & Lemyre, 2004).

Average weights were used to account for unequal probabilities of selection. The average weights were divided by the design effect reported by Statistics Canada (1.64) in order to account for increased homogeneity due to the clustered nature of the sample design (Statistics Canada, 1996).

Results

The composition of the sample can be seen in Table 6. The majority of the sample was married or living common law, had children, and was employed. A greater proportion of women

Table 6

Sample Sociodemographic and Health Behaviour Characteristics

	Men (n = 7682)	Women (n = 8097)
Median age group	40-44	40-44
Married or common law	72%	65%
With children	63%	73%
Currently working	70%	53%
Household income (% missing)	5%	4%
< $20,000	17%	25%
$20,000-$39,999	29%	28%
$40,000-$59,999	14%	13%
$60,000-$79,999	26%	23%
> $80,000	14%	11%
Daily smoker	28%	24%
Smoking intensity: mean (sd)	20.8 (9.9)	17.0 (8.9)
Physically inactive (% missing)	58% (7%)	65% (3%)
Frequency of physical activity: mean (sd)	19.9 (21.5)	18.9 (20.7)
Any activity limitation	21%	23%
Fair or poor self-rated health	10%	13%
Stressors		
Personal	56%	38%
Marital problems	16%	22%
Problems with children	33%	35%
Financial	40%	36%
Environmental	28%	26%
Family health problems	21%	25%
Life events	37%	38%
Job strain	11%	19%

Note: If missing data is not stated, it is less than 1%. There is 8% and 4% of missing data on the stressors scales for men and women respectively, except for the job strain stressors, with 14% and 9% missing data for men and women respectively.

as compared to men fell in the lowest household income group. The prevalence of smoking was higher among men, and among smokers, men had a greater smoking intensity. The prevalence of physical inactivity was higher among women; however there was little difference in the frequency of physical activity. Both number of cigarettes per day and monthly frequency of physical activities had high kurtosis. Excluding cases with z scores less than or equal to -3 and greater than or equal to 3 resulted in kurtosis falling within acceptable limits. The percentage of respondents reporting a given stressor was similar among men and women, although personal stressors were markedly more prevalent among men and job strain was more prevalent among women.

Smoking status

As shown in Table 7, after controlling for age, income group, and marital, parental, and employment status, all stressors were associated with a significantly elevated odds of being a smoker. For men, the strongest association was with life events, family health problems, and marital problems, with each of these stressors associated with odds between 1.45 and 1.50 of being a smoker. A similar pattern of associations were observed among women, with family health problems and marital problems associated with odds of over 1.6 of being a smoker, and life events and financial problems associated with an odds of 1.5 or over. The only non-significant association was for job strain among men.

Smoking intensity

As shown in Table 8, among smokers, individuals reporting problems with children, financial problems, family health problems, or life events smoked significantly more cigarettes per day than others. However, the magnitude of this difference was in the order of only one

Table 7

Adjusted Odds Ratios for Smoking and Physical Inactivity by Stressors

	Odds Ratio (95% CI)	
	Smoking	Inactivity
Men		
Personal	1.32* (1.16, 1.51)	1.07 (0.95, 1.21)
Marital	1.45* (1.20, 1.76)	1.22* (1.02, 1.47)
Children	1.30* (1.11, 1.53)	0.85* (0.73, 0.98)
Finance	1.36* (1.19, 1.55)	1.24* (1.10, 1.40)
Neighbourhood	1.30* (1.14, 1.50)	0.99 (0.87, 1.13)
Family Health	1.47* (1.27, 1.71)	0.97 (0.84, 1.12)
Life Events	1.50* (1.32, 1.71)	0.94 (0.83, 1.06)
Job strain	1.25 (0.99, 1.58)	1.02 (0.82, 1.27)
Women		
Personal	1.38* (1.21, 1.58)	1.05 (0.94, 1.18)
Marital	1.62* (1.37, 1.92)	1.33* (1.14, 1.56)
Children	1.40* (1.22, 1.61)	1.03 (0.90, 1.17)
Finance	1.50* (1.32, 1.70)	1.23* (1.10, 1.38)
Neighbourhood	1.44* (1.26, 1.64)	1.08 (0.95, 1.21)
Family Health	1.64* (1.44, 1.88)	0.93 (0.82, 1.05)
Life Events	1.51* (1.34, 1.71)	0.90 (0.80, 1.00)
Job strain	1.33* (1.09, 1.63)	0.96 (0.79, 1.16)

Note: *$p<0.05$. All models adjust for age, income group, and parental, marital, and employment status, The model predicting inactivity also is adjusted for activity limitations.

Table 8

Results of Analysis of Covariance for Smoking Intensity Among Smokers

Source	df	F	p
Personal	1	0.027	.870
sex	1	87.439*	.000
Personal by sex	1	0.079	.779
Marital	1	0.013	.910
Sex	1	60.386*	.000
Marital by sex	1	0.011	.918
Children	1	3.924*	.048
Sex	1	53.242*	.000
Children by sex	1	1.903	.168
Financial	1	5.709*	.017
Sex	1	85.358*	.000
Financial by sex	1	2.736	.098
Environment	1	2.876	.090
Sex	1	86.283*	.000
Environment by sex	1	3.433	.064
Family health problems	1	5.922*	.015
Sex	1	90.212*	.000
Family health by sex	1	0.204	.651
Life events	1	15.899*	.000
Sex	1	87.418*	.000
Life events by sex	1	12.959*	.000
Work stress	1	0.018	.894
Sex	1	72.391*	.000
Work stress by sex	1	0.454	.500

Note: * $p < 0.05$. All effects of age, marital status, parental status, income group and activity limitations are accounted for as covariates. Main effects are calculated before interaction effects.

cigarette more per day among individuals experiencing the stressor and likely not of substantive importance to health. There was a significant interaction between recent life events and sex. There was little difference in the smoking intensity of men as a function of recent life events, but a difference of more than two cigarettes per day among women was observed.

Physical activity level

As shown in Table 7, after controlling for age, income group, and marital, parental, and employment status, men and women reporting marital and financial problems were more likely to be inactive than others. For men, marital and financial problems were associated with approximately a 20% increase in the likelihood of being sedentary. For women, marital problems were associated with approximately a 30% increase in the likelihood of being sedentary and financial problems with a 20% increase. In contrast to the expected results, men reporting problems with children were about 15% less likely to be inactive than other men.

Physical activity frequency

As shown in Table 9, and consistent with the results of the logistic regression analyses predicting physical inactivity, individuals reporting marital or financial problems had lower monthly physical activity frequency than others. However, in each of these cases, the differences were small, with differences of approximately three or fewer monthly sessions. There were no significant interactions between the stressors and sex.

Stressors, health behaviours and health

All health behaviours were significantly associated with self reported fair or poor health. For men, being a smoker was associated with a 1.4 odds of reporting fair or poor self-rated health, and every cigarette smoked, among smokers, was associated with a 1.02 odds of reporting fair or poor health. For women, smoking increased the odds of reporting fair or poor health by

Table 9

Results of Analysis of Covariance for Monthly Physical Activity Frequency

Source	df	F	p
Personal	1	0.817	0.366
sex	1	5.686*	0.017
Personal by sex	1	0.171	0.679
Marital	1	20.412*	0.001
Sex	1	0.949	0.330
Marital by sex	1	0.358	0.550
Children	1	2.449	0.118
Sex	1	7.506*	0.006
Children by sex	1	1.275	0.259
Financial	1	12.938*	0.000
Sex	1	7.040*	0.008
Financial by sex	1	0.181	0.670
Environment	1	0.518	0.472
Sex	1	5.942*	0.015
Environment by sex	1	0.746	0.388
Family health problems	1	0.721	0.396
Sex	1	6.196*	0.013
Family health by sex	1	0.746	0.388
Life events	1	2.187	0.139
Sex	1	6.035*	0.014
Life events by sex	1	1.355	0.244
Work stress	1	0.001	0.976
Sex	1	0.057	0.811
Work stress by sex	1	0.124	0.724

Note: * $p < 0.05$. Effects of age, marital status, parental status, income group and activity limitations are accounted for as covariates. Main effects are calculated before interaction effects.

60%, and among smokers, each cigarette smoked was associated with a 1.04 odds of reporting fair or poor health. For men, being sedentary was associated with a 1.8 odds of being in less than good health, and each one unit increase in monthly frequency of physical activity was associated with a 1% decrease in the odds of having fair or poor health. Among women, a similar pattern was observed. Being sedentary was associated with a 1.7 odds of reporting fair or poor health, and each increase in monthly frequency of physical activity was associated with a corresponding 1% decrease in the odds of reporting fair or poor health.

As shown in Table 10, all stressors were associated with an increased odds of having fair or poor self-rated health, except for marital problems and problems with children among men, and job strain among women. The magnitude of the effect varied by stressor and by sex. For example, personal stressors and neighbourhood problems among men were associated with odds in the range of 1.8 of reporting fair or poor health, while family health problems among were associated with approximately a 30% increase in the odds. Among women, personal stressors were associated with two times the likelihood of reporting fair or poor health, while family health problems and life events were associated with approximately a 30% increase in the odds. Including health behaviours in the model predicting the odds of poor health from stressors only modestly attenuated the relationship. Reductions in fully standardized logistic regression coefficients ranged from not at all to 10% in men and not at all to 14% in women.

Discussion

Do the present results support that individuals reporting stressors have less favourable health behaviours than others? It appears this relationship varies depending on the stressor and the health behaviour of interest. There does not appear to be an entirely consistent trend across smoking and physical activity behaviours in individuals reporting stressors. A range of stressors

Table 10

Adjusted Odds Ratios for Poor Self-rated Health by Stressors, Before and After Controlling for Health Behaviours, and Reduction in Standardized Logistic Regression Coefficients

	Odds ratios		
	Model 1	Model 2	% reduction
Males			
Personal	1.89* (1.52, 2.36)	1.83* (1.47, 2.28)	6%
Marital	1.30 (0.96, 1.78)	1.26 (0.92, 1.73)	13%
Children	1.16 (0.90, 1.50)	1.18 (0.91, 1.53)	-8%
Finance	1.77* (1.40, 2.23)	1.72* (1.36, 2.17)	6%
Neighbourhood	1.84* (1.45, 2.33)	1.81* (1.43, 2.29)	4%
Family Health	1.30* (1.02, 1.67)	1.28* (1.00, 1.64)	8%
Life Events	1.71* (1.35, 2.16)	1.68* (1.32, 2.12)	5%
Job strain	1.59* (1.01, 2.52)	1.54 (0.97, 2.44)	10%
Females			
Personal	1.98* (1.66, 2.37)	1.98* (1.65, 2.37)	0%
Marital	1.74* (1.36, 2.23)	1.67* (1.30, 2.14)	9%
Children	1.46* (1.20, 1.78)	1.45* (1.19, 1.76)	4%
Finance	1.60* (1.32, 1.95)	1.53* (1.26, 1.86)	11%
Neighbourhood	1.59* (1.30, 1.93)	1.50* (1.23, 1.82)	14%
Family Health	1.29* (1.06, 1.57)	1.27* (1.05, 1.55)	7%
Life Events	1.33* (1.10, 1.61)	1.29* (1.06, 1.56)	13%
Job strain	1.34 (0.92, 1.98)	1.28 (0.87, 1.90)	18%

Note: *$p < 0.05$. All models adjust for age, parental, marital, and employment status, income group and activity limitations. Model 2 also adjusts for physical inactivity, frequency of physical activity, daily smoking, and intensity of smoking. Models are run separately for each stressor.

was associated with an increased odds of being a smoker, however the pattern of results for inactivity was less consistent. Smoking status was associated with all stressors, except for job strain among men which was marginally non-significant. Our findings concur with those of other researchers who have found that various stressors are associated with increased odds of smoking (e.g. Cohen et al., 1991; Steptoe, Fieldman, Evans, & Perry, 1996). Our exceptionally large sample may have increased our power to identify significant results. Significant associations were also observed between several stressors and intensity of smoking among smokers. Life events, problems with children, and financial and family health problems were each associated with greater intensity of smoking. However, the magnitude of this association was small and not likely of importance to health.

Marital and financial problems were associated with a greater odds of being inactive among both men and women. In contrast, problems with children were associated with a lower odds of being inactive among men only. No other significant associations were observed with inactivity. Consistent with the results of the logistic regression analyses, both marital and financial problems were associated with a lower frequency of physical activity (Steptoe et al., 1998). The present research supports the small, negative effect of certain stressors on physical activity behaviour reported by other researchers. Financial problems may be related to inactivity and lower frequency of physical activity through insufficient financial resources to engage in physical activity. Why marital problems but not other stressors are associated with inactivity is unclear, and this is inconsistent with Cohen et al.'s (1991) finding that marital conflict among men was associated with an increase in exercise behaviour. The surprisingly lower odds of being inactive associated with problems with children among men is possibly an effect of adopting physical activity as a coping strategy, although why this association is not observed for other

stressors nor among women is unclear. Conversely, it could be the participation in physical activity is decreasing the time available for parenting, and thus resulting in the children having problems. Future research may be warranted to investigate this effect.

The less consistent results observed between stressors and physical activity levels and frequencies may be due to the more diverse ways in which physical activity is related to stressors. When physical activity is used as a coping strategy, the expected relationship is positive: higher stressors should be associated with higher physical activity. However, because physical activity is an activity which requires planning and the availability of time, it is also possible that stressors interfere with the process of engaging in physical activity, which would lead to a negative association. If both of these mechanisms are functioning, then without being able to distinguish between individuals who cope with physical activity and those who don't, the interaction of coping predispositions with stressors may result in the appearance of there being no association. In contrast, it seems unlikely that stressors would interrupt either the process of smoking or the process of smoking adoption. This highlights that the relationships between stressors and health behaviours must be examined more carefully, and that further research is required to identify aspects of stressors and related coping mechanisms that may underlie these relationships.

Although these cross-sectional analyses provide support for a consistent relationship between diverse stressors and smoking, and between marital and financial problems and physical inactivity, neither the direction of causality nor the mechanisms linking stressors and health behaviours are elucidated here. Although it is unlikely that smoking could lead to many of the stressors, the positive association observed between smoking and family health problems may be a result of the effects of environmental tobacco smoke. It is also possible that the high cost of

cigarettes could lead to financial problems, especially among lower income individuals. It is difficult to conceptualize pathways leading from smoking to the other studied stressors, and thus it is likely that the direction of this relationship is from the stressor to smoking. Future studies should employ a longitudinal design, in which encountering a new stressor can be related to subsequent changes in health behaviours. There is also a possibility that an uncontrolled confounder could be driving the observed associations. For example, smoking may be correlated with negative affectivity (Kassel, Stroud, & Paronis, 2003), and negative affectivity is associated with over-reporting of stressors (Gunthert, Cohen, & Armeli, 1999). Confounding by unmeasured variables can not be ruled out.

A second goal of this study was to determine whether health behaviours explained the associations observed between reported stressors and poor self-rated health. Stressors were significantly associated with an increased odds of poor self-rated health for all stressors except for marital problems and problems with children among men, and job strain among women. Not surprisingly, health behaviours were significantly associated with a greater likelihood of also reporting fair or poor health. Including smoking status, inactivity status, smoking intensity and physical activity frequency in the model predicting poor health from stressors attenuated the fully standardized logistic regression coefficient from not at all to 10% among men and not at all to 13% among women. While this mediating effect is modest, it indicates that a small proportion of the relationship between stressors and health is explained by health behaviours. Given the demonstrated relationship between stressors and smoking, and the demonstrated mediating effect of health behaviours on the stressor-health relationship, analyses examining the effect of stressors on health may underestimate this effect if smoking is used as a control variable. Thus,

the results of this research support the use of caution when controlling for health behaviours in studies examining stressors and health.

As with the analyses examining stressors and health behaviours, the analyses examining the mediating effect of health behaviours on the relationship between stress and health could be improved by a longitudinal design. The effects of health behaviours on physical health status may have long induction periods, and thus the cross-sectional association between health behaviours and health either reflect the effects of longstanding health behaviours on current physical health, or they reflect the more immediate effects of health behaviours being taken into account when making self assessments of health (Krause & Jay, 1994). Nevertheless, because current self ratings of health have great predictive power for future early mortality and other indicators of physical health status, this effect is important, even if it reflects a more complex underlying mechanism.

Strengths of this study include its large sample and thus power to observe small effects, the representativeness of the sample to the Canadian population, and the wide range of stressors examined. However, there are certain limitations which must be highlighted. First, all data is self-reported, and thus reporting biases may affect the reported relationships. Of particular importance may be the unmeasured effect of negative affectivity, which has a possibility to distort the relationship between stressors and self-rated health and give the appearance of a stronger relationship than actually exists (Watson & Pennebaker, 1989).

To conclude, a range of stressors are consistently associated with a greater odds of being a smoker, whereas only marital and financial problems appear to be associated with a greater odds of being inactive. Health behaviours explain a modest but important amount of the variance between stressors and health, and this must be taken into account when using health behaviours

as control variable in the relationship between stressors and health, otherwise the relationship may be underestimated. Future research should focus on understanding some of the possible mechanisms and moderating variables (such as coping strategies), and as well should employ longitudinal designs.

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CHAPTER 6. General Discussion and Conclusions

The goal of this thesis was to contribute to the understanding of the mechanisms through with socioeconomic status is associated with health. More specifically, this thesis explored whether differential exposure to stressors explains part of the social gradient in health status observed across socioeconomic groups in Canada. A secondary purpose was to examine whether health behaviours explain part of the relationship between stressors and health, an important question from a theoretical as well as a methodological perspective when estimating the effects of stressors in the social gradient in health.

This thesis analysed data from the 1994/95 and 1996/97 National Population Health Surveys, in order to address the following hypotheses. First, that lower SES would be associated with a greater odds of fair/poor health, and with a decline in health status over a two-year period. Second, that lower SES would be associated with a greater reported exposure to stressors. Third, that the expected relationship between SES and health would be partially mediated by differential exposure to stressors. Finally, it was hypothesised that reported stressors would be associated with poorer health behaviours, and that these health behaviours would mediate part of the observed association between stressors and health. The first article addressed the first, second and third sets of hypotheses with the analysis of cross-sectional data, while the second article addressed these hypotheses with the analysis of longitudinal data. The third article addressed the final set of hypotheses with cross-sectional analyses.

This discussion will be presented in four sections. First, evidence relating to the structure of the social gradient in prevalent and incident fair/poor health in Canada will be discussed. Then, results supporting the psychosocial explanation of the social gradient in health will be

discussed. Next, the secondary set of hypotheses regarding the role of health behaviours in mediating the stressor-health relationship will be addressed. Finally, implications and recommendations for future research will be presented.

The Structure of the Social Gradient in Health in Canada

A clear social gradient in health was observed in both cross-sectional and longitudinal analyses, reinforcing the body of evidence describing step-wise gradients in self-rated and other indicators of health in Western societies (Cavelaars et al., 1998; Kitagawa & Hauser, 1973; Marmot et al., 1991). In the cross-sectional analyses, men in the lowest income quintile had over three times the odds of reporting fair or poor health as compared to men in the highest income quintile, after controlling for standard covariates. Men in the second lowest quintile had over twice the odds, and even men in the middle income quintile had over one and half times the odds of reporting fair or poor health. The odds of reporting fair or poor health did not differ significantly for men in the second highest income quintile. For women, women in the lowest to second highest income quintiles had odds of fair/poor health of 3.50, 2.56, 1.90, and 1.47 respectively, with only the second highest income quintile being non-significant. After controlling for social roles and health behaviours these odds were attenuated slightly, but the relatively steep gradient in self-rated health remained. The magnitude and monotonic structure of the social gradient in health observed using the National Population Health Survey is consistent with the findings of other researchers (Kunst et al., 2005).

However, because of the cross-sectional nature of the data, the direction of the relationship between income and health could not be ascertained. Whether low income precedes health problems or health problems precede low income is an important consideration when

distinguishing between health selection and social causation hypotheses (Macintyre, 1997). Thus, longitudinal analyses of the 1994/95 to 1996/97 cycles were conducted.

In the longitudinal analyses, men and women were analysed together due to the modest number of incident cases of fair or poor self-rated health. After adjusting for standard covariates, social roles, and health behaviours, only the lowest and second lowest income quintiles had significantly elevated odds of incident fair/poor health as compared to the highest income quintile. Individuals in the lowest income quintile were almost three times as likely to experience a decline in health from good or better to fair or poor, while individuals in the second lowest income quintile were over twice as likely. Although the odds ratios for the middle and second highest income quintiles followed a stepwise pattern consistent with the cross-sectional analyses, these odds ratios were not statistically significant. It is interesting that the magnitude of the prospective relationship is similar to that of the cross-sectional relationship, as it underscores that most of the social gradient in health is likely explained by a social causation explanation. If health problems were an important predictor of future income, the cross-sectional association would be considerably stronger than the longitudinal association.

The results of the longitudinal analyses concur with mortality studies and longitudinal studies of morbidity indicators. For example, Marmot et al. (1984) demonstrated that individuals in the lowest occupational grade had almost three times the risk of coronary heart disease mortality as those in the highest, while Wood et al. (1999) found that males in the lowest social class (as classified by occupation reported on death certificates) were twice as likely to die from amenable causes as those in the highest social class. Mustard et al. (2003) found that men in lower employment grades were about twice as likely to experience a decline in self-rated health over a four-year period, although no significant association was observed among employed

women. In general, a two to three fold increase in the odds of negative health events seems to be observed when comparing the lowest socioeconomic group to the highest, across various indicators of socioeconomic status and a wide range of health indicators.

Future research examining the structure of the social gradient in health would benefit from using multiple predictors of socioeconomic status and multiple measures of health. However, we did conduct analyses that are not reported here using educational attainment as the socioeconomic indicator, and a similar gradient was observed. Different measures of socioeconomic status represent different aspects of the concept, and may yield varying gradients in health. Similarly, different health indicators may impact results as well. However, the relationship between socioeconomic status and health, given a range of indicators of both concepts, tends to yield surprisingly similar results.

Another consideration is the temporality of the measures. Household income was only examined at an initial point in time, however it is becoming increasingly recognised that long term patterns of income have important effects on health (Pensola, 2003). Future analyses examining the relationship between changes in income and changes in health may contribute to a better understanding of trajectories of income and health and their interrelationship. Furthermore, this study only analysed changes in health status over two years. Examining the relationship between income and changes in health over a longer period would be interesting. While this thesis examined only the pathway from SES to health (social causation), health and social selection hypotheses should be tested as well. Reciprocal effects of health and household income could be tested in the future by the cross lagged structural equation models, similar to those conducted by Chandola et al. (2003).

Stressors as Mediators of the Social Gradient in Health in Canada

In addition to the description of the social gradient in health, this thesis examined whether differential exposure to stressors explained part of the observed social gradient in self-rated health in Canada, while acknowledging that alternative causes probably function together to create the social gradient in health. In order to demonstrate mediation, Baron and Kenny (1996) identify the following criteria which must be met. First, a relationship must be demonstrated between the predictor (SES) and the outcome (health). Then, a relationship between the predictor and the mediator (stressors), and the mediator and the outcome must be demonstrated. Finally, including the mediator in a regression predicting the outcome should attenuate the effects of the predictor. As described in the previous section of the discussion, the first relationship was demonstrated through both cross-sectional and longitudinal analyses.

The second relationship between socioeconomic status and stressors was demonstrated through cross-sectional analyses. As shown in Table 1, all stressors demonstrated a statistically significant social gradient, with higher reported stressors among lower income groups, except for problems with children, family health problems, and job strain among women. These results were consistent with those observed by other researchers in the United States (Cohen et al., 1999; McLeod & Kessler, 1990), Europe (Brown & Harris, 1978; Cohen et al., 1999; Stronks et al., 1998), and Canada (Turner & Turner, 2005; Turner, Wheaton, & Lloyd, 1995). One exception is the gradient observed for personal stressors, in which higher income groups had a slightly higher prevalence of reported personal stress.

Not surprisingly, the slope of the income gradients was steepest for financial problems. The lowest income group had a prevalence of financial problems of approximately 60%, whereas the highest income group had a prevalence of only 20%. Of course, financial problems would be

more prevalent among individuals who had limited financial resources, and it may be argued that measures of income and financial problems are overlapping constructs. However, the stressogenic component of financial problems can not be disregarded, as research has demonstrated that financial problems can lead to considerable distress (MacFayden, MacFayden, & Prince, 1996) and other researchers have reported that stressors related to finances were appraised as more threatening by individuals in lower educational groups (Almeida et al., 2005). The results of the regression predicting fair/poor health from stressors also support the proposition that financial problems are not just an alternative measure of income. These results will be discussed in depth in the next section, but warrant some attention here. In cross-sectional analyses, controlling for income in the regression predicting fair/poor health from financial problems only attenuated the odds from 2.21 to 1.88 for men and from 2.04 to 1.84 for women. If financial problems were only a proxy for income, one would expect the relationship between financial problems and health to become non-significant when income was controlled for. However, this is clearly not the case.

The reporting of neighbourhood problems, such as "You would like to move but you can not" and "Your neighbourhood or community is too noisy or polluted" also showed a steeper gradient than other stressors, with almost 40% of those in the lowest income group reporting at least one neighbourhood problem, as compared to only 20% in the highest income group. This stressor is more distal from actual income yet still directly affected by it because of the relationship between income and ability to pay rent or mortgage in a desirable neighbourhood, and as such can be seen as structural in origin.

Life events also showed a steeper social gradient than most stressors, with about 45% of those in the lowest income quintile reporting at least one life event in the past twelve months, as

compared to 28% of men and 36% of women in the highest income quintile. One explanation of this gradient in life events is that the items that make up the recent life events scale are closely related to financial difficulties. Three of the ten items address financial issues such as going on social assistance or taking a cut in pay. Of interest is that the life events questions not only pick up events that happen to the respondent, but also to his or her family and close friends. Thus, the life events scale also acts of a gauge of the stressor level of an individual's social circle, and assuming that the individual's social circle is of a similar socioeconomic status to them, this in effect increases the number of individuals sampled. Because the base rate of life events is relatively low, this increases the reliability of the measurement of stressors within a socioeconomic stratum.

Job strain demonstrated a steeper gradient for men than for women, although the overall prevalence of job strain was higher among women at all levels of income. The gradient for men was statistically significant, whereas the gradient for women was not. The lowest income quintile among men had an 8% prevalence of job strain compared to 4% in the highest income quintile, while the lowest income quintile among women had a prevalence of 12% as compared to 9% among the highest income quintile. This reflects the higher prevalence of job strain in lower prestige jobs, which are associated with lower income. However, it is interesting to note that the prevalence of job strain is actually fairly similar across the four lowest income quintiles. Reasons for the dramatic difference between these and the top income quintile require further research, especially in light of the important associations between job strain and health problems (Schnall et al., 1994). The gender differences observed reflect the nature of women's vs. men's work, with women occupying more pink collar jobs (i.e. low prestige human services such as teachers and nurses) which are known to have high levels of job strain (Karasek & Theorell, 1990).

Problems with children, marital problems and family health problems can be seen as more distal from income and its structural consequences, and thus it is not surprising that the social gradients in these reported stressors were less strongly related to income. In fact, for women in the cross-sectional sample, the trends for marital problems and problems with children across SES groups were non-significant. In the longitudinal analyses where women and men were pooled together, problems with children, personal stress, and marital problems did not display a statistically significant trend. While family health problems may be related to income only inasmuch that income is related to health, it is not surprising that a significant trend was not observed. While it is conceivable that structural stressors may result in marital conflict and behavioural problems in children, this relationship was not observed in this sample.

Interestingly, the gradient for personal stressors was the inverse of what was expected. Higher personal stressors were reported among individuals in higher income groups, although the magnitude of these differences was small and only statistically significant in the cross-sectional sample (54% for the lowest income quintile among men vs. 60% for the highest, 63% for the lowest income quintile among women vs. 65% for the highest). The items in the personal stressors scale may shed light on this relationship. Items include "You are trying to take on too many things at once," "There is too much pressure on you to be like other people" and "People are too critical of you or what you do." Items such as these may reflect the perceived pressure in higher socioeconomic groups to be high achievers, as well as reflecting demands in certain occupational roles. While higher prestige occupations that tend to be coupled with higher income are characterised by higher demands, they are also characterised by higher control, and thus according to the Demand-Control Model (Karasek & Theorell, 1990), these are active jobs that

promote feelings of mastery and positive self-esteem as opposed to feelings of stress (Siegrist & Marmot, 2004).

Unfortunately, the 1994-95 National Population Health Survey measures neither stressor appraisals nor coping strategies which have been associated with socioeconomic status and may moderate the association between socioeconomic status and stressors. Other researchers have demonstrated a relationship between socioeconomic status and threat appraisals (Chen et al., 2004), beliefs about stressors and coping resources (de Ridder, 1995), and social support (Turner & Marino, 1994). These concepts may be important to study in the context of understanding the socioeconomic distribution of stressors and the stress experience. Concepts such as self-esteem, mastery, sense of coherence, social support and coping strategies have been measured in some cycles of the NPHS, and should be incorporated in meaningful ways in future research.

Having demonstrated that the predictor is indeed associated with the mediator, the next step is to show that the mediator predicts the outcome of interest. Indeed, all stressors were associated with a higher odds of reporting fair/poor health in cross-sectional analyses, with the exception of marital stressors among men. The magnitude of this relationship in cross-sectional analyses ranged from about 1.32 (problems with children among men) to 1.97 (personal stress among women). For women, the odds of fair/poor health was considerably higher than that for men for marital problems and problems with children (1.88 vs. 1.33 for marital problems, 1.79 vs. 1.32 for problems with children, for women and men respectively). This may reflect that problems in these areas are more salient to women, and thus more stressful and potentially health-harming. In longitudinal analyses predicting incident fair/poor health, odds ratios for all stressors were significant except for marital problems, with odds ratios ranging from 1.47 for life events to 2.02 for job strain. These results concur with other research demonstrating that

stressors measured through self-report or investigator-based measures are associated with a higher risk of a range of health problems (Belkic et al., 2000; Brown & Harris, 1989; Siegrist, 2005). The weaker relationship between life events and incident fair/poor self-rated health may be because life events are more circumscribed in time, as compared the other more chronic stressors measured. Thus, their effect on health may be less important after a two-year period. It is possible that the life events had resolved themselves by the two-year follow period, whereas the other chronic stressors may still have been ongoing.

While stressors were shown to be associated with income, controlling for income in the regressions predicting poor health from stressors had very little effect the magnitude of the relationship. Reductions in these relationships were in the magnitude of 10% for most stressors, across both sexes. The exception is with more structurally related stressors of financial problems and neighbourhood problems, where controlling for income reduced the relationship by about 20%.

Given that the relationship between the predictor (SES) and the outcome (fair/poor health), the predictor and the mediator (stressors), and the mediator and the outcome were all demonstrated, the next step is to show that the relationship between the predictor and the outcome is attenuated when the mediator is included in the regression. In cross-sectional analyses, including chronic stressors and life events in the regression reduced the excess odds by about a quarter among men, and considerably less among women (from 8% to 15%). In longitudinal analyses, the reduction was smaller than that demonstrated in cross-sectional analyses for men alone and greater than that for women alone: 16% of the odds were explained for the lowest income group, and 10% for the second lowest income group. Although no tests for moderation were conducted, the pattern of results indicates that stressors may contribute more to

income differences in health with decreasing income levels. While Adler et al. (1994) proposed that psychosocial stressors may be more important causes of poor health at higher levels of the socioeconomic ladder because of a dearth of competing causes (such as poor physical environment, less access to health care, etc.), this is not the relationship observed. Indeed, Cohen et al. (1999) also observed a somewhat greater effect of stressors on health at lower ends of the socioeconomic spectrum. Research with appropriate statistical methodologies should examine this relationship further, as it may indicate differential vulnerability.

These results are in line with other research indicating a modest yet important mediating effect of psychosocial stressors. Stronks et al. found that 20% of the relationship between low income and poor health was explained by psychosocial stressors, although the mediating effect was attenuated to 10-15% when the potential confound of neuroticism was controlled for. Cohen et al. (1999) demonstrated a similar extent of mediation in both American and Finnish samples. In the Whitehall II study, job strain had the largest contribution to coronary heart disease incidence, reducing the likelihood of experiencing CHD by about half (Marmot et al., 1997). A difference between Marmot's study and the present thesis, that of Cohen et al., and that of Stronks et al. is that Marmot's study sample was an employed population, whereas the other samples include the employed, the unemployed, and those out of the workforce. Marmot's study examined only job strain, whereas the other studies examined a range of stressors. Two explanations of the stronger relationship observed in Marmot's study are possible. The first is that among employed individuals, job strain is a very important determinant of health, and thus interventions aimed at reducing job strain should yield more equitable distributions of health. A second explanation is that job strain is simply a proxy for occupational status, and thus including both indicators of socioeconomic status and job strain in the same regression may result in

statistical over-adjustment. Unfortunately, empirical techniques can not distinguish between these two explanations.

Other studies of related psychosocial mechanisms, have supported a moderate effect of psychosocial factors such as perceived control (Baillis et al., 2001), sense of coherence (Ing & Reutter, 2003), and social support (Kosteniuk & Dickinson, 2003) mediating the social gradient in health. A more comprehensive understanding of psychosocial mechanisms underlying the social gradient in health may require complex theoretical models not easily tested with traditional regression-based techniques. Structural equation modelling is one method which may advance our understanding of the psychosocial pathways linking socioeconomic status with health, allowing simultaneous estimation of the effects of various psychosocial factors and their interrelations.

Two limitations of these tests of a psychosocial hypothesis are the reliance on a statistical demonstration of mediation and the reliance on self-reported data. Statistical methods can not distinguish between confounding and mediation, because both confounding and mediation are demonstrated by an attenuation of an association between two variables when the confounder or mediator is accounted for. However, reported stressors are conceptualised as arising from the living contexts associated with one's SES, and they are plausible causes of poor health, thus these results should be interpreted as a case of mediation (Rothman & Greenland, 1998). Part of the effects observed may be attributable to shared methods variance, as all constructs were measured by self-report survey. There is potential for reporting biases, such as that associated with negative affectivity, and recall bias, in the case of retrospective reports. Negative affectivity has been associated with an over-reporting of both stressors and poor health status (Watson & Pennebaker, 1989), and appears to be more common among lower SES groups (Adler, Epel,

Castellazzo, & Ickovics, 2000) and thus may result in confounded associations between SES, stressors and poor health. However, the longitudinal analyses partially account for reporting biases, as long as they are considered to remain relatively stable, because individuals with fair/poor health status at the time that SES and stressors are measured are excluded. A related issue is that individuals with health problems may report more stressors than individuals in good health status because sick individuals are trying to find explanations for their illness (Brown & Harris, 1989). Again, the longitudinal analyses account for this because all individuals were in good or better health at the time that stressors were reported.

The results of these studies indicate that the social gradient in health in Canada is similar in size and distribution to those reported in other countries; that the social gradient in stressors is for the most part, as expected with an inverse relationship between income and stressors; and that stressors appear to mediate a modest proportion of the social gradient in health. However, the interplay between socioeconomic factors, behavioural factors, and psychosocial factors must be acknowledged, especially given the results of the last study that this thesis comprises, in which the relationship between stressors and poorer health behaviours and the behavioural mediation of the stressor-health relationship is demonstrated.

Health Behaviours as Mediators in the Stressor-Health Relationship

Although the primary focus of this thesis was determining the extent of mediation of the social gradient in health by psychosocial stressors, a secondary goal was to examine more closely the pathway between stressors and health, via health behaviours. This research is relevant in the area of understanding the social gradient in health because health behaviours are often controlled for in research examining non-behavioural pathways between SES and health (e.g.

(Cohen et al., 1999). However, it is inappropriate to control for a variable if it is indeed on the causal pathway between the predictor and the outcome of interest (Rothman & Greenland, 1998). Two main pathways between stressors and health have been proposed, a psychoneuroendocrine and psychoneuroimmune pathway and a behavioural pathway (Baum & Posluszny, 1999). The third article examined the behavioural pathway, more specifically to what extent stressors were related to health behaviours and whether health behaviours mediated the relationship between stressors and health.

Our research demonstrated that although smoking status was strongly associated with reported stressors, physical activity levels were less consistently related to stressors. Individuals reporting marital or financial problems were more likely to be inactive, but men reporting problems with children were less likely to be inactive. One explanation for these varying results may be coping responses involving physical activity. For example, one individual may go running to relieve feelings of stress, whereas another individual may decrease their involvement in physical activities in order to decrease time demands which may be heightened by ongoing stressors. In contrast, whereas adopting smoking or increasing smoking intensity has been reported as a common strategy to deal with feelings of stress (Graham, 1994), quitting smoking or decreasing the amount smoked does not appear to be reported as a coping strategy. Thus, for certain health behaviours there may be an important moderation of the effect of stressors by coping strategies. This should be investigated further. One data source for this may be in the Canadian Community Health Survey Cycle 1.2 on the Mental Health and Well-being of Canadians (Statistics Canada, 2003), because it includes questions on whether an individual uses certain health behaviours to cope.

Unfortunately, the concurrent measurement of stressors and health behaviours does not allow the direction of this effect to be elucidated. However, in most cases it is unlikely that a health behaviour can cause a given stressor. A better research design may be to follow individuals during periods of low or no stressors, and to observe changes, if any, to health behaviours upon the experience of new stressors. It would also be useful to study a broader range of health behaviours, such as sleep quality, nutrition, and use of health care services.

Health behaviours explained between 4 and 13% of the association between stressors and health. Thus, statistically controlling for health behaviours in research on psychosocial explanations of the social gradient in health may underestimate the extent of mediation. This underscores the importance of acknowledging the interrelatedness of different proposed mechanisms causing the social gradient in health. Macintyre (1997) highlights the difference between the two behavioural explanations of the social gradient in health. In the first version, health behaviours are freely chosen and thus contextual factors influencing them are ignored. In the framework of this type of a behavioural explanation of the social gradient in health, investigating other pathways from SES to health should exclude behavioural components. However, in a more comprehensive behavioural explanation, health behaviours take place in a social context, and the challenge is too understand why poorer health behaviours are associated with lower socioeconomic status. The higher prevalence of stressors in lower socioeconomic strata may account for part of this increased prevalence of poorer health behaviours among the same, and thus a pathway from SES to stressors to health behaviours to health is important to consider.

General Methodological Challenges

In addition to the methodological challenges discussed in each article as relevant to the specific questions, an overarching methodological challenge is discussed here. A strength of this series of studies is that it is based on a large-scale nationally-representative sample of Canadians. However, the trade off with using such data is that the researcher has little, if any, control over the content of the survey. Thus, research questions must be developed around available variables, which are sometime close but not optimal for the research questions posed. First, the temporal aspect of the key concepts of stressors and health must be better taken into account. Relying on self-reported survey data makes it difficult to get sufficient information about the nature and duration of stressors. The lag of time between the onset of a stressor and its health effects is unknown, thus our cross-sectional study and two-year longitudinal study may have been of insufficient duration to observe the true effect of stressors on health, and of the mediating role of these stressors. Stressors within the prior twelve months were measured, but depending on the induction period between stressor exposure and health problems, perhaps effects were observed attributable to stressors occurring before the study period.

Another technical issue is that given the complex survey design, the use of weights and/or bootstrapping is necessary to ensure that variance estimates are accurate. However, only limited statistical techniques are available (linear and logistic regression) as bootstrapping programs through Statistics Canada's Remote Data Access service. Thus, the types of analysis available to analyse particularly the longitudinal data are limited. However, use of weights and bootstrapping are critical to ensure generalisability to the Canadian population and to avoid inflated Type I error due to the homogeneity of participants sampled from the same cluster. Repeating these analyses using a proportional hazards model over numerous cycles of the study

may address some methodological issues, and would increase reliability due to the accumulation of incident cases of fair/poor health. The availability of a greater number of bootstrapping modules would be useful for future research.

Because of the importance of determining the underlying mechanisms driving the social gradient in health for the purposes of decreasing inequities, further research is warranted. This thesis focussed on a single explanation of the social gradient in health, with an acknowledgement that a psychosocial explanation is likely not the only mechanism. Research examining multiple causes organized within a theoretically-driven conceptual framework is needed. Such research is necessarily complex, because of the roles of various factors, such as the material environment, health behaviours, and psychosocial causes, as well as social and health selection, and their interactions that likely underlie the social gradient in health.

In conclusion, the present thesis succeeds at addressing the goal and objectives presented in Chapter 1. Indeed, this thesis has contributed to the understanding of the social gradient in health in Canada, and the observed relationships provide support for the hypothesis that a graded distribution of stressors mediates part of the inequitable distribution of poor health in Canada. Furthermore, it appears that a complex web of causation is at work here, as a secondary component of this thesis provided evidence that poor health behaviours associated with stressors explain part of the relationship between stressors and poor health. Future research is warranted using integrative models to further specify the mechanisms through which socioeconomic status is translated into health, in order to identify the most fruitful methods of intervention.

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Appendix A. Questionnaire, National Population Health Survey

Reprinted with permission from the National Population Health Survey Public Use Microdata Documentation (Statistics Canada, 1996).

Household Record Variables

(To be collected at initial contact from knowledgeable person)
DEMO_INT The next few questions will provide important basic information on the people in your household.
DEMO_Q1 What are the names of all persons now living or staying here who have no usual place of residence elsewhere?
(First and last names)
DEMO_Q2 Are there any persons away from this household attending school, visiting, travelling or in hospital who usually live here?
___ Yes (go to DEMO-Q1)
___ No
DEMO_Q3 Does anyone else live at this dwelling such as young children, relatives, roomers, boarders or employees?
___ Yes (go to DEMO-Q1)
___ No
DEMO_Q4 What is ... 's date of birth?
DD/MM/YY (Age is calculated and confirmed with respondent.)
DEMO_Q5 Enter or ask ... 's sex.
___ Male
___ Female
DEMO_Q6 What is ... current marital status?
(Note: if age < 15, marital status is automatically = single)
___ Now married
___ Common-law
___ Living with a partner
___ Single (never married)
___ Widowed
___ Separated
___ Divorced
DEMO_Q7 Enter ... 's family Id code.
(A to Z)
Legal household check.
Reject household at this point if screening criteria are not met.
Selection criteria applied.

Proxy Interview
(To be completed for all members of the household)
Note: In computer-assisted interviewing the options Don't Know (DK) and Refusal (R) are allowed on every question.

H05-P1 Who is providing the information for this person's form?

Restriction of Activities
RESTR-CINT If age<12, go to next section.
RESTR-INT The next few questions deal with any health limitations which affect ... (r/'s) daily activities. In these questions, "long-term conditions" refer to conditions that have lasted or are expected to last 6 months or more.
RESTR-Q1 Because of a long-term physical or mental condition or a health problem, are/is ... limited in the kind or amount of activity you/he/she can do:
a) at home?
___ Yes
___ No
R (Go to next section)
b) at school?
___ Yes
___ No
___ Not applicable
R (Go to next section)
c) at work?
___ Yes
___ No
___ Not applicable
R (Go to next section)
d) in other activities such as transportation to or from work or leisure time activities?
___ Yes
___ No
R (Go to next section)
RESTR-Q2 Do(es) ... have any long term disabilities or handicaps?
___ Yes
___ No
R (Go to next section)
If any yes in RESTR-Q1 (a)-(d), ask RESTR-Q3.
If yes in RESTR-Q2 only, ask RESTR-Q4.
Otherwise go to RESTR-Q6.
RESTR-Q3 What is the main condition or health problem causing ... to be limited in your/his/her activities?
_____(25 spaces) (Go to RESTR-Q5)
RESTR-Q4 What is the main condition or health problem causing ... to have a long term disability or handicap?
_____(25 spaces)
Education
EDUC-C1 If age<12, go to next section.
EDUC-Q1 Excluding kindergarten, how many years of elementary and high school have/has ... successfully completed?
(Do not read list. Mark one only.)
___ No schooling (Go to next section)

___ One to five years ___ Ten
___ Six ___ Eleven
___ Seven ___ Twelve
___ Eight ___ Thirteen
___ Nine DK, R (Go to next section)
(If age < 15 then go to next section)
EDUC-Q2 Have/has ... graduated from high school?
___ Yes
___ No
EDUC-Q3 Have/has ... ever attended any other kind of school such as university, community college, business school, trade or vocational school, CEGEP or other post-secondary institution?
___ Yes
___ No (Go to EDUC-C5)
DK, R (Go to next section)
EDUC-Q4 What is the highest level of education that ... have/has attained?
(Do not read list. Mark one only.)
___ Some trade, technical, vocational school or business college
___ Some community college, CEGEP or nursing school
___ Some university
___ Diploma or certificate from trade, technical or vocational school, or business college
___ Diploma or certificate from community college, CEGEP, or nursing school)
___ Bachelor's or undergraduate degree or teacher's college (e.g., B.A., B.Sc., LL.B.)
___ Master's (e.g. M.A., M. Sc., M.Ed.)
___ Degree in medicine, dentistry, veterinary medicine or optometry (M.D., D.D.S., D.M.D., D.V.M., O.D.)
___ Earned doctorate (e.g. Ph.D., D.Sc., D.Ed.)
___ Other (Specify_____)
EDUC-C5 If age >= 65, go to next section.
EDUC-Q5 Are/Is ... currently attending a school, college or university?
___ Yes
___ No (Go to next section)
DK, R (Go to next section)
EDUC-Q6 Are/Is ... enrolled as a full-time or part-time student?
___ full-time
___ part-time
Labour Force
LFS-C1 If age<15 go to next section.
LFS-Q1 What do/does ... consider to be your/his/her current main activity? (For example, working for pay, caring for
family.)
(Do not read list. Mark one only.)
___ Caring for family
___ Working for pay or profit
___ Caring for family and working for pay or profit
___ Going to school
___ Recovering from illness/on disability

___ Looking for work
___ Retired
___ Other (Specify)
LFS-I2 The next section contains questions about jobs or employment which ... have/has had during the past 12 months.
Please include such employment as part-time jobs, contract work, baby sitting and any other paid work.
LFS-C2 If LFS-Q1 = 2 or 3 ---> go to LFS-Q3.1
LFS-Q2 Have/has you/he/she worked for pay or profit at any time in the past 12 months?
___ Yes (Go to LFS-Q3.1)
___ No
DK, R (Go to next section)
Income
(Ask from knowledgeable person only)
INCOM-Q1 Thinking about your total household income, from which of the following sources did your household receive any income in the past 12 months?
(Read list. Mark all that apply.)
___ Wages and salaries
___ Income from self-employment
___ Dividends and interest on bonds, deposits and savings, stocks, mutual funds, etc.
___ Unemployment insurance
___ Worker's compensation
___ Benefits from Canada or Quebec Pension Plan
___ Retirement pensions, superannuation and annuities
___ Old Age Security and Guaranteed Income Supplement
___ Child Tax Benefit
___ Provincial or municipal social assistance or welfare
___ Child Support
___ Alimony
___ Other Income (eg. rental income, scholarships, other government income, etc.)
___ None (Go to next section)
DK, R (Go to next section)
If more than one source of income is indicated ask INCOM-Q2.
Otherwise ask INCOM-Q3.
INCOM-Q2 What was the main source of income?
(Do not read list. Mark one only.)
___ Wages and salaries
___ Income from self-employment
___ Dividends and interest on bonds, deposits and savings, stocks, mutual funds, etc.
___ Unemployment insurance
___ Worker's compensation
___ Benefits from Canada or Quebec Pension Plan
___ Retirement pensions, superannuation and annuities
___ Old Age Security and Guaranteed Income Supplement
___ Child Tax Benefit
___ Provincial or Municipal Social Assistance or Welfare

___ Child Support
___ Alimony
___ Other Income (eg. rental income, scholarships, other government income, etc.)
INCOM-Q3 What is your best estimate of the total income before taxes and deductions of all household members from all sources in the past 12 months? Was the total household income:
___ Less than $20,000?
___ Less than $10,000?
___ Less than $5,000? (go to next section)
___ $5,000 and more? (go to next section)
___ $10,000 and more?
___ Less than $15,000? (go to next section)
___ $15,000 and more? (go to next section)
___ $20,000 and more?
___ Less than $40,000?
___ Less than $30,000? (go to next section)
___ $30,000 and more? (go to next section)
___ $40,000 and more?
___ Less than $50,000 (go to next section)
___ $50,000 to less than $60,000? (go to next section)
___ $60,000 to less than $80,000? (go to next section)
___ $80,000 and more? (go to next section)
___ No income
DK, R (Go to next section)

Non-proxy Interview
(To be conducted for selected respondent only and age>=12)
(Proxy for those unable to answer due to special circumstances)
H06-P1 Who is providing the information for this person's form?

_____

H06-INT This part of the survey deals with various aspects of ... (r/'s) health. I'll be asking about such things as physical activity, social relationships, health status and stress. By health, we mean not only the absence of disease or injury but also physical, mental and social well-being. I'll start with a few questions concerning ... (r/'s) health in general.
General Health
GENHLT-Q1 In general, would you say ... r/'s health is:
(Read list. Mark one only.)
___ Excellent?
___ Very good?
___ Good?
___ Fair?
___ Poor?
Smoking
SMOK-INT The next few questions are about smoking.
SMOK-Q1 Does anyone in this household smoke regularly inside the house?
___ Yes
___ No

SMOK-Q2 At the present time do/does ... smoke cigarettes daily, occasionally or not at all?
__ Daily
__ Occasionally (Go to SMOK-Q5)
__ Not at all (Go to SMOK-Q4a)
DK, R (Go to next section)
SMOK-Q3 At what age did you/he/she begin to smoke cigarettes daily?
__ Age
SMOK-Q4 How many cigarettes do/does you/he/she smoke each day now?
__ Number of cigarettes
(Go to next section)
SMOK-Q4a Have/has you/he/she ever smoked cigarettes at all?
__ Yes
__ No (Go to next section)
DK, R (Go to next section)
SMOK-Q5 Have/has you/he/she ever smoked cigarettes daily?
__ Yes
__ No (Go to next section)
DK, R (Go to next section)
SMOK-Q6 At what age did you/he/she begin to smoke (cigarettes) daily?
__ Age
SMOK-Q7 How many cigarettes did you/he/she usually smoke each day?
__ Number of cigarettes
SMOK-Q8 At what age did you/he/she stop smoking (cigarettes) daily?
__ Age
Physical Activities
(Non-proxy only)
PHYS-INTa Now I'd like to ask you about some of your physical activities. To begin with, I'll be dealing with physical activities not related to work, that is, leisure time activities.
PHYS-Q1 Have you done any of the following in the past 3 months3?
(Read list. Mark all that apply.)

___ Walking for exercise	___ Cross-country skiing
___ Gardening, yard work	___ Bowling
___ Swimming	___ Baseball/softball
___ Bicycling	___ Tennis
___ Popular or social dance	___ Weight-training
___ Home exercises	___ Fishing
___ Ice hockey	___ Volleyball
___ Skating	___ Yoga or tai-chi
___ Downhill skiing	___ Other (specify)
___ Jogging/running	___ Other (specify)
___ Golfing	___ Other (specify)
___ Exercise class/aerobics	___ None

DK, R (Go to next section)
For each response ask PHYS-Q2 to PHYS-Q3.
If "none" go to PHYS-INTb.
PHYS-Q2 In the past 3 months, how many times did you participate in %ACTIVITY%?

___ Number of times
DK, R (Go to next activity)
PHYS-Q3 About how much time did you usually spend on each occasion?
(Do not read list. Mark one only.)
___ 1 to 15 minutes
___ 16 to 30 minutes
___ 31 to 60 minutes
___ More than one hour
Stress
(Age >= 18 and non-proxy only)
Ongoing Problems
S-INT The next portion of the questionnaire deals with different kinds of stress. Although the questions may seem repetitive, they are related to various aspects of a person's physical, emotional and mental health.
CSTRESS-INT I'll start by describing situations that sometimes come up in people's lives. As there are no right or wrong answers, the idea is to choose the answer best suited to your personal situation. I'd like you to tell me if these things are true for you at this time by answering "true" if it applies to you now or "false" if it does not.
CSTRESS-Q1 You are trying to take on too many things at once.
___ True
___ False
R (Go to next section)
CSTRESS-Q2 There is too much pressure on you to be like other people.
___ True
___ False
CSTRESS-Q3 Too much is expected of you by others.
___ True
___ False
CSTRESS-Q4 You don't have enough money to buy the things you need.
___ True
___ False
If marital status =married or living with a partner or common-law go to CSTRESS-Q5.
If marital status=single,widowed, separated or divorced go to CSTRESS-Q8.
Otherwise (i.e. marital status is unknown) go to CSTRESS-Q9.
CSTRESS-Q5 Your partner doesn't understand you.
___ True
___ False
CSTRESS-Q6 Your partner doesn't show enough affection.
___ True
___ False
CSTRESS-Q7 Your partner is not committed enough to your relationship.
___ True
___ False
Go to CSTRESS-Q9
CSTRESS-Q8 You find it is very difficult to find someone compatible with you.
___ True

___ False
CSTRESS-Q9 Do you have any children?
___ Yes
___ No (Go to CSTRESS-Q12)
DK, R (Go to CSTRESS-Q12)
CSTRESS-Q10 Remember I want to know if you feel any of these statements are true for you at this time.
One of your children seems very unhappy.
___ True
___ False
CSTRESS-Q11 A child's behaviour is a source of serious concern to you.
___ True
___ False
CSTRESS-Q12 Your work around the home is not appreciated.
___ True
___ False
CSTRESS-Q13 Your friends are a bad influence.
___ True
___ False
CSTRESS-Q14 You would like to move but you cannot.
___ True
___ False
CSTRESS-Q15 Your neighbourhood or community is too noisy or too polluted.
___ True
___ False
CSTRESS-Q16 You have a parent, a child or partner who is in very bad health and may die.
___ True
___ False
CSTRESS-Q17 Someone in your family has an alcohol or drug problem.
___ True
___ False
CSTRESS-Q18 People are too critical of you or what you do.
___ True
___ False
Recent Life Events
RECENT-INTa Now I'd like to ask you about some things that may have happened in the past 12 months. Some of these experiences happen to most people at one time or another, while some happen to only a few. First, I'd like to ask about yourself or anyone close to you (that is, your spouse or partner, children, relatives or close friends).
RECENT-Q1 In the past 12 months, was any one of you beaten up or physically attacked?
___ Yes
___ No
R (Go to next section)
RECENT-INTb Now I'd like you to think just about your family, (that is, yourself and your spouse/partner or children, if any).

RECENT-Q2 In the past 12 months, did you or someone in your family, have an unwanted pregnancy?
___ Yes
___ No
RECENT-Q3 In the past 12 months, did you or someone in your family have an abortion or miscarriage?
___ Yes
___ No
RECENT-Q4 In the past 12 months, did you or someone in your family have a major financial crisis?
___ Yes
___ No
RECENT-Q5 In the past 12 months, did you or someone in your family fail school or a training program?
___ Yes
___ No
RECENT-INTc Now I'd like you to think just about yourself and your spouse or partner.
If marital status = married/living together/common-law include the phrase "or your partner" in the RECENT-Q6 and RECENT-Q7.
RECENT-Q6 In the past 12 months, did you (or your partner) experience a change of job for a worse one?
___ Yes
___ No
RECENT-Q7 In the past 12 months, were you (or your partner) demoted at work or did you/either of you take a cut in pay?
___ Yes
___ No
If marital status = married/living together/common-law ask RECENT-Q8.
Otherwise go to RECENT-Q9.
RECENT-Q8 In the past 12 months, did you have increased arguments with your partner?
___ Yes
___ No
RECENT-Q9 Now, just you personally, in the past 12 months, did you go on Welfare?
___ Yes
___ No
IF CSTRESS-Q9 = yes (have children) ask RECENT-Q10.
Otherwise go to next section.
RECENT-Q10 In the past 12 months, did you have a child move back into the house?
___ Yes
___ No

Work Stress
(Age >= 15 and non-proxy only)
Check item: ask only of those currently employed. If more than one job is held ask for the main job.

WSTRESS-Q1 Now I'm going to read you a series of statements that might describe your job situation. Please tell me if you STRONGLY AGREE, AGREE, NEITHER AGREE NOR DISAGREE, DISAGREE, or STRONGLY DISAGREE with each of the following:
a) Your job requires that you learn new things R on first item (Go to next section)
b) Your job requires a high level of skill
c) Your job allows you freedom to decide how you do your job
d) Your job requires that you do things over and over
e) Your job is very hectic
f) You are free from conflicting demands that others make
g) Your job security is good
h) Your job requires a lot of physical effort
i) You have a lot to say about what happens in your job
j) You are exposed to hostility or conflict from the people you work with
k) Your supervisor is helpful in getting the job done
l) The people you work with are helpful in getting the job done