# A LIFE COURSE APPROACH TO SOCIOECONOMIC INEQUALITIES IN HEALTH: TRACKING THE INFLUENCE OF INCOME DYNAMICS ON THE HEALTH OF CHILDREN

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## ABSTRACT

Socioeconomic inequalities in health research comprises the investigation of the pathways through which differential access to resources affects the distribution of morbidity and mortality in the population. Because many of the factors that influence health are cumulative, researchers have incorporated a life course approach into their work by linking socioeconomic conditions in one stage of the life course to health at a later stage. The childhood period has acquired particular significance due to conflicting theories about the relative importance of early life events for health inequalities during adulthood.

Using seven waves of the child component of the National Longitudinal Study of Youth (1986-98), I employ generalized linear mixed models to examine the effect of household income on child physical and mental health over the entire childhood period. The results of this dissertation support the hypothesis that household income influences the physical and mental health of children, both concurrently and over time. In generalized linear mixed models, the stable component of household income, that is, the average household income for a given child over the period in which he or she is observed, exerts a strong influence on risk for child chronic health limitation, child anxiety/depression and

antisocial behaviour, and to a lesser extent, child medically attended accident or injury. However, the dynamic component of household income, defined as deviations in household income over time from the observed average of that household, is mostly unrelated to child health.

These findings have broader implications for life course theory and for the discipline of sociology as health inequalities researchers track the impact of socially significant events over time and reveal the long term processes underlying the social distribution of health.

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## INTRODUCTION

*I know I do not exaggerate, unconsciously or unintentionally, the scantiness of my resources or the difficulties of my life. I know that if a shilling were given to me by Mr. Quinion at any time, I spent it in a dinner or a tea. I know that I worked, from morning until night, with common men and boys, a shabby child. I know that I lounged around the streets, insufficiently and unsatisfactorily fed. I know that, but for the mercy of God, I might easily have been, for any care that was taken of me, a little robber or a little vagabond.*

David Copperfield, Charles Dickens, 1850

*We know they're the ones who will go to university, take over the family business, run the government, run the world. We'll be the messenger boys on bicycles who deliver their groceries or we'll go to England to work on the building sites. Our sisters will mind their children and scrub their floors unless they go off to England, too. We know that. We're ashamed of the way we look and if boys from the rich schools pass remarks we'll get into a fight and wind up with bloody noses or torn clothes. Our masters will have no patience with us and our fights because their sons go to the rich schools and, Ye have no right to raise your hands to a better class of people so ye don't.*

Angela's Ashes, Frank McCourt, 1996

The passages above represent autobiographical excerpts[1] written in different

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[1] Although David Copperfield is a fictional work, it is generally regarded as Dickens's recollections of his own childhood experiences.

centuries by two renowned authors. Despite the different historical periods in which they occur, these accounts strike similar chords as windows into a child's world of disadvantage and despair. More than just the torment of relentless deprivation, these accounts allude to the overwhelming feelings of worthlessness and abandonment that can be associated with being a disadvantaged child. As such, these passages bring into focus unresolved questions concerning the importance of childhood experiences for later life. Essentially, they provoke inquiry into whether there are fateful events in childhood that indelibly leave their mark on all subsequent stages of socialization and development.

Poverty and nonintact family structures are two areas that have received extensive attention as exerting damaging effects on child development (Biblarz & Raftery, 1999; Chase-Lansdale & Brooks-Gunn, 1995; Duncan & Brooks-Gunn, 1997). Yet limited by cross-sectional research, social scientists have habitually reduced children's lives to static descriptions at discrete moments in time. What is needed is the ability to view events such as upheavals in economic fortunes and changes in family structure as dynamic and process-oriented: these events start, end and even recur over the childhood period (Brooks-Gunn, Phelps, & Elder, 1991). By scrutinizing the timing and duration of these events, researchers can explore whether there is a specific period in which economic disadvantage or loss of a parent figure has particularly devastating consequences, and whether the effects of these events become more ingrained the longer they last (Allison & Furstenberg, 1989; Chase-Lansdale & Brooks-Gunn, 1995; Duncan, Brooks-Gunn & Klebanov, 1994; Korenman & Miller, 1997; McLeod & Shanahan, 1993, 1996).

Another prospect to consider is the subjective response of individuals to life events. Scholars debate whether it is the event itself or the way in which the individual perceives and reacts to the event that is most influential on outcomes (Pearlin & Schooler, 1978; Simon, 1997). Accumulated experiences in a given role become contextual characteristics that potentially modify effects associated with the timing and duration of a stressful life event (Wheaton, 1990). For example, the impact of marital disruption may depend on whether the family atmosphere prior to the break up was hostile and abusive (Seltzer, 1994), just as a short bout of poverty may more easily overwhelm a child (or family) with few coping resources (Shirk, Bennett & Aber, 1999).

Thus, the interaction of role histories with the timing and duration of life events is an important dimension in examining the impact of economic stress or family dissolution on child outcomes, a dimension that often escapes detection in cross-sectional research. Clearly, there is no necessary relationship between events such as childhood poverty and subsequent outcomes. One might even conjecture that the high level of literary success attained by Charles Dickens and Frank McCourt occurred because of their experiences. Do their lives stand out as isolated cases, merely exceptions that prove the rule (Miliband, 1973, p. 41), or do they suggest greater complexity in the links between childhood experience and adult outcomes?

This dissertation investigates some of these issues, albeit using a much narrower focus. That is, rather than a general evaluation of the effects of family structure and income on child development, I approach these issues from the perspective of social

inequalities in health. This field of research involves understanding the ways in which socially structured differences affect the distribution of disease and mortality in the population. Because the factors that influence health may take years to manifest, researchers have shown keen interest in documenting socially patterned differences in health at different stages in life as a means of unravelling the underlying causal processes. Aided by an increasing number of longitudinal studies and by advances in statistical methods (Brooks-Gunn et al., 1991; Giele & Elder, 1998; Singer & Willett, 1991), research on social inequalities in health stands poised to make substantial progress in understanding how childhood events and experiences contribute to health inequalities in later life.

This project involves the statistical analysis of the lives of young American children using a nationally representative, longitudinal survey in order to assess the relative importance of childhood events to subsequent health experiences. Specifically, this project will examine economic disadvantage and family structure during childhood as dynamic influences on health and wellbeing over time. Although these events can be mutually reinforcing, that is, changes in family structure can precipitate economic stress in the family and poverty can exacerbate family conflict and instability (Corcoran & Chaudry, 1997), greater emphasis will be placed on the effect of socioeconomic conditions on health. Consequently, this research project fits within a smaller niche in the field of social inequalities in health, namely socioeconomic inequalities in health research.

Investigation of the effects of economic disadvantage on different aspects of life is

carried out by researchers from a wide variety of disciplines including psychoneuroimmunology, economics, psychology and sociology. Each discipline has developed its own unique orientation to the issue. For example, the field of psychoneuroimmunology is engaged in the discovery of changes in brain structures that occur as a result of deprivation and poverty, while economists respond to issues concerning the mix of income and welfare policies that most efficiently and effectively produce successful child outcomes (eg. Blau, 1999). While the efforts of different disciplines are informative and generate new knowledge about the effects of economic disadvantage on children's lives, it is helpful to remember that value-free research is a myth, and that the system of beliefs that guides each researcher ultimately shapes what is deemed important (Gouldner, 1973; McKinlay & Marceau, 2000). In such a universe, conflict and disagreement among different disciplines as to which paradigm has supremacy is to be expected. With this caveat in mind, I approach this research project from the perspective of a sociologist committed to understanding the ways in which facets of social organization influence human health, and yet remain cognizant that researchers from other disciplines may find this approach unfamiliar or inadequate.

Notwithstanding cross-disciplinary challenges, sociologists themselves approach research on the effects of economic disadvantage in a variety of ways. Although this research project falls within the scope of the literature on stressful life events, there are several justifiable reasons for staying within the bounds of research on social inequalities in health. First, while there has been a move towards viewing stressful events and chronic

stressors as socially distributed (Pearlin, 1989; Turner, Wheaton & Lloyd, 1995), there is still a tendency by researchers to debate what income represents in terms of its monetary return on health outcomes (Mayer, 1997; Mirowsky & Ross, 1999). One of the great strengths of research on social inequalities in health is that it explicitly theorizes income as a fundamental aspect of stratification in hierarchically ordered societies. Second, the literature on stressful life events is directed mostly at mental health outcomes (Thoits, 1995), while research on social inequalities in health embraces a broader interpretation of health to include mortality, chronic illness and accident or injury rates. This expanded view implies that socially structured differences produce a generalized susceptibility to poor health, rather than one specific area of health (Link & Phelan, 1995; Vågerö, 1991).

Located within the sociology of health and illness, research on social inequalities in health relies on a wide range of viewpoints. Investigation into the development of socioeconomic inequalities in health over time, which is the purpose of this research project, exists at the junction of three foundational perspectives. First, a sociological perspective on socioeconomic inequalities in health is truly different from the perspectives of other disciplines. Compared to other ways of understanding the causes of disease and mortality, sociologists explicitly acknowledge that health is socially patterned and intricately bound up with one's social position. Such a perspective also decries the fundamental injustice of the unequal distribution of health in society and demands that health policy be more responsive to socioeconomic inequalities in health as an urgent ethical and social problem (Marchand, Wikler & Landesman, 1998; Vågerö, 1995).

Second, progress in identifying the causal mechanisms underlying the relationship between socioeconomic position[2] and health is influenced by an established set of explanations which form the template traditionally used by sociologists to investigate causes of socioeconomic inequalities in health. Since the inception of this set of explanations, virtually all research into socioeconomic inequalities in health has made reference to it and sought to expand its frontiers. Finally, researchers of socioeconomic inequalities in health recognize the utility of a life course approach to their work. The integration of a life course perspective into research on socioeconomic inequalities in health is relatively recent (Wadsworth, 1997), yet has advanced considerably notions about how these inequalities are generated and reproduced at different stages in the life course. In effect, these perspectives view health inequalities as a multi-layered phenomenon which operates at the macro and the micro level, is produced through a complicated set of causal processes and is moderated by the trajectory of individual biographies. The following chapters present a more detailed discussion of these three perspectives and the ways in which they illuminate different aspects of research on social inequalities in health.

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[2] The term socioeconomic position is preferred by health inequalities researchers to avoid confusion with either social class or socioeconomic status, terms that have very specific meanings for social class theorists.

# CHAPTER 1

## SOCIAL INEQUALITIES IN HEALTH AS A SOCIOLOGICAL PROJECT

Investigating the causes of illness and disease was once considered the exclusive jurisdiction of biomedical science. During the past century, this dominance has increasingly eroded as researchers from other disciplines conceptualize threats to health in ways that extend beyond the narrow focus of biomedical science (Blishen, 1991; Illich, 1976; McKeown, 1979). The corresponding shift from a 'sociology in medicine' to a 'sociology of medicine' has spawned two distinct sociological approaches to health and illness, labelled the social construction of health and the social production of health, or alternatively, meaning-seeking and structure-seeking (Conrad & Kern, 1994; Pearlin, 1992; Turner, 1992). Positing that individuals subjectively interpret reality through social interaction, meaning-seekers negate the validity of disease as an empirical entity and question the unmitigated effects of social structure on health (Brown, 1996). Structure-seekers rely on the assumption that illness is an observable and measurable construct and assert that the pervading influence of social structure on health reflects the social conditions and contexts of people's lives (Aneshensel, Rutter & Lachenbruch, 1991; Nettleton, 1995). While both meaning-seeking and structure-seeking contribute to the understanding of health as a social phenomenon (Brown, 1996; Pearlin, 1992; Walters,

1993), this research project on socioeconomic inequalities in health is grounded in the social production of health paradigm.

By claiming specialized knowledge about the disease process, both sociology and medicine transform how individuals envision and achieve healthy bodies (Fox, 1994). However, the legitimizing discourses offered by these two disciplines operate in different realms. Medical scientists draw attention to biological factors that render individuals susceptible to disease while sociologists believe that social forces circumscribe health (Turner, 1995). With their gaze fixed on individual bodies, researchers with a biomedical orientation to theories of disease causation are incapable of perceiving, much less explaining, the influence of social structure on health.

The biomedical model is premised on the notion that because disease is located in the bodies of individuals, the appropriate arena to fight the battle against disease occurs within the sphere of the body (Weitz, 1996). It is with this organizing principle that the biomedical model effectively detaches individuals from their surrounding structural, social and cultural contexts (Freund & McGuire, 1989; Nettleton, 1995; Zola, 1972). Just as physicians use objective tests and procedures to reveal disease in the body without considering patients' personal accounts or the contribution of external conditions to illness (Armstrong & Armstrong, 1996; Turner, 1992), so epidemiologists, charged with the task of uncovering the causes of disease in the general population, have accustomed themselves to glossing over social contexts and emphasizing individual risk factors (Pearce, 1996). By treating social factors as nothing more than confounding variables, epidemiologists create

a 'black box' in which their effects are rendered invisible (Skrabanek, 1994; Wing, 1998) and consequently, sacrifice a more textured understanding of the multi-levelled causes of disease (Pearce, 1996).

In contrast to the reductionist approach of the biomedical model, a social production of health approach looks further upstream to the social conditions that differentially influence the health of the population (McKinlay, 1993). Two features definitively set this approach apart from the biomedical model and any other disciplinary perspective. First, a model of disease causation based on a social production of health approach posits an essential role for the social and structural conditions that give rise to the expression of illness in individual bodies. Health and illness are not just biologically based, but socially patterned such that disease is unequally distributed among the most vulnerable and disadvantaged members of society (Nettleton, 1995). Thus, occupying a particular social location in society has the potential to confer either greater risk for poor health or afford greater protection. While this research project is interested primarily in socioeconomic inequalities in health, the social patterning of health is not simply a matter of socioeconomic differences. Gender (Doyal, 1995; Walters, Lenton & McKeary, 1995), race/ethnicity (Bolaria & Bolaria, 1994) and marital status (Simon & Marcussen, 1999; Zick & Smith, 1991) as well as the synergistic effects of occupying combined roles and positions (Macintyre & Hunt, 1997; Walters, McDonough & Strohschein, 2002; Williams & Collins, 1996), are just a few of the social differences which influence health.

The second defining feature of a social production of health approach, somewhat

intertwined with the first, is the contention that differential access to power underlies the social distribution of disease (Petersen, 1994; Weitz, 1996). As a discipline, sociology is concerned with structured differences that serve to regulate and control all aspects of social life (Grabb, 1997). Founded on the theory that societies tend to be hierarchically organized, sociologists examine the ways in which occupancy of different positions within these social hierarchies selectively determines access to social and economic resources. To the extent that stratification is seen as both natural and necessary, challenges to the social order rarely occur. Yet social structure is so pervasive that it acts as a seemingly invisible force on the life chances of all members of society. As Aneshensel and her colleagues (1991) point out

> Sociological theory explicates how normative social arrangements generate conditions that damage . . . people's lives. High rates of disorder among some social groups are seen as the inevitable by-product of ordinary facets of social life, facets that are often advantageous to other social groups (p. 167).

Therefore, it is not enough to point out which socially vulnerable populations are at risk for poorer health; to make a difference, one must critically examine the social arrangements that allow these relationships to exist.

In recent years, biomedical and social scientists have adopted a more integrated approach such that medicine concedes the social facets of disease and sociology recognizes the physical body (Fox, 1994; Fremont & Bird, 1999; Kelly & Field, 1996; Shilling, 1993). For sociologists of health and illness, the challenge has been largely the application of abstruse theories of class and power to tangible problems of human

existence. However, for epidemiologists, integrating the social has precipitated nothing less than a paradigmatic shift within the discipline (Schwartz, Susser & Susser, 1999). Risk factor epidemiology, dominant in the twentieth century, has situated the individual as the proper unit of analysis and placed greater emphasis on the identification rather than explanation of risk. The emerging view in epidemiology breaks away from the mold of fashioning 'prisoners of the proximate' (McMichael, 1999) to a field which is beginning to grasp the importance of conceptualizing different levels of influence on health in ways that acknowledge their social embeddedness.

Despite the move towards integrated approaches, difficult challenges lie ahead. The apparent consensus on multi-level models of disease causation has at times blurred the very different strategies advocated by each discipline for resolving inequalities in health. The continued dominance of biomedically oriented health policies is revealed in the use of targeted interventions to modify individual behaviours and the perception that strategies aimed at community or societal factors are unworkable (Pearce, 1997; Poland, Coburn, Robertson & Eakin, 1998). The atomistic approach of the biomedical model also surfaces in health policies that compel individuals to assume greater responsibility for their own health, while concealing the power relations that sustain social inequalities in health (Bunton, Nettleton, & Burrows, 1995; Lupton, 1993). Although insistent that policies to reduce social inequalities in health will be ineffectual unless they acknowledge that socially patterned differences in health are rooted in power relations, sociologists have had little success in placing their concerns on the agenda (McKinlay, 1993; Rahkonen, Lahelma,

Karisto & Manderbacka, 1993).

An individualizing, de-politicized view of health is at odds with the social production of health paradigm. Grounded within the discipline of sociology, the social production of health paradigm has greater capacity to explain and ameliorate socially patterned differences in health than the biomedical approach alone. This advantage stems from the recognition that humans are both biological and social beings whose health is more than just the sum of either of these influences. Moreover, by acknowledging the interplay between structure and human agency, sociologists of health and illness strike a delicate balance in conceptualizing health inequalities as a function of broader social and structural arrangements, and individual adaptations to these same environments (Bartley, Blane & Davey Smith, 1998; Popay, Williams, Thomas & Gatrell, 1998).

# CHAPTER 2

## EXPLAINING THE RELATIONSHIP BETWEEN SOCIOECONOMIC POSITION AND HEALTH

Knowledge of socioeconomic inequalities in health has a long history: awareness of the influence of social structure on health can be traced back as far as Plato (Susser, 1997). The health consequences of economic deprivation and exploitation were a major preoccupation of socially minded reformers such as Engels in Britain, Virchow in Germany, and Allende in Chile at different times over the past two centuries (Waitzkin, 1981). Each argued that the origins of disease and death could be found in the structuring of society which protected the privileged at the expense of the disadvantaged. Heightened exposure to toxic substances in the workplace, inadequate nutrition, and crowded, inferior housing were aspects of the material conditions of the poor and working classes that were blamed for the unequal social distribution of disease and death. In the twentieth century, American researchers systematically documented the relationship between social class and mental illness (eg. Faris & Dunham, 1939; Hollingshead & Redlich, 1958), while sporadic analyses of mortality rates among Britain's occupational classes eventually culminated in the most well known investigation of socioeconomic inequalities in health, the Black Report (DHSS, 1980), which became the gold standard for subsequent work in this area.

The Black Report evaluated four potential explanations for the relationship

between occupational class and morbidity and mortality rates in Britain. The first explanation questions the veracity of the relationship by conjecturing that the relationship may be artefactually produced because of the way either social class or health is measured. The second explanation for socioeconomic inequalities in health centers on the issue of social selection. Also known as reverse causation, this explanation posits that rather than socioeconomic position causing poor health, health status determines socioeconomic position. The authors of the Black Report dismissed the plausibility of both artefact and social selection and instead accepted two alternative explanations. The materialist explanation asserts that economic deprivation prevents individuals from obtaining the resources they need to maintain and promote their own health. The cultural/behavioural explanation targets patterns of socialization that predispose individuals to behave in ways that are damaging to health. For example, the authors believed that disadvantaged individuals are unlikely to appreciate the effects of smoking, poor diet and a sedentary lifestyle on their health. Although more weight was placed on the materialist explanation, the authors viewed cultural/behavioural factors as a potential barrier to equality in health. In the event that redistributive policies were enacted to reduce health inequalities, the authors speculated that their beneficial effects might not be realized if disadvantaged individuals could not overcome entrenched patterns of behaviour.

While other explanatory frameworks have been formulated to account for socioeconomic inequalities in health, the explanations proffered in the Black Report still represent the most essential typology for understanding health inequalities. Researchers

have come to recognize that the explanations themselves contain many different shades of meaning and that no one explanation is sufficient (Macintyre, 1997). By sifting and refining the explanations and contemplating how they might be interwoven, researchers have made progress in discerning more precisely the mechanisms through which socioeconomic position influences health.

Although health inequalities researchers still reject artefact as an explanation, they have sought to avoid its taint through more careful selection and theoretical justification of measures of socioeconomic position. Once the mainstay of health inequalities research, occupational class has receded in importance while education and income have gained in popularity (Fox, 1990), along with more diverse measures relating to patterns of consumption including owning a car, dishwasher, one's home, and other asset based measures. Critics contend that occupation may encompass so many meanings as to be completely worthless, that is, it begs the question of whether it is status, power or consumption that drives occupational differences in health (Illsley & Baker, 1991). Additionally, occupational measures exclude the nonemployed and the retired, arbitrarily assign women the occupational status of their fathers or husbands, and are wholly insensitive to the radical changes that have occurred within occupational classes in the last century (Feinstein, 1993; Liberatos, Link & Kelsey, 1988; Macintyre, 1986).

Measures of educational attainment are better able to classify those with a weaker attachment to the labour market, namely women and retired persons (Arber & Cooper, 2000; Elo & Preston, 1996). Increased usage of educational measures in health inequalities

research coincides with attempts to pinpoint more specifically its relevance for health (Krieger, Williams & Moss, 1997; Ross & Wu, 1995). Education is thought to operate directly on health by allocating better paying jobs to the highly educated, thus enabling the acquisition of material resources that maximize health. Indirectly, education may provide access to jobs that are stimulating and personally rewarding, and may provide opportunities to become more knowledgeable about ways of improving health (Reynolds & Ross, 1998; Ross & Wu, 1995). That measures of parental educational attainment are also highly predictive of child health status may offer insight into education as an integral family resource (Zill, 1996). The disadvantages of education in health inequalities research include a lack of universal meaning of education particularly across age cohorts and the inability to use education to track changes in adult socioeconomic position on adult health (Krieger et al., 1997; Liberatos et al., 1988).

In contrast to the stability of education measures, income exhibits considerable volatility over time (Duncan, 1988), and thus captures more effectively the health effects of changes in socioeconomic position. Its drawbacks are that income must be adjusted for family size and geographical region, and researchers must operate under the assumption that income is equitably distributed within households (Krieger et al., 1997). Distinguishing between household versus individual income (Rahkonen, Arber, Lahelma, Martikainen & Silventoinen, 2000) and assessing the impact of different sources of income such as employment income versus welfare income (Mayer, 1997) are additional factors that have been shown to influence health in unique and subtle ways, and although these

findings point to the importance of viewing income as socially embedded, an understanding of why these complexities exist remains elusive. Finally, at a practical level, survey questions about income are prone to inaccurate reporting and high levels of non-response, in the range of approximately 10 to 25 percent, which may introduce bias (Turrell, 2000).

Researchers must distinguish between income and poverty status, for although income is used to determine poverty status, the two measures are conceptually different. By treating income as a continuous measure that is linearly related to health outcomes, researchers presuppose a graded association with health, such that increases in income are met with corresponding increases in health (Evans, Barer & Marmor, 1994). This gradient relationship characterizes most findings in income-related differences in health research, although there have been reports of threshold effects and other nonlinear relationships (Backlund, Sorlie, & Johnson, 1996; McDonough, Duncan, Williams & House, 1997). As a dichotomous measure, poverty status reflects an arbitrary distinction between those who are considered able to afford the necessities of life and those who are not (Curtis, Grabb & Guppy, 1999). Official poverty measures are often severely criticized for failing to account for geographic differences in the cost of living, changes in taxation, in-kind public assistance, and various mixes of family size and adult-child composition (Lichter, 1997). Despite these shortcomings, researchers continue to utilize this measure and seek to capture more subtle variation in poverty status by developing measures that assess depth and duration of poverty (Aber, Bennett, Conley, & Li, 1997; Duncan & Rodgers, 1991;

Huston, McLoyd & Coll, 1994; McLeod & Shanahan, 1993).

Central to any discussion of income and poverty is the issue of whether relative deprivation is more consequential than absolute deprivation in affecting health. Some have found that it is not income per se, but rather the level of income inequality which affects the social patterning of health (Kennedy, Kawachi, & Prothrow-Stith, 1996; Wilkinson, 1996). This suggests that increasing the income of the poor may improve their absolute levels of health, but have no effect on their health relative to the rest of the population, if the most advantaged members increase their share of income at a higher rate. As others have shown, absolute increases in income and living standards over the course of the past century radically transformed overall patterns of mortality and morbidity, but did not alter the underlying social distribution of disease (Blane, Brunner & Wilkinson, 1996; Wilkinson, 1996). For this reason, it may not be advisable to view income solely in terms of its monetary return on health.

As health inequalities researchers have come to appreciate, designing a measure that reflects how members of a given society are differentially distributed and located in relation to various power structures in a social hierarchy is not an easy task. Yet these methodological challenges only scratch the surface of a much deeper theoretical issue (Berkman & Macintyre, 1997). Social class theorists have been harshly critical of studies that simply and crudely correlate occupation, education and income with different social phenomena without theorizing what these relationships actually mean (Higgs & Scambler, 1998; Leacock, 1972, p. 60; Susser, 1997). Although this issue has already been

discussed, the importance of connecting the social patterning of health to the discipline of sociology cannot be overstated. To extend the point further, not only do socioeconomic inequalities in health more properly apply to the realm of sociology than biomedical science, but the processes that produce health inequalities also require the consideration of different sociological theories of stratification. Wohlfarth (1997) suggests that one consequence of neglecting sociological theory is that researchers may unintentionally endorse a structural functionalist point of view. That is, unless health inequalities researchers clearly articulate measures such as education and income as the structured outcomes of unequally distributed opportunities, they may leave the unfortunate impression that hierarchical structures in society represent a consensually agreed upon mechanism for allocating rewards according to their social worth, and that individuals who acquire the most rewards are inherently superior to those occupying less advantaged positions.

The authors of the Black Report rejected social selection as an explanatory mechanism in socioeconomic inequalities in health, because they interpreted social selection as a Darwinian concept, that is, that upward mobility is awarded to those endowed with superior health (Vågerö & Illsley, 1995; West, 1991). This blanket dismissal of social selection has led to considerable confusion and acrimony in health inequalities research (Macintyre, 1997). West (1991) contends that overlooking the contribution of social selection may avoid ideologically driven debate, but runs counter to what sociologists themselves know about the stigma associated with having an

incapacitating, highly visible mental or physical illness, and the socially mediated sorting processes that act as gatekeepers of educational and occupational opportunities. Most health inequalities researchers continue to reject the direct influence of social selection, yet acknowledge that childhood conditions indirectly affect both health and socioeconomic position in adulthood (Blane, Davey Smith & Bartley, 1993; Marmot, Ryff, Bumpass, Shipley, & Marks, 1997). This has facilitated the realization that investigating relationships using synchronous measures yields an incomplete and unsatisfactory picture that can only be resolved through longitudinal research studies.

Researchers continue to rejuvenate materialist and cultural/behavioural explanations. While early responses to the materialist and behavioural explanations of the Black Report focused on their contrasting ideologies and researchers' inability to determine which was superior (Carr-Hill, 1987), there is now greater resistance towards polarizing these two explanations (Denton & Walters, 1999). Rather than simply subsume behavioural explanations into materialist explanations by asserting that all behavioural risk factors occur within the context of social structures (Bartley et al., 1998), both materialist and behavioural explanations must be viewed through the lens of power relations and class struggle which generate both macro- and micro-level effects (Scambler & Higgs, 1999). For example, Vågerö and Illsley (1995) eschew the binary distinction between structural/materialist and individual/behavioural explanations by arguing that it is possible for both materialist and behavioural explanations to be structurally and individually produced. Similarly, theories that focus exclusively on psychosocial responses to one's

location in the social hierarchy (eg. Adler et al., 1994; Arnetz, 1996) are deemed inadequate. Critics acknowledge the potential of psychosocial mechanisms to reveal the underlying processes in health inequalities, but believe they should overlay rather than replace links between materialist and behavioural explanations (Elstad, 1998).

The legacy of the Black Report rests not in its development of a set of well formulated explanations, but rather as a rallying force that spurs health inequalities researchers to uncover the subtle layers of meaning hidden within the four simple explanations. One of the greatest advances to date has been the re-conceptualization of the explanations not as competing causes but as complementary and interdependent influences. As a result, researchers have taken steps to situate their work within established theories of social stratification, have come to embrace greater complexity in modeling causal processes using longitudinal research methods and have postulated denser links between structure and agency as a means of understanding the interconnections between materialist and behavioural explanations. In one form or another, these ideas have all found expression in a life course approach.

# CHAPTER 3

## A LIFE COURSE APPROACH TO SOCIOECONOMIC INEQUALITIES IN HEALTH

Originally developed in the 1960s and 1970s by social psychologists who were attempting to reconcile theories of socialization with social change, a life course approach now underpins a diverse range of empirical research (Colby, 1998; Elder, 1994). The approach is organized around the central theme that individual lives are inextricably fused to historical and social contexts and is composed of four core elements (Elder, 1994; Giele & Elder, 1998). First, a life course approach asserts that all lives are anchored in a particular time and space, which uniquely define the experiences of those located therein. For example, Elder and Caspi (1988) report that the Great Depression enhanced adolescents' sense of competence and efficacy as they took on greater responsibility in the family and accelerated their transition into adulthood, but for younger children, economic crisis resulted in lowered feelings of self esteem and efficacy and eventually took its toll on their academic achievement. Second, a life course approach involves the notion of linked lives. Lives are spent forming intimate relationships and developing social bonds which not only socialize and regulate patterns of social interaction, but create ripple effects when events occur to any one individual within a socially bonded group. The third element of a life course approach reiterates the relevance of human agency in understanding the impact

of broader social structures on individual lives. Individuals knowingly and purposefully undertake action to achieve self-directed goals, and the influence of social structure is continually met with individual response and adaptation. Finally, a life course approach is concerned with the timing of lives. There are normative ideals about how life should unfold, broad expectations for when one should get married, bear and raise children, get a job, retire, etc. When the scheduling of life events and transitions goes awry or deviates from the anticipated course, there are consequences for the future.

The concept of the timing of lives does not suggest that the life course is inherently unpredictable and unstable. Life transitions may have uncertain moments, but they occur within the context of a long-term pattern or trajectory of prior experiences and circumstances (George, 1993). In discussing the pathways that link childhood experiences to adult outcomes, Rutter (1989) points out that

> continuities will occur because children carry with them the results of earlier learning and of earlier structural and functional change. This does not necessarily mean that a person's characteristics at one age will predict the degree or type of *change* over a later time period, but it does mean that it is likely to predict later *levels* of functioning, because they will incorporate earlier levels (p. 26, italics in the original).

In sum, a life course approach views individual lives as unique personalities that respond, pursue and give meaning to socially significant events and transitions which, subtly and profoundly influenced by the bond of social relationships, unfold as biographical trajectories delimited by history, space and time.

The growing awareness that health inequalities do not operate contiguously but

take time to develop (Macintyre, 1997; Power, 1991) has meant that sociological research on the social patterning of disease has increasingly come to value the contribution of a life course perspective (Mirowsky, 1998; van de Mheen, Stronks & Mackenbach, 1998; Wadsworth, 1997). This represents a major shift, as the bulk of research on socioeconomic inequalities in health utilizes cross-sectional surveys and conceptualizes life as a series of progressive but distinct developmental periods. While this approach reveals the immense variability in the pattern of socioeconomic inequalities in health at different periods in the life course and lends credence to the supposition that there may be unique causal mechanisms operating in each period (Ford, Ecob, Hunt, Macintyre & West, 1994; Wadsworth, 1997; West, 1988), such an approach does not adequately address causal relationships. Nonetheless, it is a useful starting point for understanding the progression from a cross-sectional, distinct-life-stages perspective to a longitudinal, life-course-oriented approach to socioeconomic inequalities in health.

Socioeconomic inequalities in health surface in the earliest moments of life, for despite tremendous medical advances in neonatal care, low income continues to be strongly associated with a higher risk of perinatal death (Wadsworth, 1997) and infant mortality (Gortmaker & Wise, 1997; Nersesian, 1988). Childhood mortality rates vary significantly according to parents' receipt of welfare benefits (Nelson, 1992), occupational status (Östberg, 1997), and poverty status (Shah, Kahan & Krauser, 1987). Children from poor families are more likely to be disabled (Wilkins & Sherman, 1999) and have significantly higher rates of infectious disease (Reading, 1997), chronic illness (Bor,

Najman, Andersen, Morrison & Williams, 1993; Cadman et al., 1986), limiting longstanding illness (Cooper, Arber & Smaje, 1998) and mental disorder (Lipman, Offord & Boyle, 1994, 1996; Takeuchi, Williams & Adair, 1991). Children from low income families are four times more likely to be injured in motor vehicle traffic accidents than their more advantaged counterparts (Dougherty, Pless & Wilkins, 1990), and more likely to be hospitalized and have a greater length of stay in hospital (Egbuono & Starfield, 1982; Miller, 2000).

While there is a clear pattern of health inequalities in childhood, results are much more ambiguous during adolescence. It appears that the transition period between childhood and adulthood is characterized by a relative lack of socioeconomic differences in health on a variety of health outcomes (Ford, et al., 1994; Glendinning, Shucksmith & Hendry, 1997; Macintyre & West, 1991; Sweeting & West, 1995; Tuinstra, Groothoff, van den Heuvel & Post, 1998; West, 1988, 1997; West, Macintyre, Annandale & Hunt, 1990; Williams, Currie, Wright, Elton & Beattie, 1996). Once adolescents make the transition to young adulthood, the familiar pattern of health inequalities emerges yet again, although the pattern is inconsistent across health conditions and there is no consensus on the precise age at which health inequalities reappear (Blane et al., 1994; Ford et al, 1994; Power, 1991; Power, Hertzman, Matthews & Manor, 1997). The relationship between socioeconomic position and health is strongest during the adult years (DHSS, 1980; Elo & Preston, 1996; House et al., 1994). Researchers report that low income in adulthood is associated with significantly higher mortality rates and rates of hospitalization (Faggiano,

Partanen, Kogevinas, & Boffetta, 1997; Roos & Mustard, 1997) while others link low educational attainment to higher mortality rates (Elo & Preston, 1996; Mustard, Derksen, Berthelot, Wolfson, & Roos, 1997), higher rates of mental illness (Kessler et al., 1994) and unhealthy behaviours such as smoking and physical inactivity (Ross & Wu, 1995; Uitenbroek, Kerekovska, & Festchieva, 1996). Evidence for the existence of health inequalities as individuals reach the latter stages of life is contradictory. Some research clearly confirms socioeconomic inequalities in health in old age (Arber & Ginn, 1993; Dahl & Birkelund, 1997; Martelin, Koskinen, & Valkonen, 1998), while others report that by old age (after the age of 80), the social patterning of health virtually disappears (Elo & Preston, 1996; House et al., 1994; Kitagawa & Hauser, cited in Feinstein, 1993; Robert and House, 1996).

The variation across different periods in the life course prompts deeper questions about causal relationships and invites a more thorough evaluation of indirect social selection explanations. By postulating that events in childhood set into motion the processes that eventually produce health inequalities, childhood conditions have been elevated to a position of prominence in many explanatory frameworks. As a first foray into a life course approach, researchers have pursued retrospective and prospective studies as a means of disentangling the relative contribution of childhood conditions to socioeconomic inequalities later in life.

Retrospective research on socioeconomic inequalities in health is primarily a matter of assessing the socioeconomic position of the parents during the respondent's childhood.

Respondents are asked to describe aspects of their childhood, including parental occupation and education, and whether they recollect experiences of economic deprivation. By assessing the extent to which these effects on health are attenuated after controlling for current measures of socioeconomic position, researchers draw conclusions about the relative importance of specific childhood conditions. Typically, researchers report that both childhood and current socioeconomic conditions are independent predictors of current health (Brunner, Shipley, Blane, Davey Smith & Marmot, 1999; Lundberg, 1997; Nyström Peck, 1994; Östberg & Vågerö, 1991; Rahkonen, Lahelma & Huuhka, 1997; van de Mheen, Stronks, van den Bos & Mackenbach, 1997, but see Lynch et al., 1994).

Although most studies confirm the importance of childhood conditions, retrospective studies can be limiting in the sense that they provide no more than a broadly drawn sketch of the relationship between childhood conditions and adult outcomes. Measures that are used in these analyses are often predicated on the assumption that events affect children similarly regardless of their prior experience and developmental history, an assumption that runs contrary to some of the core elements of a life course approach. For example, measures such as father's occupation may not be relevant for all children or for all moments of a child's life because children do experience non-normative family situations and occupations are subject to change over time (Marks, 2000). An additional concern with retrospective studies is that attempts to control for the effects of socioeconomic position can lead to residual confounding due to imprecise measurement.

As Joseph and Kramer (1996) point out

> if adjustment for socioeconomic status . . . attenuates the effect from a rate ratio of 4 to a rate ratio of 2, this raises the question of whether proper socioeconomic status quantification and control would have abolished the excess risk altogether (p. 166).

Compared to retrospective studies, prospective research yields a greater potential for understanding the links and pathways between childhood conditions and experiences of health in adulthood because they are specifically designed to track the short- and long-term effects of events. By conducting follow up interviews at regularly spaced intervals, researchers can use more advanced techniques on repeated measures to establish causal ordering and reciprocal effects. The downside to prospective studies is that by following a single cohort over time, researchers incur considerable cost, must pay attention to issues relating to attrition of the sample, and inevitably, face the criticism that results cannot be generalized beyond the cohort under study (Fox, 1990; Mausner & Kramer, 1985).

Investigation into the contribution of childhood conditions to socioeconomic inequalities in adulthood has generated two differing hypotheses concerning the degree of importance that should be attached to childhood conditions. The first, known as the biological programming hypothesis, contends that the potential for achieving optimal health for the entire adult life course is mainly determined by what occurs during the fetal and early infancy period. In contrast, the unhealthy life career hypothesis suggests that trajectories of health are shaped by the cumulative impact of prior events, so that moments of adversity do not necessarily exert a lasting effect on health but may be reshaped by

subsequent events (Lundberg, 1993). These hypotheses point to opposing policy interventions: the first suggests there is a small window of opportunity in early life to modify the social distribution of health while the second posits that intervention can be effective at all stages of the life course (Hertzman, 1994; Hertzman & Wiens, 1996).

The biological programing hypothesis has its roots in the work of Forsdahl (1978) who argued that childhood deprivation, as indexed by infant mortality rates earlier in the century, followed by economic success in adulthood, increases vulnerability to heart disease. Following this, Barker posited that cardiovascular disease is programmed during fetal development and early infancy through low birth weight (Barker & Martyn, 1992; Barker, Osmond, Simmonds, & Wield, 1993). His work also implicates a variety of hormonal and nutritional influences programmed early in life in the etiology of a number of adult diseases including stomach cancer (Barker, Coggon, Osmond & Wickham, 1990), ovarian cancer (Barker, Winter, Osmond, Phillips & Sultan, 1995), chronic bronchitis (Barker, Osmond & Law, 1989) and suicide (Barker, Osmond, Rodin, Fall & Winter, 1995). Essentially, the biological programming hypothesis postulates that poverty-related factors operating during the earliest moments of life deliver a biological insult which unconditionally imprints upon the developing organism and directly causes disease in adulthood. Thus, there is a relatively fixed interval in time during fetal development and infancy, known as a critical period, in which requisite elements such as adequate nutrition and stimulation must be in place in order to sustain proper development and achieve optimal health in adulthood (Cynader, 1994).

While there is burgeoning interest in research that seeks to relate brain function in infancy to successful development and wellbeing, preliminary work suggests that the importance of neurobiologic pathways is vastly inflated relative to the effects of poverty on children (diPietro, 2000). For example, in a longitudinal study of the effects of maternal and infant nutrition on intellectual development, Brown and Pollitt (1996) found that a protein-rich supplement given prenatally and throughout childhood significantly improved the intellectual development of disadvantaged children into adulthood, but did not raise them to the level of their middle-class counterparts. This and other research negates the exclusive effect of nutrition on brain development and suggests that poverty operates through more complex pathways than just the biologically programmed effects of nutrition in early life.

The biological programming hypothesis has also been challenged for its methodological deficiencies. The most damaging criticism is that it fails the test of causality, that is, researchers did not demonstrate independence from confounding variables, did not formulate specific hypotheses, and obtained inconsistent results leading to the identification of a confusing array of causal mechanisms (Elford, Shaper & Whincup, 1992). Other criticisms include selection bias, glossing over findings that contradict the biological programming hypothesis and the inability of the biological programming hypothesis to explain historical trends in heart disease (Elford et al., 1992; Joseph & Kramer, 1996). Finally, Vågerö and Illsley (1995) note that the distribution of birth weights in the sample used by Barker does not appear to meaningfully identify those

children suffering the effects of an impoverished fetal environment.

It is the unhealthy life career hypothesis, with its focus on the cumulative impact of events linked through time, that most closely approximates a life course approach. It is argued that meaningful analysis of the effect of childhood conditions on adult health must assess the contribution of factors operating throughout the life course because "strong correlations seen between early environment and adult [health] may simply be an effect of continued deprivation throughout life, leading to an accumulation of detrimental health effects" (Ben-Shlomo and Davey Smith, 1991, p. 533). This involves more than simply assessing circumstances at disparate stages of development, but meaningfully capturing change within and across developmental periods.

In fact, it may be the case that change within developmental periods is more important than assessing change across stages of development, and that resolving the controversy between the biological programming hypothesis and the unhealthy life career hypothesis depends on a better understanding of the dynamics that occur during the childhood period. In the last decade or so, researchers have come to recognize that household income during the childhood period is immensely volatile (Duncan, 1988) and that these fluctuations in income can have meaningful effects on children's development and life chances (Bradbury, Jenkins, & Micklewright, 2001; Chase-Lansdale & Brooks-Gunn, 1995; Duncan & Brooks-Gunn, 1997; Duncan, Yeung, Brooks-Gunn & Smith, 1998). These findings only affirm the importance of a life course approach to socioeconomic inequalities in health research.

A life course approach to childhood poverty also entails studying socioeconomic inequalities in child health in relation to larger changes that are occurring in child poverty, particularly in the United States. Child poverty in the United States has not only increased in both absolute and relative terms in recent decades (Bianchi, 1999), but has come to exhibit greater complexity, with many of its features decidedly different from child poverty of the past (Corcoran & Chaudry, 1997; Lichter, 1997). In part, these emergent features reflect the fact that broader social change inevitably leads to unique experiences of poverty among different cohorts of children (Riley, 1987). For instance, modern trends in child poverty have been positively influenced by rising parental educational attainment and declining family size, yet adversely affected by the increase in female-headed households and growing economic inequality (Corcoran & Chaudry, 1997; Duncan & Rodgers, 1991; Seccombe, 2000). These insights into changing patterns of child poverty are part and parcel of a life course approach which interweaves both individual and broader social change.

Parallel to developments in research on the consequences of dynamic aspects of household income and poverty on children, is a growing interest in dynamic measures of child health and well-being (Thornton, 2001). Not only is there a need for measures of childhood health specific to their unique stage of development (Runyan, 2001; Waters, Salmon, Wake, Wright & Hesketh, 2001), but also for measures of child health that reflect a truly longitudinal perspective. In the past, researchers have not been drawn to this issue because it has been generally assumed that the adaptability of children and the self-limiting

nature of most childhood illnesses make the study of children's health unappealing or inconsequential (Huston et al., 1994; Pollitt, 1994). But there is enough evidence pointing to the long-term repercussions associated with poor health in childhood to combat this dismissive approach. First, the literature is clear that, for some children, poor health interferes with schooling. Chronic health problems in childhood have been linked to higher rates of school absenteeism and lower school achievement (Fowler, Johnson & Atkinson, 1985), as well as to having to repeat a grade (Gortmaker, Walker, Weitzman & Sobol, 1990). Perrin (1997) notes that difficulties in school are not necessarily attributable to a specific health condition, but rather the task of managing a childhood disease creates generic issues for the family and the child that can disrupt academic performance. These consequences speak to the importance of indirect social selection as a causal mechanism in socioeconomic inequalities in health. Second, there are established ties between health in childhood and health in adulthood. Indeed, there is mounting evidence that childhood morbidity is directly associated with poorer overall health in adulthood (Power & Peckham, 1990; Starfield, 1991; Starfield et al., 1984), and some have even found that the relationship persists after controlling for both childhood and current socioeconomic position (Blackwell, Hayward & Crimmins, 2001).

An integral objective for developing valid measures of child health is a greater focus on child physical health conditions, particularly for studies that examine the effects of low income on children. Child poverty experts study mostly cognitive development, academic achievement, and more recently, socio-emotional functioning, and when they do

purport to examine child physical health in relation to child poverty, they typically restrict their measures to height, stunting, or birthweight (Brooks-Gunn & Duncan, 1997; Korenman & Miller, 1997). The criticism directed at these definitions of child health is that they are more accurately described as measures of 'well-becoming', intended to gauge future readiness for roles as adults, than accurate assessments of child health and well-being (Earls & Carlson, 2001).

One overlooked, but developmentally appropriate measure for studying child physical health over time is children's risk for accidents. Accidents are the leading cause of death in childhood, killing more children each year than all other causes combined (Tuchfarber, Zins & Jason, 1997). Moreover, there are typically 45 hospital admissions for each fatality, suggesting that mortality rates are just the tip of the iceberg (Bijur, Wilt, Kurzon, Hayes & Goodman, 1997). Although it is not known precisely how many of these accidents are of a severe or debilitating nature, the consequences for some of these children are likely to be lifelong and profound. While researchers note that accidents and injuries are more likely to occur in single-parent and blended families (Manciaux & Romer, 1991), and for children whose mothers have low levels of education (Brenner, Overpeck, Trumble, DerSimonian & Berendes, 1999), and low levels of household income (Dougherty et al., 1990), there are no longitudinal studies that examine risk for medically attended accident or injury across the childhood period. Even more importantly, there are no longitudinal studies linking risk for medically attended accident or injury across the childhood period to income histories or trajectories. These types of research questions not

only assess risk for the entire childhood period and provide additional insight into the proportion of children who are at risk for multiple accidents, but they illuminate the social and economic environments through which risk is unequally distributed and the extent to which changes in those environments modify risk.

Indeed, there are only two studies explicitly investigating the connection between dynamic measures of socioeconomic position and dynamic measures of child health and well-being, and both of these have mental health measures as their dependent variable. McLeod and Shanahan (1996) employ growth curve models to examine the impact of poverty on child mental health using the American National Longitudinal Survey of Youth (NLSY). While they report significant changes in mental health status over time as a result of prolonged exposure to poverty, there are some notable limitations to their analysis. By utilizing a dichotomous measure such as poverty rather than household income, and by treating number of years in poverty solely as an individual-level variable rather than allowing poverty status to vary over time, the authors lose important information that might track more precisely the influence of income dynamics on children's mental health. Further, their analysis covers only the first three waves of the NLSY. Since the early years of the survey consist mainly of younger, more disadvantaged women, there is some question as to whether the same effects will be found in later waves of the survey.

In their analysis covering the first three years of life for children participating in the NICHD Early Child Care Study, Dearing, McCartney and Taylor (2001) also use growth curve models to assess whether changes in income-to-needs, controlling for initial income,

have an effect on child cognitive and behavioural outcomes. This limited period of observation may explain why they found no significant effects for child behaviour problems, but other limitations of the analysis include not treating family structure as a time-varying variable and calculating but not presenting or discussing random effects for intercept and slope in their models.

By using seven waves of the NLSY to study the effect of stable and dynamic components of household income on child physical and mental health, I extend prior work on socioeconomic inequalities in health research in four ways. First, I employ different measures of child health comprising aspects of physical and mental health relevant to children's unique stage of development. As argued by socioeconomic inequalities in health researchers, measures of health must encompass a wide variety of phenomena because socially structured differences influence multiple health outcomes (Aneshensel et al., 1991; Link & Phelan, 1995; Vågerö, 1991). Second, I integrate a life course approach by conducting secondary data analysis on a longitudinal dataset that assesses children every two years and spans the entire childhood period. To date, socioeconomic inequalities in health researchers have not engaged in analyses that contain more than three waves of data or that cover the whole of childhood. Third, I attempt to approximate the trajectory of household income by distinguishing between stable and dynamic components of household income as others have done (eg. Barnett, Brennan, Raudenbush, Pleck & Marshall, 1995). That is, I estimate both the average household income for all waves that a child participates in the survey and the deviations from the child's average household income at

each point in time, as a means of determining the relative influence of stable and dynamic aspects of household income on child health over time. Such an approach is more informative than simply using a time-varying variable for household income, for it makes transparent the trajectory of household income for children over time. My measure of the stable component of household income is comparable to what some have termed the permanent income hypothesis, which posits that, because consumption patterns are based on anticipated changes in future income, average income over time may be a more accurate representation of the effects of household income on child health (Blau, 1999; Mayer, 1997). Finally, I introduce into all analytic models a rigorous set of controls, including time-varying variables for family structure, in order to rule out spuriousness and strengthen causal inference.

Conclusion

Despite the enormous potential a life course approach offers to health inequalities research and the stated desire of researchers to incorporate this approach into their own work, existing work has done little more than scratch the surface in terms of exploring the nuances of a life course approach. While the various approaches have provided insight into different patterns that exist at different stages in life and allowed researchers to carve out areas of inquiry related to specific periods of development, the underlying patterns and trajectories of children's lives remain obscure. Historically, this can be partly attributed to a dearth of research methods that could capably handle the complexity of longitudinal research. With increasingly sophisticated statistical methods such as growth curve models,

there is greater promise in specifying more precisely how income dynamics influence children's health over time.

# CHAPTER 4

## FORMAL HYPOTHESES

The purpose of this dissertation is to shed light on the socioeconomic processes that influence the physical and mental health of children over time. The dataset I will use to conduct my analysis is the child component of the National Longitudinal Survey of Youth. This survey covers the period between 1986 and 1998, and as such, has four more waves than were available to McLeod and Shanahan (1996) when they did their analysis.

The goals of this dissertation can be split into three parts. To confirm that there is a cross-sectional relationship between household income and measures of child physical and mental health, I will conduct regression analyses on two separate waves of the NLSY. I hypothesize that higher levels of household income will be associated with a lower risk for child medically attended accident or injury and health limitation, and lower levels of child anxiety/depression and antisocial behaviour. All models will control for a number of child, family and geographic characteristics that are commonly identified by researchers as having an influence on both household income and child health (Brooks-Gunn & Duncan, 1997). Further, I include in a subsequent set of models two variables, welfare recipiency and maternal health limitation, to gauge their effect on the relationship between household income and child health. The stigma of welfare recipiency, and the accumulated and severe

disadvantage that it implies, may represent an aspect of parental socioeconomic position that is not fully captured in a measure of household income. Unobserved characteristics of the parents, including maternal health limitation, are seen by some as inflating the 'true' effect of household income on child health (Mayer 1997), while others treat parental characteristics as mediating variables (Conger et al., 1992). My inclusion of maternal health limitation is not intended to prove maternal health limitation as either a background or a mediating variable, for I believe that the relationship is likely to be reciprocal, but rather to ascertain that the effect of household income on child health remains statistically significant. Therefore, I hypothesize that welfare recipiency and maternal health limitation will moderately attenuate the relationship between household income and health, but that household income, welfare recipiency and maternal health limitation will each be independently associated with measures of child health.

A second goal of the dissertation is to develop meaningful ways of describing longitudinal health profiles for children. Such health profiles have substantive and methodological importance, given growing interest in devising measures of health that are child-specific and sensitive to developmental status (Runyan, 2001). Creating these profiles can lay the groundwork for more accurate definitions of health in childhood, and can facilitate an understanding of how children's health varies over time. Profiles of children's health also contribute to statistical methods for describing changes in health status over time. Profiles represent an analytic tool for uncovering patterns in the data, and can be inspected for adequate variability in the health outcomes of children over time.

Techniques for graphical displays of large longitudinal datasets are still in their infancy. While there is work in this area (eg. Diggle, Liang & Zeger, 1994; Pinheiro & Bates, 2000; Stoolmiller, 2001), graphical displays are, for the most part, limited to smaller samples and mostly continuous outcomes. I intend to use a number of different graphical and tabular techniques, in a very preliminary manner, to attempt to describe change in children's health over time, for measures of health that are discrete and contain approximately 30,000 observations.

Finally, I will utilize generalized linear mixed models on the full person-period observation file comprising the repeated measures of all children participating in the NLSY to test the hypothesis that both stable and dynamic aspects of household income affect the physical and mental health of children. Children who come from households whose average income over time is low should exhibit patterns of health that are significantly worse compared to children living in households where average income is high. Further, changes in household income that are above their average income should have beneficial effects on child health, and conversely, drops in income below a household's average income should have deleterious effects on child health. I argue that stable measures of income will affect both physical and mental health measures, but that dynamic measures of income will have a greater impact on mental health than on physical health. Although there is no empirical work to justify this stance, I find it plausible to hypothesize that changes in economic fortune will impact more readily on children's emotions and behaviours, while physical health measures, though malleable, will be less responsive to fluctuations in the

family's economic situation. I will include many of the same control variables used in cross-sectional analyses, but the majority of these, including family structure, are treated as time-varying variables. Although stronger than conventional cross-sectional methods in ruling out threats to causal inference, mixed models do not eliminate the possibility of reverse causation or model misspecification (Brennan, Barnett & Gareis, 2001). As with cross-sectional models, I add welfare recipiency and maternal health limitation to analytic models, with the expectation that, adjusting for each other, household income, welfare recipiency and maternal health limitation will each exert direct effects on child health.

# CHAPTER 5

# METHODS

## Sample

The National Longitudinal Study of Youth (NLSY) is an American survey conducted annually since 1979 on the labour market experiences of a nationally representative sample of men and women who were between the ages of 14 and 21 when the survey commenced. In 1986, a new series of surveys collected information on all children born to the original cohort of female participants of the NLSY. Conducted every other year since 1986, the child component of the NLSY contains a number of measures of child development, health and well being which can be linked to the data obtained on the child's mother. Currently, there are seven waves available for analysis with approximately 10,918 children born to the 6283 women participating in the original NLSY survey (CHRR, 2000). Included in this count are women who were in the military (N=456) and an oversample of economically disadvantaged white women (N=901) who were subsequently dropped from the study in 1984 and 1990, respectively. In 1998, there were 4944 eligible women of whom 3533 were mothers (CHRR, 2000).

It is important to note that the children themselves do not constitute a nationally representative sample of American children. Rather, they represent a cross-section of

children born to a nationally representative sample of women between the ages of 14 and 21 in 1979 (CHRR, 2000). As the original cohort of women complete their childbearing years, it is anticipated that the sample of children will increasingly conform to a nationally representative sample of children born to the original cohort (CHRR, 2000). As the survey necessarily excludes women and their children who would have immigrated to the United States after 1979, the sample cannot be considered a nationally representative sample of contemporary American children.

The sample will be restricted in several ways. Since socioeconomic measures gathered in the survey pertain solely to the characteristics of the mother's household, the sample will be restricted to children who live with their mothers. Further, the sample will be limited to cases in which the mother is consistently the main informant of the child's behaviour. Prior research has established that children's mental health measures vary considerably according to the relationship of the informant to the child (Offord, 1995). The lack of agreement among informants may reflect the unique perceptions of individuals whose relationship to and interactions with a child are fundamentally different (Offord, Boyle & Racine, 1989). This is particularly relevant in longitudinal analyses where it is essential to use measures that are directly equatable (Willett, Singer & Martin, 1998).

Not only must the informant be the same person at each wave, but the questions directed to the informant must be asked identically at each wave of the survey. For this reason, the sample will include only children younger than 14 years whose mothers were asked the same questions about their child's health at each interval. Physical health

measures are asked of children at all ages while mental health measures are only applicable to children ages 4 to 14. Once children turn 15, they become the main informant and are given different questions appropriate to their status; therefore, children older than 14 cannot be included in the present analysis.

## Measures

Both time-varying and time-invariant measures will be utilized in the analysis. By definition, the dependent variables are time-varying: the object of this study is to understand patterns of change in health over time. It is also possible to have independent variables or predictors that exhibit change over time. Sex of the child, year of birth, and mother's age at birth of child are time-invariant. Household income, household size, and family structure are measures that may take on different values over time.

## Health Measures

### *Physical Health*

There are two outcome measures of physical health: medically attended accident or injury and health limitation. Medically attended accident or injury is assessed by asking the mother whether, in the past 12 months, her child experienced any accidents or injuries requiring medical attention. Health limitation is assessed by asking the mother whether her child has a physical, emotional or mental condition that limits or prevents his or her ability to (a) attend school regularly; (b) do regular school work; (c) do usual childhood activities such as play, or participate in games or sports; or whether her child requires (d) frequent attention from a doctor or other health professional; (e) regular use of any medicine or

drug; or (f) use of any special equipment, such as a brace, crutches, a wheelchair, special shoes, a helmet, etc. A positive response to any of the six items is coded 1 and 0 otherwise.

*Mental Health*

In each wave of the survey, mothers responded to questions on child behavioural problems for each of their children aged 4 to 14. The questions were used to create scales for different aspects of child behaviour, including anxiety/depression and antisocial behaviour. These scales are a modification of the Achenbach Behaviour Problems Checklist (Achenbach & Edelbrock, 1983) developed by Zill and Peterson (CHRR, 2000). Anxiety/depression is a five item scale which asks the mother to indicate whether, in the last three months, it is never true, sometimes true or often true (scored 0, 1, and 2 consecutively) that her child has sudden changes in mood or feeling; feels or complains that no one loves him or her; is too fearful or anxious; feels worthless or inferior; or is unhappy, sad or depressed. Responses are summed to produce a scale that ranges from 0 to 10, with higher scores denoting increasing levels of anxiety/depression. Antisocial behaviour is a four item scale which asks the mother to indicate whether, in the last three months, it is never true, sometimes true or often true (scored 0,1, and 2 consecutively) that her child cheats or tells lies; bullies or is cruel or mean to others; doesn't seem to feel sorry after he or she misbehaves; or breaks things on purpose or deliberately destroys his or her own or another's things. Responses are summed to produce a scale ranging from 0 to 8, with higher scores representing greater levels of antisocial behaviour.

*Parental Socioeconomic Position*

Two measures of parental socioeconomic position, maternal education and household income, will be utilized in this study, although only household income is of central interest. To accurately specify the effects of household income on child health, researchers contend that adjustment must be made for family characteristics such as maternal education, family size and family structure (Brooks-Gunn & Duncan, 1997). Maternal education is an important predictor of child health in its own right and is often analyzed simultaneously with household income to determine relative importance. Depending on the measure of health, some studies show that maternal education exerts stronger effects than household income (Kovar, 1982), while others report that household income is stronger (Duncan et al., 1994; Nersesian, 1988). However, researchers agree that both are significantly and independently associated with all aspects of child health (Brooks-Gunn, Duncan & Britto, 1999; Lee & Barratt, 1993).

Maternal education is evaluated as years of schooling. There was a small number of mothers who continued their education during the course of the survey, and therefore, education of the mother will be treated as a time-varying variable.

Household income is also a time-varying variable that assesses the total income of the mother's household from all sources for the preceding year. Household income will be reported in units of thousands of dollars per year after being adjusted to constant 1998 dollars. Over the course of the survey, three different methods were used to top code income (CHRR, 1999). For 1986 and 1988, income values over $100,000 were coded at

$100,001. Between 1990 and 1994, all income values over $100,000 were replaced with the average of those above the cutline. Beginning in 1996, top coding was reserved for the top 2% of the income distribution by replacing their actual values with its averaged value. To ensure equatability, income values will be capped at the 1998 constant dollar equivalent of $100,000 for all years.

Although the NLSY dataset includes a net family income variable for each wave of analysis, the measure of household income in this study is derived differently. The NLSY survey assesses but excludes from its net family income variable the income of a non-spousal partner residing in the mother's household, with the justification that it is inaccurate to assume that anyone with a non-legal, non-biological relationship to the mother makes any financial contribution to the household (CHRR, 2000). I believe this assumption may be invalid for two reasons. First, I find that of the 454 mothers who are living at any one point in time with a male partner, 206 or 45.4% of their male partners are also a biological parent of at least one child in the household, suggesting that their contributions to the household income are both reasonable and expected. Further, of these 454 mothers, 166 or 36.6% go on to marry their male partner, at which point the spouse's earnings are duly counted. Thus, failing to include the income of a male partner prior to the creation of a legal relationship will artificially inflate the change in household income of families making this transition.

With the same justification, the NLSY includes the income of any biological relative of the mother living in the household. However, there is little evidence to suggest

that biological relatives such as siblings, parents or cousins devote all of their income to the mother's family, even though they may contribute both monetarily and in other ways to the economic wellbeing of the family. However, these contributions are not limited to families who have relatives living with them. For example, grandparents may purchase items or supply babysitting services for their offspring. To suggest that living in the household implies equal responsibility for contributing to household income is likely to overestimate the real contribution made by relatives living in the mother's household and underestimate the contribution of relatives not living in the same household. Given that the NLSY does not ask whether the income of co-residing relatives is actually available to the mother and her children, it seems reasonable to exclude this source of income from the net family income variable.

Measured originally in thousand-dollar units, household income is transformed into its natural logarithm because of its positively skewed distribution. As such, the interpretation of its effect is the average change in the dependent variable as a result of increasing household income by a factor of 2.718. Such an interpretation is consistent with the idea that income increases have greater effect at the lower end of the income distribution and smaller effects at high income levels.

Because income may exert even greater effects at the extreme lower end of the income distribution, I also assess welfare recipiency as a measure of socioeconomic position. There are several interpretations of the effects of welfare recipiency on health. I include it because it may more accurately capture the effects of extreme or accumulated

deprivation than household income alone and because the social stigma associated with being dependent on welfare may exert its own health-damaging effects (McLanahan, 1985). Since it is not possible to test these potential explanations for the effects of welfare recipiency using the NLSY dataset, I will not speculate further about possible explanations. Clearly however, if welfare recipiency is significantly associated with child health after controlling for household income, then welfare recipiency does represent an aspect of disadvantage that is not adequately accounted for in models utilizing household income alone. Similarly, if the effect of household income is negligible after adjusting for welfare recipiency, one may conclude that the effects of disadvantage operate mainly at the extreme lower end of the income distribution.

*Family Structure and Household Size*

Family structure is linked to income and child health. Due to gender inequalities in the labour market and the unavailability of another adult income-earner, mother-headed households typically earn less than two-parent households (Corcoran & Chaudry, 1997). Family structure is also linked to income trajectories over time. Marital dissolution often exerts a strong downward pull on the income of women living with their dependent children, while re-marriage generally boosts household income (Holden & Smock, 1991). Moreover, there is a direct relationship between family structure and child health. Controlling for the effects of income, children who grow up in single-parent families are at greater risk for behavioural problems (McLanahan, 1997), are in poorer physical health (Spruijt & de Goede, 1997; Montgomery, Kiely & Pappas, 1996) and are more likely to

experience accidents and hospitalization (O'Connor, Davies, Dunn & Golding, 2000). Parental divorce is associated with a subsequent increased risk for child injuries requiring medical attention and chronic illness (Dawson, 1991; Mauldon, 1990).

It is necessary to utilize family structure as a time-varying variable since changes in family structure can substantially alter household income. Assessed in each wave of the study, family structure will be modeled with dummy variables that will compare single-mother households and biological mother, stepfather households to households with two biological parents (the reference category). It should be noted that the design of the NLSY precludes analysis of children belonging to single-parent households headed by fathers; therefore, any reference to single-parent families in this study is to households headed by females.

Household size is included in all analytic models to adjust for its effect on household income. This adjustment takes into account that larger families require more resources to take care of the needs of family members. What is also important to note is that while family sizes have been declining in recent decades, and thus exerting an ameliorative effect on rates of child poverty in the United States (Lichter, 1997), poor families on average continue to have more children than the general population (Betson & Michael, 1997). Household size is a time-varying, quantitative variable which is assessed in each wave and is expected to fluctuate as new children are born into the family and other members depart.

*Characteristics of the child*

Age, sex, race/ethnicity and the year in which the child entered the survey will be included in all models. Age of child is reported in years, and sex is a dichotomous variable with females acting as the reference category. Race/ethnicity is a categorical variable with three levels: black, Hispanic and white, with the latter acting as the reference category. The reference category includes whites as well as other ethnic groups, such as Asians and Native Americans, who could not be analyzed separately because of their smaller numbers. This racial classification was the primary screening instrument used for selection into the NLSY sample. Although the text subsequently refers to the reference category as white for ease of presentation, the reader should bear in mind that the white category, while mostly white, does include other races.

In the United States, socioeconomic position is sharply divided along racial lines, with poverty and economic disadvantage much higher among black and Hispanic populations (Eggebeen & Lichter, 1991; Foster & Furstenberg, 1999; Seccombe, 2000). Research also suggests that racial differences in child health may persist after controlling for income (Miller, 2000), and that the effect of income may exhibit different effects on child health according to one's race/ethnicity (McLeod & Edwards, 1995; Pamuk, Makuc, Heck, Reuben & Lochner, 1998).

The year the child first began participating in the survey is intended to distinguish the effect of overlapping cohorts in the survey (Raudenbush & Chan, 1993). As indicated earlier, differences may exist because the mothers of children participating in the first few

waves of the survey were younger and more disadvantaged relative to women who delayed childbearing until later in the survey (CHRR, 2000). In the case of the physical health measures, the first year of assessment occurs at birth, but for the mental health measures, the first year of assessment occurs when the child reaches the eligible age of four. This variable is treated as quantitative measure ranging from one to seven, with one and seven representing the year 1986 and 1998, respectively.

*Characteristics of the Mother*

Mother's age at birth of first child is a time-invariant, quantitative variable. Mother's age at birth of first child is associated with both her socioeconomic position and her child's health (Aber et al., 1997; Hobcraft & Kiernan, 2001; McLeod & Shanahan, 1993). Women who become mothers at an early age tend to be economically disadvantaged, often because motherhood interferes with educational attainment and places limits on their occupational opportunities. Young age at motherhood is also associated with higher rates of child mortality and behavioural problems (McLeod & Shanahan, 1993; Nersesian, 1988).

Maternal health limitation is a dichotomous, time-varying variable that asks the mother in each wave whether she is limited in the amount or type of work that she could do on a job for pay because of her health (yes=1, no=0). For those who argue that the relationship between household income and child health is really due to unobserved characteristics of the mother (Mayer, 1997), the relationship between household income and child health is spurious to the extent that maternal health causes both. A more

plausible approach involves modeling a reciprocal relationship between maternal health and household income. In other words, poor maternal health is both cause and consequence of low income, and has direct and indirect effects on child health.

*Geographical Measures*

The NLSY collects detailed geographic information on all respondents but limits the disclosure of this information to American researchers living within the continental United States (Meisenheimer, personal communication, 2001). Therefore, this study utilizes very broad geographical measures to assess regional differences in income and economic opportunity. Region of residence is a categorical variable with four levels: north central, northeast and west, with south as the omitted comparison group. Urban residency is a dichotomous variable that compares respondents whose county of residence is at least 50% urbanized with those living in mainly rural counties. Although not described in the NLSY documentation, there was a change in the way the urban variable was constructed for the 1998 survey year (McClaskie, personal communication, 2001). The measure for 1998 is more precise than previous measures because it identifies respondents living in an urban area regardless of whether or not their county is mostly urban. However, this more recent measure differs substantially from previous measures, such that urban residency comprises less than 70% of the sample in 1998 but approximately 80% in all previous waves. To make the 1998 urban variable more comparable, I employed an imputation procedure that changed the value from rural to urban if the respondent lived in an urban setting in all previous waves and did not move to a different region of the country since

the last interview. Both region of residence and urban residency are time-varying variables.

*Analytic Model*

Growth curve models belong to a general class of mixed models which take into consideration variables measured at different levels of aggregation (Kreft and de Leuuw, 1998). Although researchers have developed a number of methods for analyzing nested data structures, mixed models have the advantage of being able to partition the contribution of micro- and macro-level influences on dependent variables (Heck & Thomas, 2000). Growth curve models are superior to traditional repeated measures approaches because of their ability to handle unbalanced designs and time-varying covariates (Raudenbush & Chan, 1993; Snijders & Bosker, 1999), and because they can be generalized to non-normally distributed data.

Longitudinal data exhibit the following structure (Laird, Donnelly & Ware, 1992). There are N subjects, indexed by i=1 . . . N, and responses are measures of $n_i$ occasions for the *i*th subject, producing the $n_i$ x 1 response vector $y_i$. Measurement occasions are indexed by *t* and refer to within-subject differences. These timepoints, or *t*, will refer to the age of the child at each specific moment of assessment. This does not assume that age causes behaviour, but rather that age is indexing a developmental process which cumulatively and differentially contributes to an overall health profile for each child (Settersten & Mayer, 1997). Each child also has a set of covariates which may be fixed on all occasions (such as race, gender) or which may vary over time (family structure, household size).

The formulation of a mixed model is merely an extension of the general linear model, and is written as

$$y = X\beta + Z\gamma + \varepsilon$$

where y denotes the vector of observed $y_i$, X is the known design matrix of elements $x_{ij}$ for the fixed effects, $\beta$ is the unknown fixed effects parameter vector, Z is the known design matrix of elements $Z_{ij}$ for the random effects, $\gamma$ is the vector of unknown random-effects coefficients and $\varepsilon$ is an unknown random error vector. It is assumed that $\gamma$ and $\varepsilon$ are normally distributed with means 0 and

$$\text{var}\begin{bmatrix}\gamma \\ \varepsilon\end{bmatrix} = \begin{bmatrix}G & 0 \\ 0 & R\end{bmatrix}$$

which allows for correlated random effects and correlated, and possibly heteroscedastic, errors. Specifically, one can relax the assumption that level one residuals are independent and instead model first-order autocorrelation (Snijders & Bosker, 1999). Such a specification suggests dependence between observations that are adjacent and correspondingly smaller correlations for observations that are spaced further apart.

Ordinary least squares regression is inappropriate for this analysis. First, random error in the level 2 model means that standard errors will be biased downwards leading to more significant results than there really are (Guo & Zhao, 2000), and second, the inclusion of time-varying variables means that OLS regression yields inefficient estimates (Raudenbush & Chan, 1993). Instead, researchers must employ mixed models, iteratively

using full or restricted maximum likelihood methods, to produce coefficients that are asymptotically efficient and unbiased. These methods can be applied to normally distributed outcome measures, but binary and non-normally distributed health measures require pseudo-likelihood or quasi-likelihood approaches.

To facilitate convergence, it is common to center variables around their mean values (Kreft, de Leeuw & Aiken, 1995). For time-varying variables that represent within-subject differences, such as age of child and household size, I use grand mean centering. For time-invariant or between-subject variables, such as year child entered the survey and age of mother at birth of first child, means are centered within context ie. child-centered.

Because I am interested in the stable and dynamic effects of household income on child health, I evaluate household income using two variables. The first, representing the stable aspect of income, is the mean value of household income for a given child over all of their valid observation points. This mean is centered around the mean for child mean household income. Second, I assess the dynamic influence of household income by calculating the difference in household income at a given point in time from the child's mean household income. The logarithmic transformation of household income has unique implications for these variables; they will be more fully discussed in a later chapter.

As already mentioned, an advantage of mixed models is that they make use of all cases even when there are instances in which a child participates in only one wave of the survey. Thus, there is no need to discard cases if there are missing points in time. However, if attrition from the study is correlated with specified predictors of the

dependent variable, missing data may lead to bias (Raudenbush & Chan, 1993; Foster & Bickman, 1996). This study will investigate the extent to which selective attrition has an impact on results, but will not attempt to resolve any potential problems. Proposed solutions to remedy attrition bias are both controversial and computationally intensive (Foster & Bickman, 1996).

*Sampling Weights*

The NLSY dataset contains sampling weights that can be used by researchers to adjust for (1) sample attrition since 1979 including the loss of the military and economically disadvantaged white oversample, and (2) over-representation of black and Hispanic youth. Incorporating sampling weights facilitates generalization of results to the larger population, but their use is not always appropriate. The CHRR advises researchers not to use sampling weights in regression analyses nor in any multi-wave analysis (CHRR, 2000), but with few exceptions (eg. Guo, 1998), most researchers routinely employ sampling weights in their analysis of NLSY data. Indeed, quantitative researchers have paid little attention to the issue of sampling weights in complex survey data and often fail to realize that more sophisticated techniques such as the jacknife and bootstrap, although computationally intensive, adequately address this problem (Lee, Forthofer and Lorimor, 1986).

This analysis is less concerned with ensuring that results can be generalized to the population than it is with tracking a developmental process over time. Consequently, sampling weights will not be used in this analysis.

# CHAPTER 6

## CROSS-SECTIONAL ANALYSES OF THE RELATIONSHIP BETWEEN CHILD HEALTH AND HOUSEHOLD INCOME

Before proceeding to the longitudinal analysis with generalized linear mixed models, socioeconomic inequalities in child health will be examined cross-sectionally using two waves of the NLSY dataset. The 1998 survey year has been selected because it is the most recent wave available for analysis. I selected the 1992 survey year because it contains a measure of maternal mental health that was assessed intermittently over the course of the survey and therefore cannot be included in any longitudinal analyses. Selecting this survey year allows me to test maternal depression as an intervening variable in the income-child health relationship. The selection of these two survey years has the added advantage of minimizing overlap in the two samples. Children who are older than eight in 1992 are no longer included in the 1998 wave, and children younger than six in 1998 had not yet been born in 1992. Since mothers were between the ages of 14 and 21 in 1979, older children in the 1992 survey year are more likely to come from economically disadvantaged families; conversely, mothers who delayed childbearing and did not become eligible for interview until after 1992 are likely to occupy a higher socioeconomic position. Any observed differences between these two groups of children may point to period differences, an issue

that will require further attention in longitudinal analyses. To facilitate comparison, analysis of the two waves will be conducted in parallel fashion, with child physical health conditions preceding child mental health problems.

Physical Health

Table 1 presents characteristics of children between the ages of 0 and 14 in 1992 and 1998. Geographic characteristics remain similar across both waves with disproportionately more children living in the south and in urbanized counties. While the majority of children live in a household with two biological parents, there has been an increase in these types of households and a corresponding decrease in blended and single parent families between the two survey years. Household size remains stable between these two time periods, but the mothers of children in the 1998 survey have higher average levels of education, a higher average age at birth of first child and a higher average logged household income suggesting that mothers who participate in the 1998 wave are more economically advantaged relative to mothers in the 1992 survey year. Although the dollar figures presented have not been adjusted for comparison in the table, bringing the 1992 amount to the constant 1998 dollar does not make up the difference.

While it was anticipated that cohort differences (ie. delayed childbearing) would account for socioeconomic differences in the two survey years, the disparity can be traced to at least two other factors. The higher average logged household income in 1998 partially reflects gains made by the mothers and/or their spouses in acquiring experience and seniority in the labour market, but is also due to higher rates of attrition among lower

Table 1 Sample characteristics, children ages 0 - 14, NLSY, 1992 and 1998.

| | 1992 | 1998 |
|---|---|---|
| **Geographic Characteristics** | Percent | |
| Region | | |
| North central | 25.7 | 26.9 |
| Northeast | 14.3 | 16.4 |
| West | 21.0 | 20.0 |
| South | 39.0 | 36.7 |
| Urban | 79.6 | 80.1 |
| **Family Characteristics** | | |
| Family structure | | |
| Two biological parents | 60.4 | 65.9 |
| Biological mother and stepfather | 8.9 | 7.1 |
| Biological mother only | 30.7 | 27.0 |
| | Mean (s.d.) | |
| Household size | 4.55 | 4.58 |
| | (1.50) | (1.35) |
| Mother's education (in years) | 12.31 | 13.21 |
| | (2.32) | (2.52) |
| Mother's age at birth of first child | 21.48 | 24.17 |
| | (3.98) | (4.88) |
| Household income (thousands of dollars) | | |
| 1st quartile | 14 | 22 |
| median | 28 | 44 |
| 3rd quartile | 45 | 70 |
| Household income logged | 3.20 | 3.60 |
| | (.81) | (.86) |
| | Percent | |
| Welfare recipiency | 27.7 | 15.8 |
| Maternal health limitation | 9.4 | 8.6 |
| **Child characteristics** | | |
| Male | 50.1 | 50.4 |
| Age | 6.56 | 7.76 |
| | (3.96) | (3.90) |
| Race | | |
| Black | 31.2 | 26.6 |
| Hispanic | 21.7 | 19.3 |
| White | 47.1 | 54.1 |
| Child chronic health limitation | 10.5 | 10.9 |
| Child medically attended accident/injury | 10.7[a] | 9.8[b] |
| Number of children | 5483 | 4134 |
| Number of mothers | 2773 | 2285 |
| Number of children/number of mothers | 1.98 | 1.81 |

Note: characteristics refer to sample of children with non-missing information on chronic health limitation

[a] N=5461 [b] N=4133 (sample sizes for child medically attended accident/injury)

income families. There is also a sharp drop in the proportion of children living in families that are dependent on welfare (from 27.7% to 15.8%). Improving financial fortunes and selective attrition may partially explain the decrease but may also be related to macro-level changes in welfare policy.

There are equal proportions of male and female children in both survey years. The average age of children is higher in 1998; as mothers get older, the average age of their children is expected to rise. The proportion of black children decreases between 1992 and 1998 (from 31.2% to 26.6%) while there is a smaller decrease for Hispanics and an overall increase in the white population.

Approximately one in ten children in each wave experiences a health limitation. In other studies on children's health, prevalence estimates range from 7 to 35% depending on definition, source and respondent (Perrin, 1997). The proportion of children in the NLSY sample with a health limitation is slightly higher than the 6.5% reported in the National Health Interview Survey in 1992 for all children under the age of 18 (Newacheck & Halfon, 1998). One in ten children in each survey year experiences a medically/attended accident or injury, a rate that is consistent with other published reports (Manciaux & Romer, 1991).

The clustering of children within families violates the assumption of independence of observations and requires more sophisticated techniques for analysis. However, the amount of clustering is not large. For the physical health measures which assess children between the ages of 0 and 14, mothers have on average 1.98 children participating in the

survey in 1992 and 1.81 children in 1998. Kish (1965) demonstrates that when clustering is small, normal regression procedures are appropriate. To ensure that the clustering of children within families did not affect results, I first conducted similar analyses using a random sample of one child from each family and found that results did not differ substantially. However, the intra-class correlations were not negligible, indicating, for example, that approximately 14.8% and 27.7% of the total variability in child medically attended accident or injury and child health limitation in 1992, respectively, could be attributed to the family level. Nevertheless, I chose not to incorporate the complexity of a mixed model into the cross-sectional analyses because initial results using mixed models were similar to what was obtained using the simpler generalized linear model, and because the statistical methods I used in the longitudinal analyses precluded accommodating a third level of aggregation, that is, I am able to model measurement occasions of children, but not measurement occasions of children nested within families. Thus, omitting the level associated with children nested within families in the cross-sectional analyses presented a more straightforward progression to the longitudinal models. While this may represent a methodological limitation of this work, these types of models are operating at the boundaries of statistical knowledge, and must await further development.

Logistic regression is utilized for both medically attended accident or injury and health limitation. All models report coefficients and their standard errors along with odds ratios. Hypotheses about the effects of income on child health are tested in a series of consecutive models. The first model consists of the control variables alone; the addition of

logged household income to the controls-only model appears in the second model. The third model tests for an interaction between race and logged household income (only models with significant interactions are displayed). In models where there are significant interactions between variables, all continuous variables have been centered around their sample means as recommended by Aiken and West (1991).

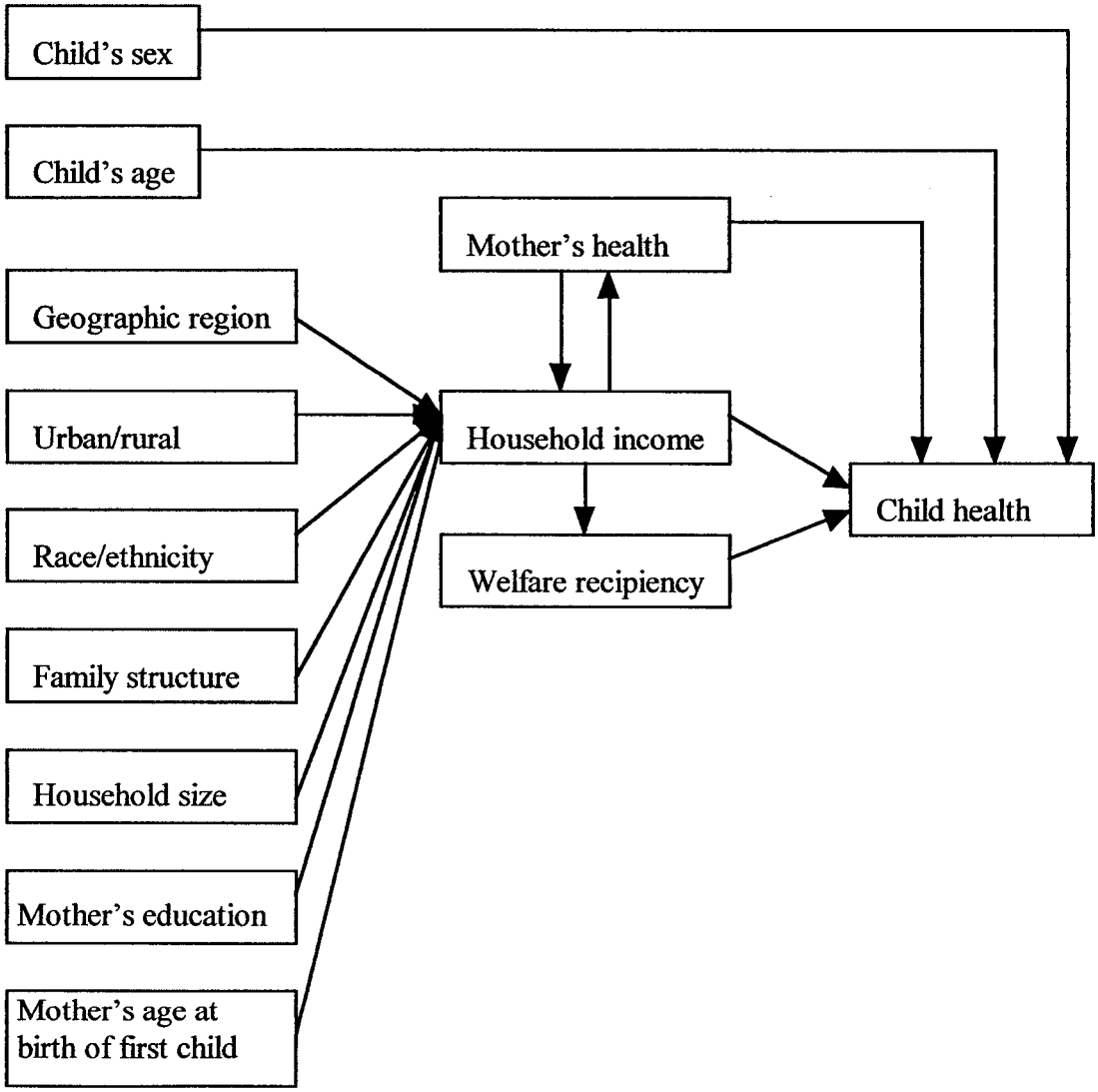
The final two sets of models test whether household income remains statistically significant with the consecutive addition of welfare recipiency and maternal health. As already discussed, a statistically significant effect of welfare recipiency may either reflect the social-psychological and health-related impacts associated with the stigma of being a welfare recipient, or it may capture the effects of accumulated or severe deprivation operating outside of the relation between household income and child health. If, as I anticipate, the adjusted effects of household income and welfare recipiency are both statistically significant, this would alert researchers to the need to pay attention to the ways in which different forms of disadvantage play out on the health of children. However, if the effect of household income is reduced to non-significance after adjusting for welfare recipiency, this would suggest that only the health of the most disadvantaged children is at risk.

Maternal health limitation has also various interpretations in the household income-child health relationship. It may operate as a background variable which influences both household income and child health. A maternal health limitation impedes participation in the labour market, and may directly increase risk for child accident or injury because of the

mother's restricted ability to supervise her children, just as the hereditary component of a disease and/or the shared environments of a family may directly link a mother's health limitation to her child's health limitation. In this scenario, researchers would include maternal health limitation in the model so that the unobserved characteristics of the mother do not artificially inflate the effect of household income on child health (Mayer, 1997). However, much more work focuses on parental characteristics as mediating variables, such that low household income affects parental behaviour and health, which in turn, influences the health of their children (Bradley & Corwyn, 2002; Conger et al., 1992). I would argue that maternal health is both cause and consequence of the mother's own socioeconomic position. Poor maternal health may reduce the earning potential of the household which creates social and environmental conditions that increase risk for child medically attended accident or injury and child health limitation. As important, a mother in a low income household has fewer resources and opportunities to maintain her own health and wellbeing. I anticipate that the coefficient for household income will remain statistically significant when variables representing maternal health are added to the models, but do not attempt to untangle the precise ordering of maternal health limitation in the household income-child health relationship. While the issue of reciprocal causation can be addressed through non-recursive modeling techniques, it is beyond the scope of the present study. These relationships, as well as the ordering of other variables in the model, are depicted in Figure 1.

Table 2 and Table 2a assess the effect of household income on child medically

Figure 1 Conceptual Model for the Effect of Household Income on Child Health



attended accident or injury for the 1992 survey year. The controls-only model indicates that male children are significantly more likely than female children to experience a medically attended accident or injury. A piecewise segmented regression line with a knot at age two was fit based on an observed pattern of a rapidly increasing rate of injuries between the ages of zero and two, and a levelling off of the rate of medically attended accident or injury for children older than two.[3] The estimated slope for children under the age of two is .66; the estimated slope for children over the age of two is .02 and not significantly different from zero. Black and Hispanic children are significantly less likely than white children to experience a medically attended accident or injury. Also, higher levels of maternal education are associated with a greater risk of medically attended accident or injury.

The second model in Table 2 adds logged household income to the controls-only model. A one unit increase in logged income (ie. multiplying income by a factor of 2.718) reduces the odds by 14%. Stated in the original metric of thousands of dollars, increasing household income by one percent reduces the odds for medically attended accident or

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[3] Fitted equation for children whose age is less than two:

$$Y = \beta_0 + B_1(AGE) + \text{other variables} + \varepsilon$$

Fitted equation for children older than age two:

$$Y = \beta_0 + B_1(AGE) + \beta_2(AGE>2) + \text{other variables} + \varepsilon$$

where AGE>2 is 0 if age is two or less, and age minus two if older than two. Therefore, the variable AGE>2 can be viewed as an adjustment to the slope for age that is applicable only for children older than the age of two.

injury by approximately .16%. Model 3 tests for the interaction of logged household income with race. Relative to the main effects model, the model with the interaction of household income and race provides a significantly better fit [L.R. $\chi^2$=15.81, df=2, p <.001]. The model with interactions suggests that at lower levels of income, white children experience higher rates of medically attended accident or injury than black or Hispanic children. As income increases, the odds of accident or injury decrease rapidly for white children and less so for Hispanic children, but exhibits the opposite effect for black children. Subsequent tests for the effect of income on black and Hispanic children respectively indicate that these slopes are not significantly different from zero (for black children, $\chi^2$=3.46 p=.07; for Hispanic children, $\chi^2$=1.47 p=.23). Therefore, the only significant relationship between household income and risk for medically attended accident or injury occurs for children who are white.

Figure 2 exhibits the fitted probabilities of experiencing a medically attended accident or injury for the three racial groups across the observed range of values for household income (which has been transformed from logarithmic scale back into its original unit of thousands of dollars). All other variables in the model are fixed at their observed sample mean or proportion values.

Model 4 in Table 2a adds welfare recipiency to the previous model. Welfare recipiency is associated with a significantly higher odds for medically attended accident or injury. Once adjusted for welfare recipiency, the effect of household income on medically attended accident or injury for white children remains statistically significant although

Table 2 Logistic regression of medically attended accident or injury on geographic, child and household characteristics, NLSY, 1992 (N=5461).

| | Model 1 | | Model 2 | | Model 3 | |
|---|---|---|---|---|---|---|
| | b (s.e.) | Odds | b (s.e.) | Odds | b (s.e.) | Odds |
| **Geographic Characteristics** | | | | | | |
| Region (ref=south) | | | | | | |
| North central | .11 | 1.11 | .11 | 1.11 | .10 | 1.11 |
| | (.12) | | (.12) | | (.12) | |
| Northeast | .19 | 1.21 | .21 | 1.24 | .22 | 1.25 |
| | (.14) | | (.14) | | (.14) | |
| West | .22 | 1.25 | .22 | 1.25 | .20 | 1.22 |
| | (.13) | | (.13) | | (.13) | |
| Urban (ref=rural) | -.14 | .87 | -.12 | .89 | -.13 | .88 |
| | (.11) | | (.11) | | (.11) | |
| **Child Characteristics** | | | | | | |
| Male (ref=female) | .44 | 1.56 **** | .44 | 1.56 **** | .45 | 1.57 **** |
| | (.09) | | (.09) | | (.09) | |
| Age | .66 | 1.94 **** | .66 | 1.94 **** | .65 | 1.06 **** |
| | (.14) | | (.14) | | (.14) | |
| Age (older than 2) | -.64 | .53 **** | -.64 | .53 **** | -.62 | .54 **** |
| | (.15) | | (.15) | | (.15) | |
| Race (ref=white) | | | | | | |
| Black | -.72 | .49 **** | -.74 | .47 **** | -.64 | .53 **** |
| | (.13) | | (.13) | | (.13) | |
| Hispanic | -.40 | .67 ** | -.42 | .66 ** | -.45 | .63 *** |
| | (.13) | | (.13) | | (.13) | |
| **Household Characteristics** | | | | | | |
| Structure (ref=two biological parents) | | | | | | |
| Blended family | -.17 | .84 | -.18 | .84 | -.20 | .81 |
| | (.17) | | (.17) | | (.17) | |
| Single parent family | .12 | 1.13 | -.04 | .96 | -.01 | .99 |
| | (.12) | | (.14) | | (.14) | |
| Household size | -.07 | .93 | -.08 | .92 * | -.07 | .93 |
| | (.04) | | (.04) | | (.04) | |
| Mother's education (in years) | .05 | 1.06 * | .06 | 1.06 * | .06 | 1.06 * |
| | (.02) | | (.02) | | (.02) | |
| Mother's age at birth of first child | -.01 | .99 | .00 | 1.00 | .00 | 1.00 |
| | (.02) | | (.01) | | (.02) | |
| Logged household income | | | -.16 | .86 * | -.31 | .73 *** |
| | | | (.08) | | (.09) | |
| Interactions | | | | | | |
| Black * Logged income | | | | | .56 | 1.75 **** |
| | | | | | (.14) | |
| Hispanic * Logged income | | | | | .14 | 1.15 |
| | | | | | (.15) | |
| Welfare recipiency | | | | | | |
| Maternal health limitation | | | | | | |
| Constant | -3.58 | | -3.22 | | -3.71 | |
| Model chi-square (df) | 128.36 (14) | | 132.31 (15) | | 148.12 (17) | |
| N | 5461 | | 5461 | | 5461 | |

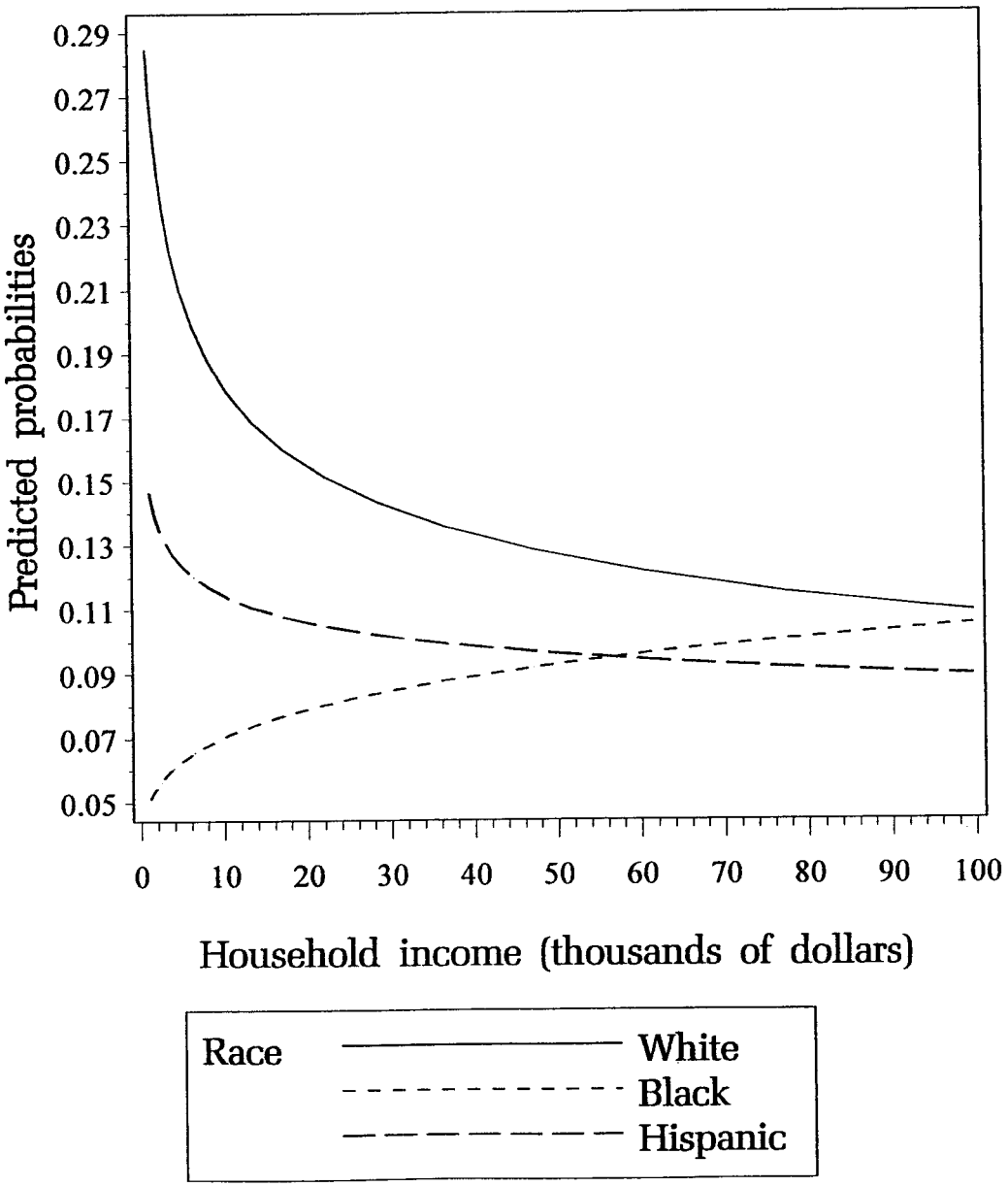
* p<.05 ** p<.01 *** p<.001 **** p<.0001

Table 2a Logistic regression of medically attended accident or injury on geographic, child and household characteristics, NLSY, 1992 (N=5461).

| | Model 4 | | Model 5 | |
|---|---|---|---|---|
| | b (s.e.) | Odds | b (s.e.) | Odds |
| **Geographic Characteristics** | | | | |
| Region (ref=south) | | | | |
| North central | .07 | 1.08 | .07 | 1.07 |
| | (.12) | | (.12) | |
| Northeast | .18 | 1.20 | .19 | 1.20 |
| | (.14) | | (.14) | |
| West | .17 | 1.18 | .17 | 1.18 |
| | (.13) | | (.13) | |
| Urban (ref=rural) | -.12 | .89 | -.13 | .88 |
| | (.11) | | (.11) | |
| **Child Characteristics** | | | | |
| Male (ref=female) | .45 | 1.56 **** | .45 | 1.56 **** |
| | (.09) | | (.09) | |
| Age | .65 | 1.92 **** | .65 | 1.92 **** |
| | (.14) | | (.14) | |
| Age (older than 2) | -.62 | .54 **** | -.62 | .54 **** |
| | (.15) | | (.15) | |
| Race (ref=white) | | | | |
| Black | -.68 | .51 **** | -.69 | .50 **** |
| | (.13) | | (.13) | |
| Hispanic | -.47 | .62 *** | -.47 | .62 *** |
| | (.13) | | (.13) | |
| **Household Characteristics** | | | | |
| Structure (ref=two biological parents) | | | | |
| Blended family | -.26 | .77 | -.26 | .77 |
| | (.17) | | (.17) | |
| Single parent family | -.06 | .94 | -.05 | .95 |
| | (.14) | | (.14) | |
| Household size | -.08 | .93 * | -.08 | .93 * |
| | (.04) | | (.04) | |
| Mother's education (in years) | .06 | 1.06 ** | .07 | 1.07 ** |
| | (.02) | | (.02) | |
| Mother's age at birth of first child | .00 | 1.00 | .00 | 1.00 |
| | (.02) | | (.02) | |
| Logged household income | -.21 | .81 * | -.20 | .82 * |
| | (.10) | | (.10) | |
| Interactions | | | | |
| Black * Logged income | .60 | 1.83 **** | .60 | 1.83 **** |
| | (.14) | | (.14) | |
| Hispanic * Logged income | .18 | 1.20 | .18 | 1.20 |
| | (.15) | | (.15) | |
| Welfare recipiency | .44 | 1.55 ** | .41 | 1.50 ** |
| | (.13) | | (.14) | |
| Maternal health limitation | | | .31 | 1.36 * |
| | | | (.14) | |
| Constant | -3.87 | | -3.87 | |
| Model chi-square (df) | 158.58 (18) | | 162.94 (19) | |
| N | 5461 | | 5461 | |

* p<.05 ** p<.01 *** p<.001 **** p<.0001

Figure 2 Effect of household income on predicted probability of child medically attended accident or injury, by race, NLSY, 1992 (N=5461)



much smaller in magnitude, but for black children the effect of household income becomes stronger. In other words, deprivation associated with receiving welfare accounts for most but not all of the variation in child medically attended accident or injury by household income for white children, while for black children, adjusting for welfare recipiency means that the odds for medically attended accident or injury increase as household income rises. A test for the slope of income for black children for a model that includes welfare recipiency now indicates that increasing levels of income are significantly associated with a higher risk of medically attended accident or injury ($\chi^2$=7.78 p<.01). Higher order interactions for race, logged household income and welfare recipiency were tested but not found to be significant.

A final model in Table 2a adds maternal health limitation to the previous model. Results demonstrate that while maternal health limitation is associated with a significantly higher risk for medically attended accident or injury, it does not affect the relationship between household income and child health.

Table 3 and 3a present models testing the relationship between household income and child medically attended accident or injury for the 1998 survey year. As in 1992, the risk for child medically attended accident or injury is higher for males relative to females, and lower for black and Hispanic children relative to white children. The pattern of increased risk for medically attended accident or injury for children up to two years of age and no age related differences after the age of two is again captured in the piecewise segmented regression line with a knot at the age of two. Additionally, children from larger

Table 3 Logistic regression of medically attended accident or injury on geographic, child and household characteristics, NLSY, 1998 (N=4133).

| | Model 1 | | Model 2 | |
|---|---|---|---|---|
| | b (s.e.) | Odds | b (s.e.) | Odds |
| **Geographic Characteristics** | | | | |
| Region (ref=south) | | | | |
| North central | .05 | 1.05 | .05 | 1.05 |
| | (.14) | | (.14) | |
| Northeast | .05 | 1.05 | .05 | 1.05 |
| | (.16) | | (.16) | |
| West | .22 | 1.24 | .22 | 1.24 |
| | (.16) | | (.16) | |
| Urban (ref=rural) | .16 | 1.17 | .16 | 1.17 |
| | (.14) | | (.14) | |
| **Child Characteristics** | | | | |
| Male (ref=female) | .43 | 1.54 **** | .43 | 1.54 **** |
| | (.11) | | (.11) | |
| Age | .66 | 1.93 ** | .66 | 1.93 ** |
| | (.22) | | (.22) | |
| Age (older than 2) | -.63 | .53 ** | -.63 | .53 ** |
| | (.23) | | (.23) | |
| Race (ref=white) | | | | |
| Black | -.98 | .37 **** | -.98 | .37 **** |
| | (.17) | | (.17) | |
| Hispanic | -.55 | .58 *** | -.55 | .58 *** |
| | (.16) | | (.16) | |
| **Household Characteristics** | | | | |
| Structure (ref=two biological parents) | | | | |
| Blended family | .15 | 1.16 | .15 | 1.16 |
| | (.19) | | (.20) | |
| Single parent family | -.09 | .91 | -.11 | .90 |
| | (.15) | | (.18) | |
| Household size | -.12 | .89 * | -.12 | .89 * |
| | (.05) | | (.05) | |
| Mother's education (in years) | -.01 | .99 | -.01 | .99 |
| | (.02) | | (.02) | |
| Mother's age at birth of first child | -.01 | .99 | -.01 | .99 |
| | (.02) | | (.02) | |
| Logged household income | | | -.01 | .99 |
| | | | (.09) | |
| Welfare recipiency | | | | |
| Maternal health limitation | | | | |
| Constant | -2.65 | | -2.62 | |
| Model chi-square (df) | 102.87 (14) | | 102.89 (15) | |
| N | 4133 | | 4133 | |

* p<.05 ** p<.01 *** p<.001 **** p<.0001

Table 3a Logistic regression of medically attended accident or injury on geographic, child and household characteristics, NLSY, 1998 (N=4133).

| | Model 3 | | Model 4 | |
|---|---|---|---|---|
| | b (s.e.) | Odds | b (s.e.) | Odds |
| **Geographic Characteristics** | | | | |
| Region (ref=south) | | | | |
| North central | .05 | 1.05 | .05 | 1.05 |
| | (.14) | | (.14) | |
| Northeast | .04 | 1.04 | .04 | 1.04 |
| | (.16) | | (.16) | |
| West | .21 | 1.23 | .20 | 1.22 |
| | (.16) | | (.16) | |
| Urban (ref=rural) | .15 | 1.16 | .16 | 1.17 |
| | (.14) | | (.14) | |
| **Child Characteristics** | | | | |
| Male (ref=female) | .42 | 1.53 **** | .42 | 1.53 **** |
| | (.11) | | (.11) | |
| Age | .66 | 1.93 ** | .66 | 1.93 ** |
| | (.23) | | (.22) | |
| Age (older than 2) | -.63 | .53 ** | -.64 | .53 ** |
| | (.23) | | (.23) | |
| Race (ref=white) | | | | |
| Black | -1.02 | .36 **** | -1.02 | .36 **** |
| | (.17) | | (.17) | |
| Hispanic | -.57 | .56 *** | -.56 | .57 *** |
| | (.16) | | (.16) | |
| **Household Characteristics** | | | | |
| Structure (ref=two biological parents) | | | | |
| Blended family | .10 | 1.10 | .09 | 1.09 |
| | (.20) | | (.20) | |
| Single parent family | -.16 | .85 | -.15 | .86 |
| | (.18) | | (.18) | |
| Household size | -.14 | .87 ** | -.14 | .87 ** |
| | (.05) | | (.05) | |
| Mother's education (in years) | -.01 | .99 | -.01 | .99 |
| | (.02) | | (.02) | |
| Mother's age at birth of first child | -.01 | .99 | -.02 | .98 |
| | (.02) | | (.02) | |
| Logged household income | .07 | 1.07 | .08 | 1.08 |
| | (.10) | | (.10) | |
| Welfare recipiency | .46 | 1.58 * | .40 | 1.50 * |
| | (.18) | | (.19) | |
| Maternal health limitation | | | .28 | 1.32 |
| | | | (.18) | |
| Constant | -2.89 | | -2.96 | |
| Model chi-square (df) | 108.98 (16) | | 111.33 (17) | |
| N | 4133 | | 4133 | |

* p<.05 ** p<.01 *** p<.001 **** p<.0001

households are at lower risk for child medically attended accident or injury. These control variables remain significant once logged household income is added to the model (Model 2); however, the effect of income is not significant, nor does a model testing the interaction of logged household income with race provide a better fit. Model 3 in Table 3a indicates that welfare recipiency is associated with a significantly higher odds of a medically attended accident or injury. The final model demonstrates that maternal health limitation is not associated with a significantly higher risk for medically attended accident or injury, nor does it attenuate the relationship between welfare recipiency and child health.

Table 4 and 4a present models for the effect of household income on child health limitation for the 1992 survey year. The model with controls only indicates that males are more likely than females to have a health limitation, and that black and Hispanic children are significantly less likely than white children to have a health limitation. Blended families and single-mother households are significantly more likely than two-biological-parent households to have children with a health limitation.

With the exception of the effect of single-mother families, the statistical significance of control variables remain unchanged with the addition of logged household income. The nonsignificant effect of single-mother families adjusted for household income suggests that the higher risk of health limitation in children from lone-mother families occurs simply because of their lower levels of income relative to two-biological- parent families. Logged household income is a significant predictor of child health limitation, with

Table 4 Logistic regression of child health limitation on geographic, child and household characteristics, NLSY, 1992 (N=5483).

| | Model 1 | | Model 2 | |
|---|---|---|---|---|
| | b (s.e.) | Odds | b (s.e.) | Odds |
| **Geographic Characteristics** | | | | |
| Region (ref=south) | | | | |
| North central | -.03 | .97 | -.03 | .97 |
| | (.12) | | (.12) | |
| Northeast | .11 | 1.12 | .14 | 1.15 |
| | (.14) | | (.14) | |
| West | .20 | 1.22 | .20 | 1.22 |
| | (.13) | | (.13) | |
| Urban (ref=rural) | -.05 | .95 | -.02 | .98 |
| | (.11) | | (.11) | |
| **Child Characteristics** | | | | |
| Male (ref=female) | .39 | 1.48 **** | .39 | 1.48 **** |
| | (.09) | | (.09) | |
| Age | .02 | 1.02 | .02 | 1.02 |
| | (.02) | | (.01) | |
| Race (ref=white) | | | | |
| Black | -.25 | .78 * | -.29 | .75 * |
| | (.12) | | (.12) | |
| Hispanic | -.35 | .70 ** | -.37 | .69 ** |
| | (.13) | | (.13) | |
| **Household Characteristics** | | | | |
| Structure (ref=two biological parents) | | | | |
| Blended family | .34 | 1.41 * | .34 | 1.40 * |
| | (.16) | | (.16) | |
| Single parent family | .43 | 1.53 *** | .19 | 1.21 |
| | (.11) | | (.14) | |
| Household size | -.02 | .98 | -.03 | .97 |
| | (.03) | | (.03) | |
| Mother's education (in years) | -.04 | .96 | -.02 | .98 |
| | (.02) | | (.02) | |
| Mother's age at birth of first child | .00 | 1.00 | .01 | 1.01 |
| | (.01) | | (.02) | |
| Logged household income | | | -.23 | .80 ** |
| | | | (.08) | |
| Welfare recipiency | | | | |
| Maternal health limitation | | | | |
| Constant | -2.07 | | -1.55 | |
| Model chi-square (df) | 53.86 | (13) | 62.61 | (14) |
| N | 5483 | | 5483 | |

* p<.05 ** p<.01 *** p<.001 **** p<.0001

Table 4a Logistic regression of child health limitation on geographic, child and household characteristics, NLSY, 1992 (N=5483).

| | Model 3 | | Model 4 | |
|---|---|---|---|---|
| | b (s.e.) | Odds | b (s.e.) | Odds |
| **Geographic Characteristics** | | | | |
| Region (ref=south) | | | | |
| North central | -.06 | .94 | -.08 | .92 |
| | (.12) | | (.12) | |
| Northeast | .10 | 1.10 | .10 | 1.10 |
| | (.14) | | (.14) | |
| West | .17 | 1.18 | .15 | 1.17 |
| | (.13) | | (.13) | |
| Urban (ref=rural) | -.01 | .99 | -.02 | .98 |
| | (.11) | | (.11) | |
| **Child Characteristics** | | | | |
| Male (ref=female) | .39 | 1.48 **** | .39 | 1.48 **** |
| | (.09) | | (.09) | |
| Age | .02 | 1.02 | .02 | 1.02 |
| | (.01) | | (.01) | |
| Race (ref=white) | | | | |
| Black | -.34 | .71 ** | -.35 | .70 ** |
| | (.12) | | (.12) | |
| Hispanic | -.39 | .68 ** | -.38 | .68 ** |
| | (.13) | | (.13) | |
| **Household Characteristics** | | | | |
| Structure (ref=two biological parents) | | | | |
| Blended family | .29 | 1.34 | .29 | 1.34 |
| | (.16) | | (.16) | |
| Single parent family | .14 | 1.15 | .15 | 1.16 |
| | (.14) | | (.14) | |
| Household size | -.04 | .96 | -.05 | .95 |
| | (.03) | | (.03) | |
| Mother's education (in years) | -.01 | .99 | -.01 | .99 |
| | (.02) | | (.02) | |
| Mother's age at birth of first child | .01 | 1.01 | .01 | 1.01 |
| | (.02) | | (.02) | |
| Logged household income | -.11 | .89 | -.10 | .90 |
| | (.08) | | (.08) | |
| Welfare recipiency | .42 | 1.52 ** | .36 | 1.43 ** |
| | (.13) | | (.13) | |
| Maternal health limitation | | | .66 | 1.94 **** |
| | | | (.13) | |
| Constant | -2.11 | | -2.12 | |
| Model chi-square (df) | 73.30 (15) | | 98.14 (16) | |
| N | 5483 | | 5483 | |

* p<.05 ** p<.01 *** p<.001 **** p<.0001

each one percent increase in income reducing the odds of a child health limitation by .23% A test for the differential effect of income by racial group was not significant, so I retain the main effects model.

When welfare recipiency is added to the model (Model 3), results indicate that the odds of a health limitation for children whose families receive welfare are 52% higher than children whose families do not report welfare as a source of income. The effect of welfare recipiency attenuates the relationship between household income and child health limitation to nonsignificance, which may suggest that deprivation at the lower end of the income scale is more important than effects along the entire spectrum of household income. Children whose mother has a health limitation experience nearly double the odds for a health limitation (Model 4), but, maternal health does not alter the relationship between socioeconomic disadvantage and child health limitation.

Tables 5 and 5a present results for the effect of household income on child health limitation for the 1998 survey year. As in 1992, male children are at higher risk than female children, and black and Hispanic children are at lower risk than white children. Children living in the north central region of the United States experience a significantly lower risk for health limitation relative to children living in the south. Risk for child health limitation also increases significantly with age, while children from larger households experience a significantly lower risk.

All of the control variables remain significant when logged household income is added to the model (Model 2), but household income itself is not significant. A test for the

Table 5 Logistic regression of child health limitation on geographic, child and household characteristics, NLSY, 1998 (N=4134).

| | Model 1 | | Model 2 | | Model 3 | |
|---|---|---|---|---|---|---|
| | b (s.e.) | Odds | b (s.e.) | Odds | b (s.e.) | Odds |
| **Geographic Characteristics** | | | | | | |
| Region (ref=south) | | | | | | |
| North central | -.28 | .75 * | -.27 | .76 * | -.28 | .75 * |
| | (.13) | | (.13) | | (.13) | |
| Northeast | -.11 | .89 | -.10 | .90 | -.10 | .91 |
| | (.15) | | (.15) | | (.15) | |
| West | -.28 | .76 | -.27 | .76 | -.27 | .76 |
| | (.15) | | (.15) | | (.15) | |
| Urban (ref=rural) | .06 | 1.06 | .07 | 1.07 | .08 | 1.09 |
| | (.13) | | (.13) | | (.13) | |
| **Child Characteristics** | | | | | | |
| Male (ref=female) | .51 | 1.66 **** | .50 | 1.66 **** | .51 | 1.66 **** |
| | (.10) | | (.10) | | (.10) | |
| Age | .06 | 1.06 **** | .06 | 1.06 **** | .06 | 1.06 **** |
| | (.02) | | (.02) | | (.02) | |
| Race (ref=white) | | | | | | |
| Black | -.55 | .58 **** | -.57 | .57 **** | -.50 | .60 *** |
| | (.14) | | (.14) | | (.15) | |
| Hispanic | -.41 | .66 ** | -.42 | .66 ** | -.43 | .65 ** |
| | (.15) | | (.15) | | (.15) | |
| **Household Characteristics** | | | | | | |
| Structure (ref=two biological parents) | | | | | | |
| Blended family | .31 | 1.36 | .29 | 1.34 | .26 | 1.30 |
| | (.18) | | (.18) | | (.18) | |
| Single parent family | .14 | 1.15 | .03 | 1.03 | .05 | 1.05 |
| | (.13) | | (.16) | | (.16) | |
| Household size | -.12 | .89 ** | -.12 | .88 ** | -.11 | .89 * |
| | (.04) | | (.04) | | (.04) | |
| Mother's education (in years) | .00 | 1.00 | .01 | 1.01 | .01 | 1.01 |
| | (.02) | | (.02) | | (.02) | |
| Mother's age at birth of first child | -.03 | .97 | -.02 | .98 | -.02 | .98 |
| | (.02) | | (.01) | | (.01) | |
| Logged household income | | | -.10 | .90 | -.29 | .75 ** |
| | | | (.08) | | (.10) | |
| Interactions | | | | | | |
| Black * Logged income | | | | | .37 | 1.46 ** |
| | | | | | (.14) | |
| Hispanic * Logged income | | | | | .44 | 1.57 ** |
| | | | | | (.17) | |
| Welfare recipiency | | | | | | |
| Maternal health limitation | | | | | | |
| Constant | -1.49 | | -1.24 | | -2.13 | |
| Model chi-square (df) | 93.21 | (13) | 94.85 | (14) | 105.47 | (16) |
| N | 4134 | | 4134 | | 4134 | |

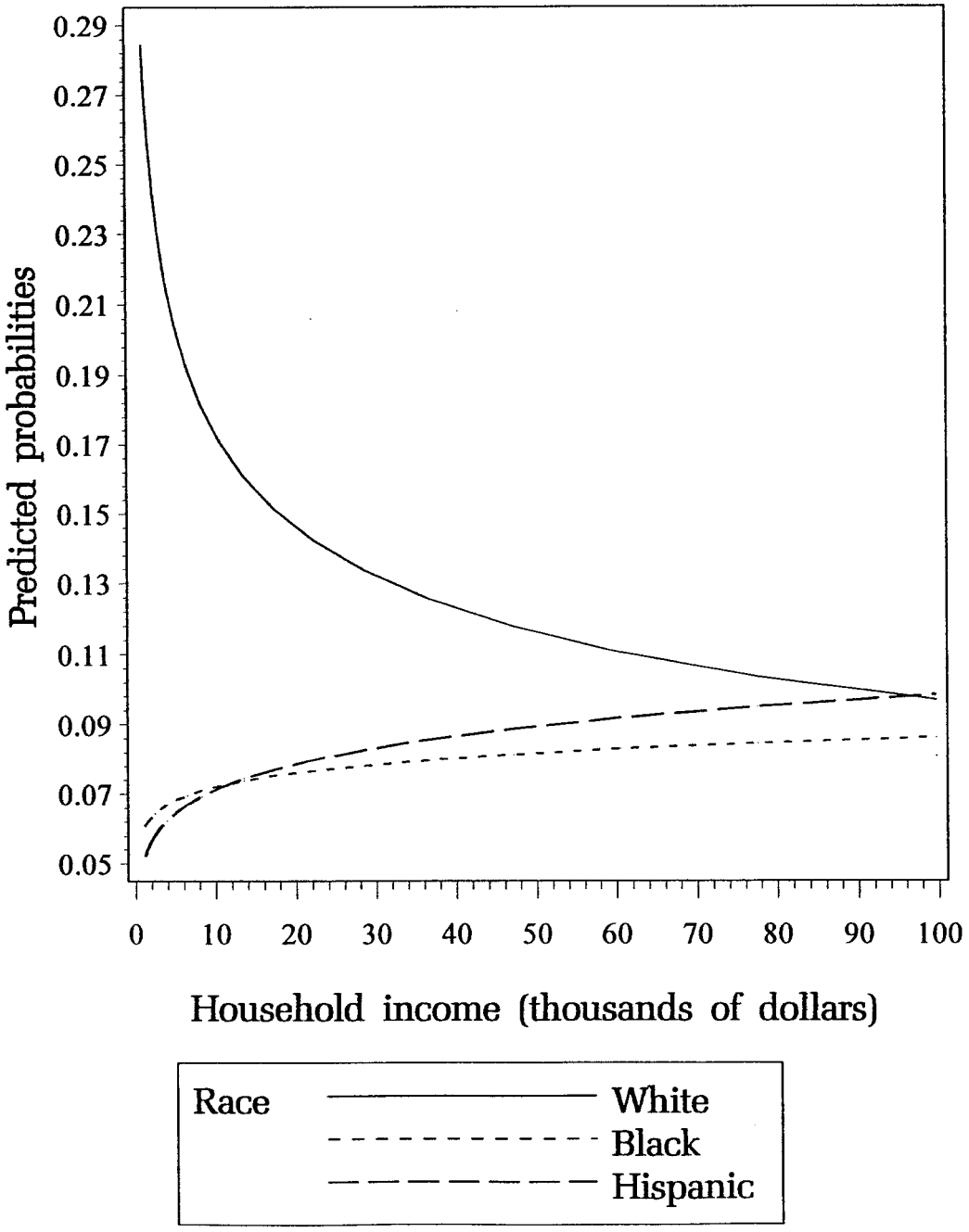
* p<.05 ** p<.01 *** p<.001 **** p<.0001

Table 5a Logistic regression of child health limitation on geographic, child and household characteristics, NLSY, 1998 (N=4134).

| | Model 4 | | Model 5 | |
|---|---|---|---|---|
| | b (s.e.) | Odds | b (s.e.) | Odds |
| **Geographic Characteristics** | | | | |
| Region (ref=south) | | | | |
| North central | -.31 | .73 * | -.28 | .75 * |
| | (.13) | | (.13) | |
| Northeast | -.13 | .88 | -.13 | .87 |
| | (.15) | | (.15) | |
| West | -.31 | .73 * | -.33 | .72 * |
| | (.15) | | (.16) | |
| Urban (ref=rural) | .08 | 1.09 | .10 | 1.11 |
| | (.13) | | (.13) | |
| **Child Characteristics** | | | | |
| Male (ref=female) | .50 | 1.65 **** | .50 | 1.65 **** |
| | (.10) | | (.10) | |
| Age | .07 | 1.07 **** | .06 | 1.07 **** |
| | (.02) | | (.02) | |
| Race (ref=white) | | | | |
| Black | -.57 | .56 **** | -.56 | .57 *** |
| | (.15) | | (.15) | |
| Hispanic | -.50 | .61 ** | -.46 | .63 ** |
| | (.16) | | (.16) | |
| **Household Characteristics** | | | | |
| Structure (ref=two biological parents) | | | | |
| Blended family | .14 | 1.16 | .13 | 1.14 |
| | (.18) | | (.18) | |
| Single parent family | -.06 | .94 | -.02 | .98 |
| | (.16) | | (.16) | |
| Household size | -.16 | .85 *** | -.15 | .86 *** |
| | (.04) | | (.05) | |
| Mother's education (in years) | .02 | 1.02 | .02 | 1.02 |
| | (.02) | | (.02) | |
| Mother's age at birth of first child | -.02 | .98 | -.03 | .97 |
| | (.01) | | (.02) | |
| Logged household income | -.16 | .85 | -.11 | .89 |
| | (.10) | | (.10) | |
| Interactions | | | | |
| Black * Logged income | .48 | 1.62 ** | .46 | 1.59 ** |
| | (.15) | | (.15) | |
| Hispanic * Logged income | .56 | 1.75 ** | .55 | 1.74 ** |
| | (.18) | | (.18) | |
| Welfare recipiency | .96 | 2.62 **** | .81 | 2.25 **** |
| | (.16) | | (.16) | |
| Maternal health limitation | | | .77 | 2.15 **** |
| | | | (.15) | |
| Constant | -2.21 | | -2.31 | |
| Model chi-square (df) | 140.55 (17) | | 164.09 (18) | |
| N | 4134 | | 4134 | |

* p<.05 ** p<.01 *** p<.001 **** p<.0001

Figure 3 Effect of household income on predicted probability of child health limitation by race, NLSY, 1998 (N=4134).



interaction of logged household income with race indicates that it provides a better fit than the main effects model [L.R. $\chi^{2=}$=10.62, 2 df, p<.01]. Figure 3 displays the fitted probabilities of having a health limitation for the three racial groups using the range of observed values for household income (which have been transformed back into the original units of thousands of dollars from the logarithmic scale). All other variables in the model have been fixed at their observed sample mean or proportion values.

The model with interactions between race and household income suggests that at lower levels of household income, white children experience significantly higher odds of a health limitation relative to black and Hispanic children, but that at higher levels of household income, the differences by race disappear. Tests for the effect of household income on black and Hispanic children show that their respective slopes are not significantly different from zero ($\chi^2$=.42, p=.51 for blacks; $\chi^2$=.81, p=.36 for Hispanics). Thus, the only significant relationship between logged household income and risk for health limitation occurs for children who are white.

Model 4 in Table 5a adds the effect of welfare recipiency, which is highly significant. The odds of a health limitation are more than two and a half times greater for children whose families report welfare as a source of income. Once adjusted for welfare recipiency, the effect of logged household income for white children is reduced to nonsignificance but becomes stronger for both black and Hispanic children. Subsequent tests for the effect of logged household income on black and Hispanic children, adjusting for welfare recipiency, indicates a marginally significant positive slope for both racial

groups ($\chi^2$=5.02, p=.02 for Hispanic children; $\chi^2$=5.12, p.=.02 for black children). In essence, welfare recipiency accounts for the effects of lower income on risk for health limitation for white children, and brings into significance the effect of household income for both black and Hispanic children, but in the opposite direction. Higher order interactions among race, logged household income and welfare recipiency were tested but failed to reach statistical significance.

Model 5 adds the effect of maternal health limitation. Children whose mothers report a health limitation experience more than double the odds of having a health limitation themselves compared to children whose mothers report no health limitation. Maternal health limitation does not alter the relationship between household income and child health, but does slightly reduce the coefficient for welfare recipiency by 16% from 0.96 to 0.81.

In sum, the effects of household income on the physical wellbeing of children are mixed. In 1992, increased levels of household income are associated with a significantly lower risk of medically attended accident or injury for white children, but the relationship does not hold for black or Hispanic children. In 1998, child medically attended accident or injury is unrelated to household income. In 1992, increased levels of household income are associated with a lower risk of health limitation for all children regardless of race, but in 1998, increased levels of household income decreases the risk of health limitation for white but not black or Hispanic children.

These findings corroborate what has been reported in the literature, although there

is little research that notes the differential effect of household income on child health by race. The lower risk for health limitations among black and Hispanic children relative to white children has been documented but there is little attempt to understand why this is so (Newacheck & Taylor, 1992; Newacheck & Halfon, 1998). For example, Pamuk and colleagues (1998) simply note that the income gradient in activity limitation for Hispanic children is less steep compared to what is found for white children, while Miller (2000) reports that increased levels of income reduce the risk of asthma for white but not black children, and Korenman and Miller (1997) find that the effect of income on stunting is stronger for white than for black or Hispanic children. The lower risk for black and Hispanic children for both medically attended accident or injury and chronic health problem as well as the differential effect of income by race are findings that deserve further examination, particularly since as adults, blacks and Hispanics are in significantly poorer overall health than whites (Williams & Collins, 1996).

Welfare recipiency increases the odds of child medically attended accident or injury by approximately 50% in both survey years. In 1992, reporting welfare as a source of income also results in a 50% higher odds of child health limitation, while in 1998, the odds of child health limitation are more than double for children whose families receive welfare. The consistently significant effect of welfare recipiency on child health adjusted for household income suggests that there is an aspect of disadvantage that is not fully captured by the household income measures alone. That is, welfare recipiency may reflect the effects of severe or accumulated disadvantage, or it may represent a psychosocial

pathway in which the stigma of welfare recipiency exerts health-damaging effects.

Adjusting for welfare recipiency also has variable consequences for the relationship between household income and child health. In 1992, after adjusting for welfare recipiency, the relationship between logged household income and medically attended accident or injury is attenuated but still significant for children who are white, while for black children, the relationship becomes significant, but in the opposite direction. In 1992, adjusting for welfare recipiency nullifies the strong and significant negative relationship between child health limitation and logged household income. In 1998, the relationship between logged household income and child health limitation is also reduced to nonsignificance when welfare recipiency is added to the model, but this only holds for children who are white. For black and Hispanic children, adjusting for welfare recipiency translates into a small but positive relationship between logged household income and child health limitation.

Finally, it appears that maternal health limitation is strongly associated with child health limitations in both 1992 and 1998, but is less predictive of child medically attended accident or injury. Moreover, maternal health limitation does not appear to change appreciably the relationship between logged household income and child health; the reduction in the size of the coefficients for logged household income after adjusting for maternal health limitation is minimal at best. There is some evidence to suggest that maternal health limitation does alter the relationship between welfare recipiency and child health. For child medically attended accident or injury, the effect of welfare recipiency

drops by 7% and 13% respectively in 1992 and 1998, after adjusting for maternal health limitation. For child health limitation, the effect of welfare recipiency is reduced by 14% and 16% respectively in 1992 and 1998, when maternal health limitation is added to the models.

Mental Health

The mental health measures are applicable only to children ages 4-14; as they involve a subset of children used in the preceding analysis, sample means and proportions for these children are shown in Table 6. Because of the economic disadvantage associated with early childbearing, excluding younger children implies that mothers of 4-14 year olds in 1992 may be more disadvantaged relative to mothers of children ages 0 to 14. These comparisons are borne out (see Table 1).

As in the sample for children aged 0 to 14, children between the ages of 4 and 14 in 1998 fare considerably better in economic terms than children of the same age in 1992. A higher proportion of children in 1998 belong to two-biological-parent families, and their mothers report higher average levels of education and higher average age at birth of first child. The proportion of children living in families reporting welfare as a source of income is nearly twice as high in 1992 as in 1998, and median household income in 1998 is much higher than median household income in 1992, even adjusting to 1998 constant dollars (displayed dollar amounts are not adjusted).

Approximately 10% of mothers in 1992 and 1998 report a health limitation. Maternal depression was evaluated in only a few waves of the NLSY survey. In 1992, the

Table 6 Sample characteristics, children ages 4 - 14, NLSY, 1992 and 1998.

| | 1992 | 1998 |
|---|---|---|
| **Geographic Characteristics** | Percent | |
| Region | | |
| North central | 24.6 | 27.8 |
| Northeast | 13.6 | 16.0 |
| West | 21.6 | 19.4 |
| South | 40.2 | 36.8 |
| Urban | 79.0 | 79.9 |
| **Household Characteristics** | | |
| Family structure | | |
| Two biological parents | 54.0 | 62.1 |
| Biological mother and stepfather | 11.8 | 8.8 |
| Biological mother only | 34.2 | 29.1 |
| | Mean (s.d.) | |
| Household size | 4.62 | 4.58 |
| | (1.53) | (1.35) |
| Mother's education (in years) | 12.05 | 13.08 |
| | (2.22) | (2.43) |
| Mother's age at birth of first child | 20.47 | 23.42 |
| | (3.23) | (4.29) |
| Household income (thousands of dollars) | | |
| 1st quartile | 13 | 21 |
| median | 26 | 42 |
| 3rd quartile | 42 | 67 |
| Household income logged | 3.14 | 3.56 |
| | (.80) | (.86) |
| | Percent | |
| Welfare recipiency | 30.1 | 16.2 |
| Maternal health limitation | 10.1 | 9.4 |
| Maternal depression (CESD scale) | 2.97 | - |
| | (1.54) | |
| **Child characteristics** | | |
| Male | 49.7 | 50.9 |
| Age | 8.39 | 9.04 |
| | (2.94) | (2.93) |
| Race | | |
| Black | 33.3 | 27.7 |
| Hispanic | 22.9 | 18.8 |
| White | 43.8 | 53.5 |
| Child anxiety/depression scale (range 0-10) | 1.83 | 1.64 |
| | (1.76) | (1.75) |
| Child antisocial behaviour scale (range 0-8) | 1.34[a] | 1.16[b] |
| | (1.43) | (1.39) |
| Number of children | 3944 | 3291 |
| Number of mothers | 2260 | 1982 |
| Number of children/number of mothers | 1.74 | 1.66 |

Note: Characteristics refer to sample of children with non-missing information on anxiety/depression

[a] N=3928 [b] N=3287 (sample sizes for child antisocial behaviour)

mother was asked to complete the 20 item Center for Epidemiological Studies Depression Scale (CESD Scale), which is a valid and reliable depression inventory (Radloff, 1977). I include maternal depression in analytic models for the same reason I include maternal health limitation: to examine whether the household income-child mental health relationship is statistically significant after controlling for the mental state of the mother. It should be noted that the bulk of research in this area positions maternal mental health as a mediating variable in the household income-child health relationship (Conger, Ge, Elder, Lorenz & Simons, 1994; Duncan et al., 1994; McLeod & Shanahan, 1993, McLoyd, 1998; Mistry, Vandewater, Huston & McLoyd, 2002). The distribution of maternal depression has a marked positive skew; therefore, I use a square root transformation to normalize the distribution. It is the mean and standard deviation of the square root transformation of maternal depression which is reported in Table 6.

Child anxiety/depression and antisocial behaviour are slightly higher in 1992 compared to 1998. Reliability coefficients using Cronbach's alpha were in the acceptable range for child anxiety/depression (.69 in 1992 and .73 in 1998), and somewhat lower for child antisocial behaviour (.62 in 1992 and .63 in 1998). Although child anxiety/depression and antisocial behaviour are continuous measures, they do not follow the normal distribution. Rather, both mental health measures approximate the Poisson distribution. Generally used for count data, the Poisson distribution also applies for discrete quantitative measures in which the mean is roughly equivalent to its variance. Poisson regression models belong to the family of generalized linear models (McCullagh & Nelder,

1989). A Poisson regression model is similar to the logistic regression model in that both models are linear in their parameters when the response is transformed. Thus, what is being modeled is the log of the expected value for either the anxiety/depression scale or the antisocial behaviour scale; the regression coefficients are interpreted as the logarithm of the ratio of the expected value before and after a one unit increase in an explanatory variable with all other explanatory variables held constant (Diggle et al., 1994).

A series of models for child anxiety/depression and antisocial behaviour in both survey years were constructed testing consecutively for the effects of controls, the effect of logged household income, the interaction of race with logged household income (displayed if the interaction significantly improves the fit of the model), the effect of welfare recipiency, and finally, the effect of maternal health. Only the models for 1992 include both maternal health limitation and maternal depression.

Table 7 and 7a display results for the effect of household income on child anxiety/depression for the 1992 survey year. The controls-only model (Model 1) includes a quadratic term for age to capture its nonlinear effect on child anxiety/depression. To reduce collinearity between age and its cross products, age has been centered around the sample mean (Aiken & West, 1991). The coefficients for age and age squared produce successively higher levels of child anxiety/depression until approximately age 11; thereafter child anxiety/depression gradually decreases with age. Child anxiety/depression is significantly higher in blended families and in single-mother families relative to two-biological-parent families. Larger household size and older age of mother at birth of first

Table 7 Poisson regression of child anxiety/depression on geographic, child and household characteristics, children ages 4 - 14, NLSY, 1992 (N=3944).

| | Model 1 | | Model 2 | | Model 3 | |
|---|---|---|---|---|---|---|
| | b (s.e.) | exp | b (s.e.) | exp | b (s.e.) | exp |
| **Geographic Characteristics** | | | | | | |
| Region (ref=south) | | | | | | |
| North central | -.06 | .94 * | -.06 | .94 | -.05 | .95 |
| | (.03) | | (.03) | | (.03) | |
| Northeast | -.04 | .96 | -.02 | .98 | -.02 | .98 |
| | (.04) | | (.04) | | (.04) | |
| West | -.06 | .94 | -.05 | .95 | -.06 | .94 |
| | (.03) | | (.03) | | (.03) | |
| Urban (ref=rural) | -.01 | .99 | .01 | 1.01 | .01 | 1.01 |
| | (.03) | | (.03) | | (.03) | |
| **Child Characteristics** | | | | | | |
| Male (ref=female) | -.01 | .99 | -.01 | .99 | -.01 | .99 |
| | (.02) | | (.02) | | (.02) | |
| Age | .06 | 1.06 **** | .06 | 1.06 **** | .06 | 1.06 **** |
| | (.00) | | (.00) | | (.00) | |
| Age squared | -.01 | .99 **** | -.01 | .99 **** | -.01 | .99 **** |
| | (.00) | | (.00) | | (.00) | |
| Race (ref=white) | | | | | | |
| Black | -.06 | .94 * | -.09 | .91 ** | -.07 | .93 * |
| | (.03) | | (.03) | | (.03) | |
| Hispanic | -.01 | .99 | -.03 | .97 | -.03 | .97 |
| | (.03) | | (.03) | | (.03) | |
| **Household Characteristics** | | | | | | |
| Family structure (ref=two bio parents) | | | | | | |
| Blended family | .20 | 1.22 **** | .19 | 1.21 **** | .18 | 1.20 **** |
| | (.04) | | (.04) | | (.04) | |
| Single parent family | .21 | 1.24 **** | .08 | 1.08 * | .08 | 1.09 * |
| | (.03) | | (.03) | | (.03) | |
| Household size | .03 | 1.03 **** | .03 | 1.03 *** | .03 | 1.03 *** |
| | (.01) | | (.01) | | (.01) | |
| Mother's education (in years) | -.04 | .96 **** | -.03 | .97 **** | -.03 | .97 **** |
| | (.01) | | (.01) | | (.01) | |
| Mother's age at birth of first child | .02 | 1.02 **** | .02 | 1.02 **** | .02 | 1.02 **** |
| | (.00) | | (.00) | | (.00) | |
| Logged household income | | | -.13 | .88 **** | -.21 | .81 **** |
| | | | (.02) | | (.03) | |
| Interactions | | | | | | |
| Black * Household income | | | | | .15 | 1.16 **** |
| | | | | | (.04) | |
| Hispanic * Household income | | | | | .11 | 1.11 ** |
| | | | | | (.04) | |
| Welfare recipiency | | | | | | |
| Maternal health limitation | | | | | | |
| Maternal depression (CESD scale) | | | | | | |
| Constant | .64 | | .68 | | .69 | |
| Deviance | 6717.65 | | 6676.68 | | 6658.73 | |
| N | 3944 | | 3944 | | 3944 | |

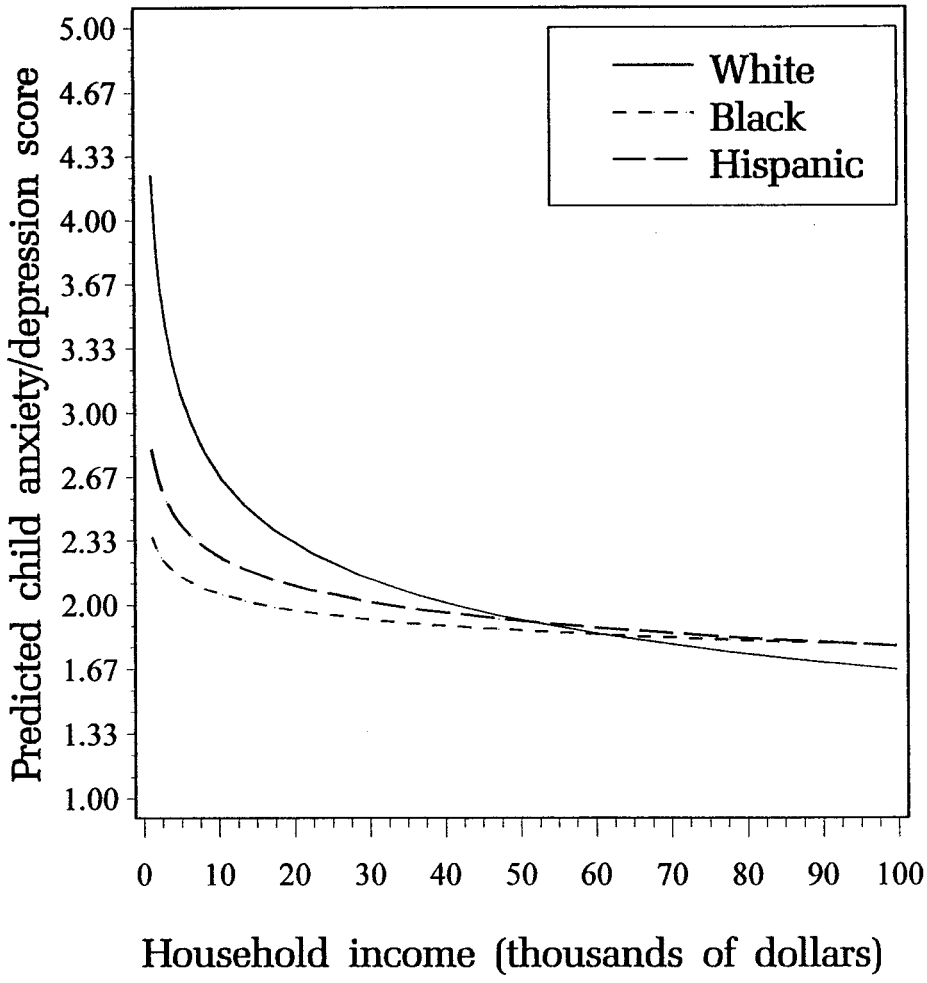
* p<.05, ** p <.01, *** p<.001, **** p<.0001

Table 7a Poisson regression of child anxiety/depression on geographic, child and household characteristics, children ages 4 - 14, NLSY, 1992 (N=3944).

| | Model 4 | | Model 5 | |
|---|---|---|---|---|
| | b (s.e.) | exp | b (s.e.) | exp |
| **Geographic Characteristics** | | | | |
| Region (ref=south) | | | | |
| North central | -.07 | .93 * | -.07 | .93 * |
| | (.03) | | (.03) | |
| Northeast | -.04 | .96 | -.02 | .98 |
| | (.04) | | (.04) | |
| West | -.08 | .92 * | -.07 | .93 * |
| | (.03) | | (.03) | |
| Urban (ref=rural) | .02 | 1.02 | .01 | 1.01 |
| | (.03) | | (.03) | |
| **Child Characteristics** | | | | |
| Male (ref=female) | -.01 | .99 | -.02 | .98 |
| | (.02) | | (.02) | |
| Age | .06 | 1.06 **** | .06 | 1.06 **** |
| | (.00) | | (.00) | |
| Age squared | -.01 | .99 **** | -.01 | .99 **** |
| | (.00) | | (.00) | |
| Race (ref=white) | | | | |
| Black | -.10 | .91 ** | -.12 | .89 *** |
| | (.03) | | (.03) | |
| Hispanic | -.04 | .96 | -.06 | .94 |
| | (.03) | | (.03) | |
| **Household Characteristics** | | | | |
| Family structure (ref=two biological parents) | | | | |
| Blended family | .16 | 1.18 **** | .13 | 1.14 *** |
| | (.04) | | (.04) | |
| Single parent family | .06 | 1.06 | .02 | 1.04 |
| | (.04) | | (.03) | |
| Household size | .02 | 1.02 ** | .02 | 1.02 * |
| | (.01) | | (.01) | |
| Mother's education (in years) | -.03 | .97 **** | -.02 | .98 *** |
| | (.01) | | (.01) | |
| Mother's age at birth of first child | .02 | 1.02 **** | .03 | 1.03 **** |
| | (.00) | | (.00) | |
| Logged household income | -.16 | .85 **** | -.09 | .91 ** |
| | (.03) | | (.03) | |
| Interactions | | | | |
| Black * Household income | .16 | 1.17 **** | .10 | 1.10 ** |
| | (.04) | | (.04) | |
| Hispanic * Household income | .12 | 1.13 ** | .08 | 1.08 * |
| | (.04) | | (.04) | |
| Welfare recipiency | .19 | 1.21 **** | .12 | 1.13 *** |
| | (.03) | | (.03) | |
| Maternal health limitation | | | -.04 | .96 |
| | | | (.04) | |
| Maternal depression (CESD scale) | | | .17 | 1.18 **** |
| | | | (.01) | |
| Constant | .66 | | .68 | |
| Deviance | 6625.33 | | 6208.30 | |
| N | 3944 | | 3944 | |

* p<.05, ** p <.01, *** p<.001, **** p<.0001

Figure 4 Effect of household income on predicted child anxiety/depression score, NLSY, 1992 (N=3944)



child are associated with higher levels of anxiety/depression, while each additional year of maternal education is associated with significantly lower levels of child anxiety/depression. Child anxiety/depression is significantly lower in black children relative to white children.

The addition of logged household income in Model 2 largely attenuates the effect of living in a single-mother household, although it remains marginally significant. As noted earlier, the attenuation of this effect suggests that the disadvantaged economic position of single mothers relative to two-biological-parent households is responsible for poorer child mental health rather than simply the absence of a biological father. Belonging to a step-parent family remains highly significant, suggesting that family structure does have a direct influence on child mental health. Adjusting for logged household income also strengthens the effect of race as the expected value for black children is approximately 9% lower than the expected value for white children. Logged household income is statistically significant such that a one percent increase in household income translates into a .13% decrease in the expected value for child anxiety/depression.

A third model suggests the interaction between logged household income and race provides a more adequate fit than the main effects model (LR $\chi^2$=17.95, 2 df, p<.0001). The effect of logged household income on child anxiety/depression results in a more sharply negative slope for white children relative to black or Hispanic children. Subsequent tests for the effect of income on black and Hispanic children respectively indicate that these slopes are statistically significant ($\chi^2$=4.20, p=.04 for black children; $\chi^2$= 8.93, p=.003 for Hispanic children). Figure 4 demonstrates the interaction between race and

logged household income by plotting expected values for child anxiety/depression for each racial group. As with preceding figures, measures for household income cover the range of observed values (transformed back into the original units of thousands of dollars), with all other variables in the model fixed at their observed sample mean or proportion values.

Model 4 in Table 7a adds the effect of welfare recipiency. Reporting welfare as a source of income is associated with a significantly higher level of child anxiety/depression. Adding welfare recipiency to the model attenuates somewhat the coefficient for logged household income for children who are white, but the relationship remains significant. For black and Hispanic children, adjusting for welfare recipiency reduces the effect of logged household income to nonsignificance (test for slopes: LR $\chi^2$=.01, p =.91 for blacks and LR $\chi^2$=1.33, p=.25 for Hispanics). This suggests that, for black and Hispanic children, belonging to a household reporting welfare as a source of income is more important than lower levels of household income in contributing to higher levels of child anxiety/depression. For white children, household income continues to exert effects on child anxiety/depression over and above the effects of welfare recipiency.

A final model adds the effect of maternal health limitation and maternal depression. Maternal health limitation is not significantly associated with child depression while maternal depression is highly significant such that higher levels of maternal depression are associated with higher levels of child anxiety/depression. The relationship between logged household income and child anxiety/depression for whites is further attenuated but remains statistically significant after taking maternal depression into account.

Table 8 and 8a display results for the effect of household income on child anxiety/depression in the 1998 survey year. As in 1992, the effect of child age on anxiety/depression is nonlinear, with levels of anxiety/depression increasing with age but flattening out after the age of 11. Male children have significantly lower levels of anxiety/depression relative to female children. Children living in the northeast region of the United States have a significantly higher expected value for anxiety/depression relative to children living in the south. Blended and single-parent families are associated with higher levels of child anxiety/depression relative to two-biological-parent families and each one year increase in maternal education reduces the expected value for child anxiety/depression by approximately three percent.

The addition of logged household income changes the significance level of several variables in the second model. Single-mother families are no longer associated with higher levels of child anxiety/depression once adjusted for household income, a finding that mirrors the situation in 1992. Black children have significantly lower expected values for anxiety/depression relative to white children. Once adjusted for logged household income, maternal education becomes marginally significant. Logged household income is highly significant; a one unit increase in logged household income (ie. multiplying income by a factor of 2.718) reduces the expected value for child anxiety/depression by approximately 16%. A test for the interaction of logged household income with race indicates that the main effects model provides a satisfactory fit.

Adding welfare recipiency to Model 3 in Table 8a indicates that reporting welfare

Table 8 Poisson regression of child anxiety/depression on geographic, child and household characteristics, children ages 4 - 14, NLSY, 1998 (N=3291).

| | Model 1 | | Model 2 | |
|---|---|---|---|---|
| | b (s.e.) | exp | b (s.e.) | exp |
| **Geographic Characteristics** | | | | |
| Region (ref=south) | | | | |
| North central | -.01 | .99 | .00 | 1.00 |
| | (.04) | | (.04) | |
| Northeast | .09 | 1.09 * | .11 | 1.12 * |
| | (.04) | | (.04) | |
| West | .05 | 1.05 | .07 | 1.07 |
| | (.04) | | (.04) | |
| Urban (ref=rural) | -.03 | .97 | -.01 | .99 |
| | (.04) | | (.04) | |
| **Child Characteristics** | | | | |
| Male (ref=female) | -.07 | .93 * | -.08 | .92 ** |
| | (.03) | | (.03) | |
| Age | .07 | 1.07 **** | .07 | 1.07 **** |
| | (.00) | | (.00) | |
| Age squared | -.01 | .99 **** | -.01 | .99 **** |
| | (.00) | | (.00) | |
| Race (ref=white) | | | | |
| Black | -.07 | .93 | -.10 | .90 ** |
| | (.04) | | (.04) | |
| Hispanic | .01 | 1.01 | -.01 | .99 |
| | (.04) | | (.04) | |
| **Household Characteristics** | | | | |
| Family structure (ref=two biological parents) | | | | |
| Blended family | .12 | 1.12 * | .10 | 1.10 * |
| | (.05) | | (.05) | |
| Single parent family | .19 | 1.21 **** | .01 | 1.01 |
| | (.03) | | (.04) | |
| Household size | -.01 | .99 | -.01 | .99 |
| | (.01) | | (.01) | |
| Mother's education (in years) | -.03 | .97 **** | -.01 | .99 * |
| | (.01) | | (.00) | |
| Mother's age at birth of first child | .01 | 1.01 | .01 | 1.01 * |
| | (.00) | | (.00) | |
| Logged household income | | | -.18 | .84 **** |
| | | | (.02) | |
| Welfare recipiency | | | | |
| Maternal health limitation | | | | |
| Constant | .52 | | .57 | |
| Deviance | 5829.05 | | 5759.34 | |
| N | 3291 | | 3291 | |

* p<.05, ** p <.01, *** p<.001, **** p<.0001

Table 8a Poisson regression of child anxiety/depression on geographic, child and household characteristics, children ages 4 - 14, NLSY, 1998 (N=3291).

| | Model 3 | | Model 4 | |
|---|---|---|---|---|
| | b (s.e.) | Log | b (s.e.) | Log |
| **Geographic Characteristics** | | | | |
| Region (ref=south) | | | | |
| North central | .00 | 1.00 | .00 | 1.00 |
| | (.04) | | (.04) | |
| Northeast | .10 | 1.11 * | .10 | 1.11 * |
| | (.04) | | (.04) | |
| West | .06 | 1.06 | .06 | 1.06 |
| | (.04) | | (.04) | |
| Urban (ref=rural) | -.02 | .98 | -.02 | .98 |
| | (.04) | | (.04) | |
| **Child Characteristics** | | | | |
| Male (ref=female) | -.08 | .92 ** | -.08 | .92 ** |
| | (.03) | | (.03) | |
| Age | .07 | 1.07 **** | .07 | 1.07 **** |
| | (.00) | | (.00) | |
| Age squared | -.01 | .99 **** | -.01 | .99 **** |
| | (.00) | | (.00) | |
| Race (ref=white) | | | | |
| Black | -.11 | .89 ** | -.11 | .89 ** |
| | (.04) | | (.04) | |
| Hispanic | -.02 | .98 | -.02 | .98 |
| | (.04) | | (.04) | |
| **Household Characteristics** | | | | |
| Family structure (ref=two biological parents) | | | | |
| Blended family | .08 | 1.08 | .08 | 1.08 |
| | (.05) | | (.05) | |
| Single parent family | -.01 | .99 | -.01 | .99 |
| | (.04) | | (.04) | |
| Household size | -.02 | .98 * | -.02 | .98 * |
| | (.01) | | (.01) | |
| Mother's education (in years) | -.01 | .99 * | -.01 | .99 * |
| | (.00) | | (.00) | |
| Mother's age at birth of first child | .01 | 1.01 * | .01 | 1.01 * |
| | (.00) | | (.00) | |
| Logged household income | -.15 | .86 **** | -.15 | .86 **** |
| | (.02) | | (.02) | |
| Welfare recipiency | .16 | 1.17 *** | .15 | 1.16 *** |
| | (.04) | | (.04) | |
| Maternal health limitation | | | .04 | 1.04 |
| | | | (.05) | |
| Constant | .56 | | .84 | |
| Deviance | 5745.13 | | 5744.45 | |
| N | 3291 | | 3291 | |

* p<.05, ** p <.01, *** p<.001, **** p<.0001

as a source of income is significantly associated with higher levels of child anxiety/depression. There is little attenuation of the effect of logged household income after adjustment for welfare recipiency, but the effect of living in a blended family becomes nonsignificant and the effect of household size achieves statistical significance. Maternal health limitation is not associated with child anxiety/depression in 1998 (Model 4).

Table 9 and 9a present the results for the effect of household income on child antisocial behaviour in 1992. The controls-only model indicates that male children and children who are black have significantly higher levels of antisocial behaviour relative to females and white children respectively. Blended and single-parent families have significantly higher levels of child antisocial behaviour relative to two-biological-parent families, and larger family size is associated with significantly higher levels of child antisocial behaviour. Relative to children who live in the southern United States, children living in the northeast have significantly lower levels of antisocial behaviour and children living in the west have significantly higher levels of antisocial behaviour. Each year of maternal education reduces the expected value for antisocial behaviour by approximately six percent.

Adding logged household income in Model 2 of Table 9 reduces the magnitude of the coefficient for single-mother families, although it remains statistically significant. Each one percent increase in household income reduces the expected value for child antisocial behaviour by approximately .11%. A test for the interaction of logged household income with race indicates that the main effects model provides a satisfactory fit.

Table 9 Poisson regression of child antisocial behaviour on geographic, child and household characteristics, children ages 4 - 14, NLSY, 1992 (N=3928).

| | Model 1 | | Model 2 | |
|---|---|---|---|---|
| | b (s.e.) | exp | b (s.e.) | exp |
| **Geographic Characteristics** | | | | |
| Region (ref=south) | | | | |
| North central | -.04 | .96 | -.03 | .97 |
| | (.04) | | (.04) | |
| Northeast | -.10 | .90 * | -.09 | .91 |
| | (.05) | | (.05) | |
| West | .08 | 1.08 * | .08 | 1.08 * |
| | (.04) | | (.04) | |
| Urban (ref=rural) | -.06 | .94 | -.05 | .95 |
| | (.04) | | (.04) | |
| **Child Characteristics** | | | | |
| Male (ref=female) | .20 | 1.21 **** | .20 | 1.21 **** |
| | (.03) | | (.03) | |
| Age | -.01 | .99 | -.01 | .99 |
| | (.00) | | (.00) | |
| Race (ref=white) | | | | |
| Black | .13 | 1.14 *** | .11 | 1.11 ** |
| | (.04) | | (.04) | |
| Hispanic | -.04 | .96 | -.05 | .95 |
| | (.04) | | (.04) | |
| **Household Characteristics** | | | | |
| Family structure (ref=two bio parents) | | | | |
| Blended family | .23 | 1.26 **** | .23 | 1.26 **** |
| | (.04) | | (.04) | |
| Single parent family | .23 | 1.26 **** | .12 | 1.13 ** |
| | (.03) | | (.04) | |
| Household size | .06 | 1.06 **** | .06 | 1.06 **** |
| | (.01) | | (.01) | |
| Mother's education (in years) | -.06 | .94 **** | -.05 | .95 **** |
| | (.01) | | (.01) | |
| Mother's age at birth of first child | .00 | 1.00 | .00 | 1.00 |
| | (.00) | | (.00) | |
| Logged household income | | | -.11 | .89 **** |
| | | | (.02) | |
| Welfare recipiency | | | | |
| Maternal health limitation | | | | |
| Maternal depression (CESD scale) | | | | |
| Constant | .52 | | .80 | |
| Deviance | 6113.74 | | 6091.38 | |
| N | 3928 | | 3928 | |

* p<.05, ** p <.01, *** p<.001, **** p<.0001

Table 9a Poisson regression of child antisocial behaviour on geographic, child and household characteristics, children ages 4 - 14, NLSY, 1992 (N=3928).

| | Model 3 | | Model 4 | |
|---|---|---|---|---|
| | b (s.e.) | exp | b (s.e.) | exp |
| **Geographic Characteristics** | | | | |
| Region (ref=south) | | | | |
| North central | -.05 | .95 | -.05 | .95 |
| | (.04) | | (.04) | |
| Northeast | -.11 | .89 * | -.08 | .92 |
| | (.05) | | (.05) | |
| West | .06 | 1.06 | .07 | 1.07 |
| | (.04) | | (.04) | |
| Urban (ref=rural) | -.04 | .96 | -.04 | .96 |
| | (.03) | | (.03) | |
| **Child Characteristics** | | | | |
| Male (ref=female) | .19 | 1.21 **** | .19 | 1.21 **** |
| | (.03) | | (.03) | |
| Age | -.01 | .99 | -.01 | .99 |
| | (.00) | | (.00) | |
| Race (ref=white) | | | | |
| Black | .08 | 1.08 * | .07 | 1.06 |
| | (.04) | | (.04) | |
| Hispanic | -.06 | .94 | -.08 | .92 * |
| | (.04) | | (.04) | |
| **Household Characteristics** | | | | |
| Family structure (ref=two biological parents) | | | | |
| Blended family | .21 | 1.22 **** | .18 | 1.20 **** |
| | (.04) | | (.04) | |
| Single parent family | .10 | 1.11 * | .06 | 1.06 |
| | (.04) | | (.04) | |
| Household size | .05 | 1.05 **** | .05 | 1.05 **** |
| | (.01) | | (.01) | |
| Mother's education (in years) | -.05 | .95 **** | -.04 | .96 **** |
| | (.01) | | (.01) | |
| Mother's age at birth of child | .01 | 1.01 | .01 | 1.01 |
| | (.00) | | (.00) | |
| Logged household income | -.06 | .94 * | -.03 | .97 |
| | (.03) | | (.03) | |
| Welfare recipiency | .19 | 1.21 **** | .13 | 1.14 *** |
| | (.04) | | (.04) | |
| Maternal health limitation | | | -.02 | .98 |
| | | | (.04) | |
| Maternal depression (CESD scale) | | | .15 | 1.16 **** |
| | | | (.01) | |
| Constant | .53 | | -.06 | |
| Deviance | 6066.49 | | 5808.24 | |
| N | 3928 | | 3928 | |

* p<.05, ** p <.01, *** p<.001, **** p<.0001

The effect of welfare recipiency (Model 3) is significant with an antisocial behaviour score that is 21% higher on average for children whose families report welfare as a source of income. Adjusting for welfare recipiency reduces the effect of logged household income on child antisocial behaviour, but the relationship remains marginally significant. These results suggest that deprivation at the extreme lower end of the income distribution, as evidenced in welfare recipiency, is responsible for much of the effect of household income on child antisocial behaviour.

The final model (Model 4) assesses whether adding maternal health changes the relationship between economic disadvantage and child mental health. Maternal health limitation is not statistically significant, while mothers with higher levels of maternal depression report significantly higher levels of antisocial behaviour in their children. Adjusting for maternal health reduces the coefficient for logged household income to nonsignificance. The effect of welfare recipiency drops by 32 percent from 0.19 to 0.13, but remains statistically significant. While maternal depression does account for some of the effect of economic disadvantage on child mental health, confirming the work of others in this area, welfare recipiency continues to exert direct effects on child mental health.

Table 10 and 10a present models for the effect of household income on child antisocial behaviour in the 1998 survey year. The controls-only model indicates that male children exhibit significantly higher levels of antisocial behaviour than female children and that black children have higher levels of antisocial behaviour than white children. Both blended families and single-mother families have significantly higher expected values for

child antisocial behaviour than two-biological parent families, while more years of maternal education are associated with lower levels of child antisocial behaviour. Children living in the west have significantly higher levels of antisocial behaviour than children living in the south.

The addition of logged household income (Model 2) reduces by more than half the effect of belonging to a single parent family. Each one percent increase in household income reduces the expected value for child antisocial behaviour by approximately .14%. Model 3 includes the effect of welfare recipiency which is statistically significant but does not affect the association between logged household income and child antisocial behaviour. Model 4 adds maternal health limitation, which fails to reach statistical significance.

In sum, household income exerts significant effects on child mental health in both 1992 and 1998, with higher levels of income resulting in lower levels of child anxiety/depression and antisocial behaviour. In 1992, there is a significant interaction of household income with race, indicating a faster rate of decline in child anxiety/depression with rising household income for white compared to black and Hispanic children. These findings are consistent with other work reporting race differences in the effect of household income on child mental health (McLeod & Edwards, 1995; McLeod & Nonnemaker, 2000), although not all have found statistically significant results (McLeod & Shanahan, 1993). Welfare recipiency is also strongly and significantly associated with higher levels of child anxiety/depression and child antisocial behaviour. Adding welfare

Table 10 Poisson regression of child antisocial behaviour on geographic, child and household characteristics, children ages 4 - 14, NLSY, 1998 (N=3287).

| | Model 1 | | Model 2 | |
|---|---|---|---|---|
| | b (s.e.) | exp | b (s.e.) | exp |
| **Geographic Characteristics** | | | | |
| Region (ref=south) | | | | |
| North central | .07 | 1.07 | .08 | 1.08 |
| | (.04) | | (.04) | |
| Northeast | .04 | 1.04 | .05 | 1.05 |
| | (.05) | | (.05) | |
| West | .15 | 1.16 ** | .16 | 1.17 *** |
| | (.05) | | (.05) | |
| Urban (ref=rural) | .01 | 1.01 | .02 | 1.02 |
| | (.04) | | (.04) | |
| **Child Characteristics** | | | | |
| Male (ref=female) | .17 | 1.19 **** | .17 | 1.19 **** |
| | (.03) | | (.03) | |
| Age | .01 | 1.01 | .01 | 1.01 |
| | (.01) | | (.01) | |
| Race (ref=white) | | | | |
| Black | .14 | 1.15 ** | .11 | 1.12 * |
| | (.04) | | (.04) | |
| Hispanic | .02 | 1.02 | .00 | 1.00 |
| | (.05) | | (.05) | |
| **Household Characteristics** | | | | |
| Family structure (ref=two biological parents) | | | | |
| Blended family | .25 | 1.29 **** | .24 | 1.27 **** |
| | (.06) | | (.06) | |
| Single parent family | .29 | 1.33 **** | .14 | 1.15 ** |
| | (.04) | | (.05) | |
| Household size | .00 | 1.00 | .00 | 1.00 |
| | (.01) | | (.01) | |
| Mother's education (in years) | -.06 | .94 **** | -.04 | .96 **** |
| | (.01) | | (.01) | |
| Mother's age at birth of child | -.01 | .99 | .00 | 1.00 |
| | (.00) | | (.00) | |
| Logged household income | | | -.14 | .87 **** |
| | | | (.02) | |
| Welfare recipiency | | | | |
| Maternal health limitation | | | | |
| Constant | .66 | | .98 | |
| Deviance | 5334.26 | | 5301.47 | |
| N | 3287 | | 3287 | |

* p<.05, ** p <.01, *** p<.001, **** p<.0001

Table 10a Poisson regression of child antisocial behaviour on geographic, child and household characteristics, children ages 4 - 14, NLSY, 1998 (N=3287).

| | Model 3 | | Model 4 | |
|---|---|---|---|---|
| | b (s.e.) | exp | b (s.e.) | exp |
| **Geographic Characteristics** | | | | |
| Region (ref=south) | | | | |
| North central | .08 | 1.08 | .08 | 1.08 |
| | (.04) | | (.04) | |
| Northeast | .05 | 1.05 | .05 | 1.05 |
| | (.05) | | (.05) | |
| West | .16 | 1.17 ** | .16 | 1.17 ** |
| | (.05) | | (.05) | |
| Urban (ref=rural) | .02 | 1.02 | .02 | 1.02 |
| | (.04) | | (.04) | |
| **Child Characteristics** | | | | |
| Male (ref=female) | .17 | 1.18 **** | .17 | 1.18 **** |
| | (.03) | | (.03) | |
| Age | .01 | 1.01 | .01 | 1.01 |
| | (.01) | | (.01) | |
| Race (ref=white) | | | | |
| Black | .10 | 1.11 * | .10 | 1.11 * |
| | (.05) | | (.05) | |
| Hispanic | .00 | 1.00 | .00 | 1.00 |
| | (.05) | | (.05) | |
| **Household Characteristics** | | | | |
| Family structure (ref=two biological parents) | | | | |
| Blended family | .23 | 1.25 **** | .23 | 1.25 **** |
| | (.06) | | (.06) | |
| Single parent family | .12 | 1.13 ** | .12 | 1.13 ** |
| | (.05) | | (.05) | |
| Household size | -.01 | .99 | -.01 | .99 |
| | (.01) | | (.01) | |
| Mother's education (in years) | -.04 | .96 **** | -.04 | .96 **** |
| | (.01) | | (.01) | |
| Mother's age at birth of first child | .00 | 1.00 | .00 | 1.00 |
| | (.00) | | (.00) | |
| Logged household income | -.13 | .88 **** | -.12 | .88 **** |
| | (.03) | | (.03) | |
| Welfare recipiency | .10 | 1.11 * | .10 | 1.11 * |
| | (.05) | | (.05) | |
| Maternal health limitation | | | .03 | 1.03 |
| | | | (.05) | |
| Constant | .92 | | .91 | |
| Deviance | 5296.93 | | 5296.66 | |
| N | 3287 | | 3287 | |

* p<.05, ** p <.01, *** p<.001, **** p<.0001

recipiency to the models attenuates the marginal effect of logged household income on anxiety/depression for black and Hispanic children in 1992, but the relationship remains highly significant for white children. In 1992, adjusting for welfare recipiency reduces the relationship between logged household income and child antisocial behaviour, although it is still marginally significant. Adjusting for welfare recipiency does not reduce the coefficient for logged household income for either anxiety/depression or for antisocial behaviour in 1998.

Maternal health limitation is not significantly associated with either child mental health measure in either year. In contrast, the measure of maternal depression, which was only available in 1992, is significantly associated with both measures of child mental health. Further, adjusting for maternal depression in the models for 1992 attenuates the relationship between logged household income and child mental health, confirming other studies which show that maternal depression does represent a mediating pathway through which household income influences child mental health.

Summary of Cross-sectional Analysis

This chapter has presented results for the effects of household income on child physical and mental health measures for two survey years, 1992 and 1998. Household income exerts stronger effects on children's mental health measures than on their physical health, but the evidence clearly indicates that higher levels of household income are associated with better physical and mental health in children. On several measures, household income has exerted different effects depending on racial group. This is an

interesting finding that is occasionally reported in the literature, but without any systematic investigation of the ways in which they are linked (but see McLeod & Nonnemaker, 2000). Welfare recipiency is also a strong predictor of child physical and mental health. In some instances, welfare appears to account for the effect of household income suggesting that threshold effects are more important than gradient effects. More often, the effects of welfare operate independently of household income, which may be interpreted as the failure of household income to account fully for the effects of economic disadvantage on health. It is not possible to know whether the effect of welfare recipiency stands for extreme or accumulated deprivation or whether it is a marker for belonging to a socially stigmatized group.

I was not able to detect any systematic differences in the pattern of results between the earlier and later waves. Rather, there was considerable variation across waves and across outcomes preventing any firm conclusion. Given that sociodemographic and socioeconomic characteristics explain very little of the variation in child health, the lack of firm conclusions is unsurprising. This does not mean however, that socioeconomic differences in child health are unimportant. Instead, the consistency of these effects, in different samples of children utilizing different measures of health, points to the subtle yet pervasive influence of living in a society that is hierarchically organized. It is anticipated that a wider view of the life course that takes into account changes in family structure and changes in the economic fortunes of the family will afford a more informative view of the many ways in which social structure is impressed on children's health.

# CHAPTER 7

## A LONGITUDINAL PROFILE OF CHILDREN'S HEALTH

Very few studies are long enough to create a comprehensive profile of children's health over time. As a longitudinal survey that repeatedly measures children's health using identically worded questions at each wave, the NLSY permits a unique view of variability in health over the entire childhood period. This chapter describes profiles of children's medically attended accident or injury, health limitation, anxiety/depression and antisocial behaviour utilizing all seven waves (representing 14 years) of the NLSY. The chapter concludes with a description of the changes that occur in household income for this sample of children.

Table 11 describes the characteristics of the entire sample of children ages 0 to 14 and their mothers for each wave of the survey and as a whole. The overall sample of 32,104 observations represents the person-period file to be used in the generalized linear mixed models in the next chapter. It should be noted that the sample reported here is applicable only to the health limitation measure, since missing cases and the restricted age range for the mental health measures results in a smaller sample size for the other health variables: medically attended accident or injury (32,082), anxiety/depression (22,474) and antisocial behaviour (22,383). As in the previous chapter, a description of

Table 11 Child and household characteristics, children ages 0 - 14, NLSY, 1986-98 (N=32104).

| | 1986 | 1988 | 1990 | 1992 | 1994 | 1996 | 1998 | Overall |
|---|---|---|---|---|---|---|---|---|
| **Child Characteristics** | | | | | | | | |
| Male | 51.0 | 51.1 | 51.6 | 50.1 | 50.6 | 50.0 | 50.4 | 51.1 |
| Age | | | | | | | | |
| 1st quartile | 2 | 2 | 3 | 3 | 4 | 4 | 5 | 3.5 |
| Median | 4 | 5 | 6 | 7 | 7 | 8 | 8 | 6 |
| 3rd quartile | 6 | 8 | 9 | 10 | 10 | 11 | 11 | 8.3 |
| Race | | | | | | | | |
| Black | 37.9 | 35.1 | 32.7 | 31.2 | 29.1 | 28.4 | 26.6 | 32.1 |
| Hispanic | 21.3 | 21.6 | 21.4 | 21.7 | 21.2 | 20.2 | 19.3 | 21.5 |
| White | 40.8 | 43.3 | 45.9 | 47.1 | 49.7 | 51.4 | 54.1 | 46.3 |
| Biological father in household | 56.6 | 58.5 | 60.0 | 61.4 | 62.7 | 64.4 | 67.6 | 61.2 |
| N (children) | 3477 | 4289 | 4854 | 5483 | 5205 | 4662 | 4134 | 8305 |
| **Household Characteristics** | | | | | | | | |
| Geographic region | | | | | | | | |
| Northeast | 14.1 | 14.9 | 14.6 | 14.8 | 15.0 | 15.0 | 15.9 | 15.7 |
| North central | 23.0 | 24.3 | 25.7 | 25.0 | 25.8 | 25.3 | 25.3 | 24.0 |
| West | 19.6 | 19.7 | 19.7 | 20.4 | 19.2 | 19.6 | 19.4 | 19.5 |
| South | 43.3 | 41.1 | 40.0 | 39.7 | 40.0 | 40.1 | 39.4 | 40.7 |
| Urban | 78.7 | 78.2 | 78.8 | 80.1 | 80.1 | 79.5 | 79.5 | 79.9 |
| Household size | 4.03 | 4.04 | 4.08 | 4.12 | 4.14 | 4.18 | 4.23 | 4.10 |
| | (1.64) | (1.45) | (1.42) | (1.41) | (1.28) | (1.27) | (1.28) | (1.16) |
| Family structure | | | | | | | | |
| Mother only household | 36.7 | 34.1 | 31.9 | 31.7 | 30.2 | 29.1 | 28.8 | 31.2 |
| Mother and partner household | 4.8 | 5.1 | 5.2 | 4.8 | 5.1 | 4.9 | 4.4 | 5.2 |
| Mother and spouse household | 58.5 | 60.8 | 62.9 | 63.5 | 64.7 | 66.0 | 66.8 | 63.6 |
| Mother's age birth of first child | 19.90 | 20.77 | 21.53 | 22.13 | 22.77 | 23.45 | 24.23 | 22.87 |
| | (2.93) | (3.45) | (3.88) | (4.29) | (4.58) | (4.89) | (5.22) | (5.13) |
| Household income (1998$) | | | | | | | | |
| 1st quartile | 11 | 14 | 18 | 17 | 19 | 21 | 23 | 19.5 |
| Median | 23 | 29 | 35 | 35 | 38 | 42 | 44.5 | 36.5 |
| 3rd quartile | 41 | 48 | 53 | 55 | 59 | 65 | 70 | 56 |
| Received welfare previous year | 32.9 | 26.8 | 22.9 | 23.7 | 23.6 | 17.4 | 13.7 | 23.2 |
| Mother's education (in years) | 11.79 | 12.11 | 12.36 | 12.50 | 12.73 | 12.98 | 13.15 | 12.59 |
| | (2.00) | (2.09) | (2.20) | (2.31) | (2.34) | (2.39) | (2.48) | (2.41) |
| Mother currently working | 51.8 | 55.2 | 59.5 | 57.0 | 62.2 | 66.8 | 70.7 | 59.7 |
| Mother has health limitation | 5.2 | 5.9 | 5.0 | 9.3 | 9.6 | 9.4 | 9.4 | 7.9 |
| N (mothers) | 2041 | 2297 | 2499 | 2779 | 2685 | 2482 | 2285 | 3661 |

percentages and means (standard deviation in parentheses)

the sample for children for whom mental health measures are applicable is included in a later section of this chapter. Since the characteristics of the sample are nearly identical for both physical health measures, the slightly larger sample is described here.

In total, 8305 children born to 3661 mothers participate in the NLSY survey. While the proportion of male children remains consistent at approximately 50% in each wave, the average age of children increases. As the mothers complete their childbearing years, fewer newborn children and the maturation of the children already participating contribute to the rising average age. The proportion of black children decreases in each wave of the survey with a smaller decrease for Hispanic children and an overall increase in the proportion of white children. The number of children whose biological father lives in the same household also increases over the course of the survey from more than one half in 1986 to slightly more than two thirds in 1998.

The households in which children live also exhibit change over time. The proportion of households from the southern part of the United States declines over time, while there are slight increases in the proportion of participating households from the north central region. A stable percentage of households live in urbanized counties throughout the survey, and household size gradually increases over time. Although common-law unions are relatively rare, the proportion of women living with an opposite-sex partner does not fluctuate with time. In contrast, the proportion of mother-headed families decreases between 1986 and 1998, and an increasing proportion of households include the mother and her legally married spouse.

There is an upward trend in the average age of mother at birth of first child over the course of the survey, which is expected given that mothers who delay childbearing until they are older do not appear in the initial waves of the survey. As the sample becomes more representative of the childbearing careers of the NLSY mothers, the variability in age of mother at birth of first child also increases. Transformed into constant 1998 dollars, household income increases in each wave of the survey, while the proportion of households reporting welfare as a source of income decreases. Average education of the mother increases, as does the proportion of women who are currently working. A final trend to note in the characteristics of mothers is that, over the course of the survey, there are successively higher proportions of women who report a health limitation, with the largest increase occurring between 1990 and 1992.

As reported in the previous chapter, there are several potential explanations for the trend of rising average socioeconomic position in each successive wave. First, women are at a stage in their life course in which they and their partners are being launched into careers paths that will determine their future earnings, and it is anticipated that earnings will increase as they acquire experience and seniority in their respective positions. Further, women who delay childbirth until later in life and thus only participate in the latter stages of the survey enjoy a more privileged economic position relative to women who become mothers much earlier in the survey. Finally, attrition from the sample is selective in that disadvantaged women drop out of the survey at a higher rate than more economically advantaged women.

Selective attrition from the survey is depicted in Table 12 by comparing characteristics of children who drop out of the survey with those who do not. Of the 8305 children, 6521 (78.5%) were either participants in the 1998 survey year, or had participated in the survey until they were no longer age-eligible, that is, older than 14. Many of the differences between children who drop out of the survey versus those who participate in all age-eligible waves are statistically significant. Males are more likely to drop out than females; and of course, the average age of children who remain in the survey is higher than children who leave. Black and Hispanic children are more likely to drop out than white children. Children who leave the survey early are more likely to have ever lived in a single parent household, and their mother's age at birth of her first child is younger relative to mothers of children who remain in the survey. Children from disadvantaged families are more likely to leave the survey early: their mothers have significantly lower levels of education and income, and they are more likely to have ever lived in a household that received welfare. Conversely, children who remain in the survey are more likely to have a mother reporting a health limitation, and are more likely themselves to have ever experienced a health limitation and a medically attended accident or injury. Survey dropouts participate in an average of 2.73 waves compared to an average of 4.17 waves for children who participate in all age-eligible waves.

Although attrition from the survey occurs more frequently among children from economically disadvantaged households, attrition bias is only likely to be a problem if differences in health between children who do and do not drop out differs between

Table 12 Differences between children who participate in all age-eligible waves of the survey and children who leave the survey early, NLSY, 1986-1998 (N=8305).

| | Leave survey early | | |
|---|---|---|---|
| | No | Yes | |
| Male | 50.0 | 54.8 | *** |
| Age | 6.29 | 4.74 | **** |
| | (3.19) | (2.64) | |
| Race | | | |
| Black | 31.5 | 34.6 | * |
| Hispanic | 20.5 | 25.2 | **** |
| White | 48.0 | 40.2 | **** |
| Ever lived in a single parent household | 42.3 | 46.7 | ** |
| Average household size | 4.54 | 4.49 | |
| | (1.28) | (1.38) | |
| Mother's age at birth of first child | 22.14 | 21.16 | **** |
| | (4.94) | (4.09) | |
| Mother's education (in years) | 12.52 | 11.81 | **** |
| | (2.49) | (2.17) | |
| Average household income (constant 1998 dollars) | 40,608 | 33,157 | **** |
| | (25,346) | (24,109) | |
| Household ever received welfare | 39.0 | 44.2 | **** |
| Mother ever had a health limitation | 19.8 | 15.0 | **** |
| Child ever experienced a chronic health limitation | 25.1 | 21.0 | *** |
| Child ever experienced a medically attended accident/injury | 32.5 | 21.8 | **** |
| Average number of waves child participated in survey | 4.17 | 2.73 | **** |
| | (1.68) | (1.42) | |
| N | 6521 | 1784 | |

* p<.05 ** p<.01 *** p<.001 **** p<.0001

economically advantaged and disadvantaged children (Foster & Bickman, 1996; Mirowsky & Reynolds, 2000). Specifically, if healthy children from poor families and chronically ill children from non-poor families are more likely to drop out, differences in health between these two groups of children will appear larger than they actually are. By including as covariates those characteristics of children that are systematically linked to attrition from the sample, attrition bias is less likely to be problematic, but, it will be necessary to include attrition status as a dummy variable in analytic models to test this assumption.

Profiles for Child Physical Health

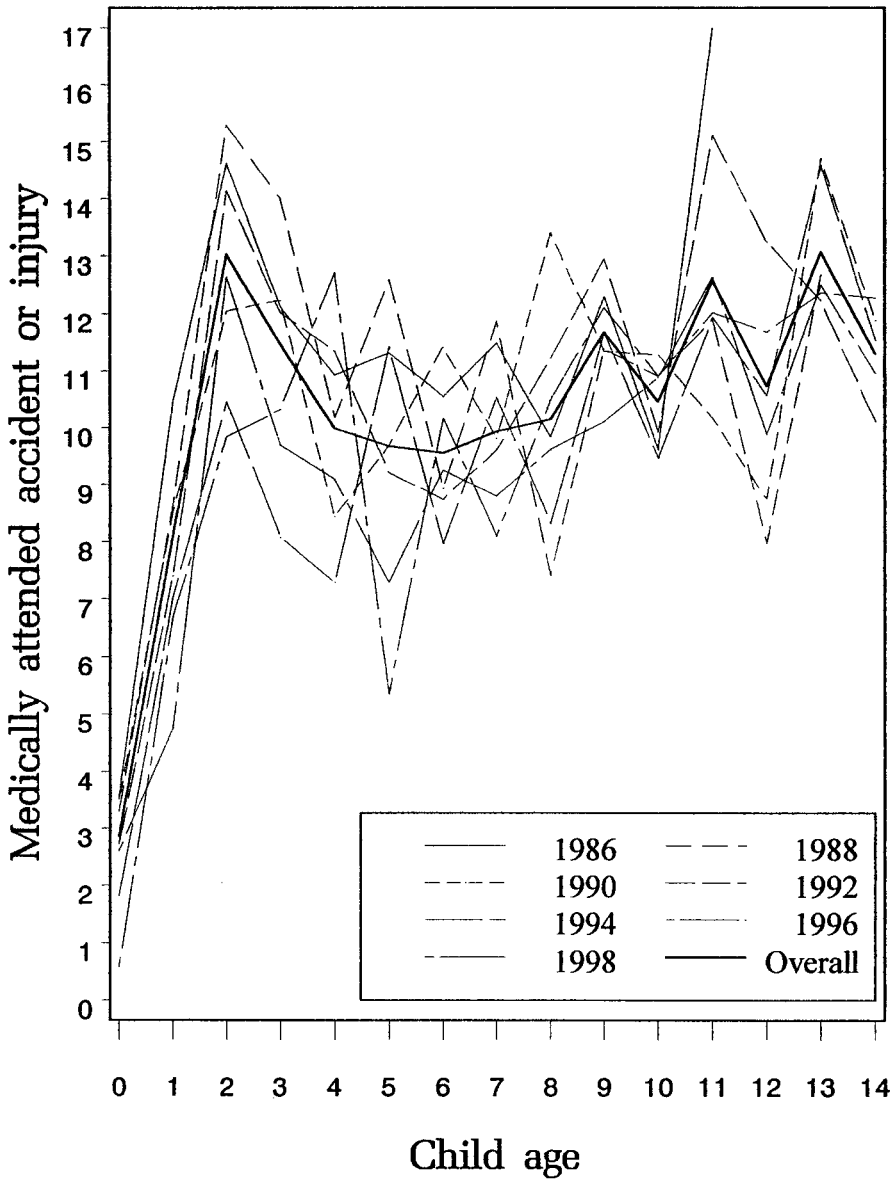
Table 13 presents the proportion of children experiencing a medically attended accident or injury by survey year and by age. The same information is presented in a graph in Figure 5. Because there were few mothers in 1986 with children older than 11 in 1986, these cells each contain fewer than 25 children, and thus exhibit greater variability (these estimates are not included in the graph). With approximately ten percent of children in each survey year affected, there is little variation in the proportion of children experiencing a medically attended accident or injury across the seven waves. The proportion of children experiencing a medically attended accident or injury in the first year of life is extremely low, but increases sharply for the next two years, and thereafter exhibits no consistent pattern of change. This pattern of rapid increase during the first two years of life and a levelling off after the second year of life has already been noted in the previous chapter for the 1992 and 1998 survey years, but can now be seen as a consistent pattern in every wave of the survey. Given that children become more mobile as they mature and thus expand the

Table 13 Proportion of children experiencing a medically attended accident or injury, by survey year and age, NLSY, 1986-98 (N=32082).

| Age | 1986 | 1988 | 1990 | 1992 | 1994 | 1996 | 1998 | Overall | N |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 3.6 | 3.3 | 3.5 | 2.7 | 1.8 | 1.0 | 2.6 | 2.8 | 1996 |
| 1 | 10.4 | 8.6 | 8.5 | 7.4 | 7.0 | 6.7 | 4.8 | 8.1 | 2273 |
| 2 | 14.6 | 15.3 | 12.0 | 14.1 | 10.4 | 9.8 | 12.6 | 13.0 | 2379 |
| 3 | 12.1 | 14.0 | 12.2 | 12.0 | 8.1 | 10.3 | 9.7 | 11.5 | 2538 |
| 4 | 10.9 | 10.2 | 8.4 | 11.3 | 7.3 | 12.7 | 9.1 | 10.0 | 2534 |
| 5 | 11.3 | 12.6 | 9.7 | 9.2 | 11.4 | 5.3 | 7.3 | 9.7 | 2604 |
| 6 | 10.5 | 8.9 | 11.4 | 8.7 | 8.0 | 10.2 | 9.3 | 9.5 | 2587 |
| 7 | 11.5 | 11.9 | 9.8 | 9.6 | 10.5 | 8.1 | 8.8 | 9.9 | 2508 |
| 8 | 9.8 | 7.4 | 13.4 | 11.2 | 8.3 | 10.5 | 9.6 | 10.1 | 2396 |
| 9 | 12.3 | 11.4 | 11.3 | 12.9 | 11.7 | 12.1 | 10.1 | 11.7 | 2271 |
| 10 | 9.6 | 10.9 | 11.3 | 9.9 | 9.5 | 10.9 | 10.9 | 10.4 | 2095 |
| 11 | 17.0 | 11.9 | 10.2 | 15.1 | 11.9 | 12.0 | 12.6 | 12.6 | 1900 |
| 12 | 4.2[a] | 8.0 | 8.7 | 13.2 | 10.6 | 11.7 | 9.9 | 10.7 | 1696 |
| 13 | 10.0[a] | 12.7 | 14.7 | 12.2 | 14.6 | 12.4 | 12.5 | 13.1 | 1500 |
| 14 | 0.0[a] | 12.5 | 11.9 | 10.1 | 11.5 | 12.3 | 10.9 | 11.3 | 805 |
| Overall | 10.6 | 10.5 | 10.3 | 10.7 | 9.7 | 10.0 | 9.7 | 10.2 | |
| N | 3479 | 4292 | 4851 | 5461 | 5205 | 4661 | 4133 | | 32082 |

[a] estimates based on fewer than 25 subjects

Figure 5 Percentage of children experiencing a medically attended accident or injury, by survey year and age, NLSY, 1986-98 (N=32082).



range of potential types of accidents and injuries to which they are vulnerable, this age related pattern of medically attended accident or injury is reasonable. This description is more finely-grained than what is typically reported for child injury rates as researchers tend to use collapsed age groups for children under the age of 14 (eg. Fingerhut & Warner, 1997; Tuchfarber et al., 1997).

Variation across age and time, however, does not reveal whether children experience more than one medically attended accident or injury during their childhood. Table 14 presents a profile of children's experiences of a medically attended accident or injury according to how many times they participated in the survey between 1986 and 1998. For example, 946 of the 8305 children were only included once in the survey, and of those, approximately 4.8% experienced a medically attended accident or injury. As the number of times children participated in the survey increases, the proportion of children not experiencing a medically attended accident or injury declines. There is a small proportion of children experiencing two episodes of medically attended accident or injury but very few children experience more than two.

It is important to reiterate that there are seven waves of the survey spanning 14 years, and that to be included in the survey, children must be between the ages of 0 and 14. Therefore, the 470 children for whom information is obtained in all seven waves were necessarily in their first year of life in 1986 and their profile covers their entire period of eligibility, that is, the whole of childhood. Over the entire course of childhood, slightly more than half of these children did not experience a medically attended accident or injury,

Table 14 Child medically attended accident or injury profile, NLSY, 1986-98 (N=8305).

| Number of times participated in survey | Number of times child has medically attended accident/injury | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | N |
| 1 | 95.2 | 4.8 | | | | | | | 946 |
| 2 | 82.4 | 16.7 | 0.9 | | | | | | 1158 |
| 3 | 75.0 | 21.2 | 3.5 | 0.3 | | | | | 1354 |
| 4 | 68.0 | 25.2 | 5.7 | 1.0 | 0.1 | | | | 1601 |
| 5 | 59.6 | 30.3 | 8.2 | 1.6 | 0.2 | 0.0 | | | 1590 |
| 6 | 54.0 | 29.9 | 11.4 | 3.4 | 1.0 | 0.2 | 0.2 | | 1186 |
| 7 | 53.4 | 30.6 | 10.0 | 4.3 | 0.9 | 0.9 | 0.0 | 0.0 | 470 |

Note: Rows may not add up to 100% due to rounding

Table 15 Conditional percentages for absence/presence of a child medically attended accident or injury at a subsequent observation given previous observation, NLSY, 1986-98 (N=23777).

| | | Previous Observation: Absence | Previous Observation: Presence | Total |
|---|---|---|---|---|
| Current Observation | Absence | 19192<br>89.8% | 1998<br>83.2% | 21190<br>89.1% |
| | Presence | 2183<br>10.2% | 404<br>16.8% | 2587<br>10.9% |
| | Total | 21375<br>89.9% | 2402<br>10.1% | 23777<br>100.0% |

while approximately 16% of these children had two or more such episodes.

A final way of capturing change in medically attended accident or injury over time is the transition table which appears in Table 15. A transition table provides the conditional percentages for a medically attended accident or injury in a current observation given a previous observation. Of the 23,777 transitions (32,082 - 8,305=23,777), the overwhelming majority are free of a medically attended accident or injury in two consecutive periods. Only 1.7% of all transitions involve consecutive experiences of a medically attended accident or injury (404/23777). Nonetheless, medically attended accident or injury is not entirely random - given a previously reported accident or injury, 16.8% also experience a medically attended accident or injury in the following observation period.

Table 16 and Figure 6 describe the proportion of children with a health limitation by survey year and age. Cells containing fewer than 25 observations are noted in the table, but not reproduced in the graph. As with medically attended accident or injury, there is little variation by survey year such that approximately ten percent of children in any given period have a health limitation. The overall pattern of child health limitation by age indicates a very gradual increase as children grow older.

Table 17 presents the profile for child health limitation broken down according to the number of waves in which information on the child's health was provided. The profile differs from the medically attended accident or injury profile in two ways. First, it appears that of those children observed for the entire childhood period (N=471), a higher

Table 16 Percentage of children with a health limitation, by survey year and age, NLSY, 1986-98 (N=32104).

| Age | 1986 | 1988 | 1990 | 1992 | 1994 | 1996 | 1998 | Overall | N |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 7.4 | 9.4 | 12.9 | 9.4 | 2.7 | 4.6 | 4.6 | 8.1 | 1996 |
| 1 | 10.3 | 11.0 | 12.7 | 11.1 | 7.0 | 5.7 | 5.4 | 9.7 | 2270 |
| 2 | 12.0 | 6.4 | 13.5 | 9.1 | 7.2 | 9.0 | 7.5 | 9.5 | 2382 |
| 3 | 8.3 | 6.2 | 10.9 | 10.2 | 6.7 | 9.2 | 8.8 | 8.5 | 2538 |
| 4 | 11.4 | 10.2 | 6.5 | 8.3 | 5.4 | 10.2 | 9.5 | 8.7 | 2535 |
| 5 | 12.1 | 8.2 | 8.3 | 9.9 | 8.9 | 10.1 | 6.6 | 9.2 | 2607 |
| 6 | 8.4 | 9.2 | 8.4 | 7.8 | 9.5 | 12.4 | 11.7 | 9.5 | 2585 |
| 7 | 7.1 | 9.3 | 10.5 | 9.8 | 11.1 | 14.9 | 9.4 | 10.5 | 2510 |
| 8 | 11.4 | 7.7 | 10.3 | 10.1 | 11.0 | 14.6 | 9.6 | 10.7 | 2403 |
| 9 | 9.8 | 9.7 | 11.6 | 12.9 | 9.2 | 15.1 | 12.4 | 11.7 | 2275 |
| 10 | 7.7 | 9.1 | 9.2 | 11.8 | 13.8 | 14.5 | 12.9 | 12.0 | 2096 |
| 11 | 11.3 | 11.2 | 9.3 | 14.4 | 13.0 | 15.3 | 15.4 | 13.5 | 1904 |
| 12 | 8.3[a] | 7.1 | 17.5 | 9.0 | 11.4 | 15.9 | 13.7 | 12.5 | 1697 |
| 13 | 10.0[a] | 9.8 | 10.2 | 12.7 | 13.0 | 12.6 | 13.0 | 12.5 | 1501 |
| 14 | 0.0[a] | 6.2 | 8.9 | 15.2 | 11.5 | 14.1 | 15.1 | 12.9 | 805 |
| Overall | 9.8 | 8.7 | 10.5 | 10.5 | 9.6 | 12.5 | 10.9 | 10.4 | |
| N | 3477 | 4289 | 4854 | 5483 | 5205 | 4662 | 4134 | | 32104 |

[a] estimates based on fewer than 25 subjects

Figure 6 Percentage of children with a health limitation, by survey year and age, NLSY, 1986-98 (N=32104).

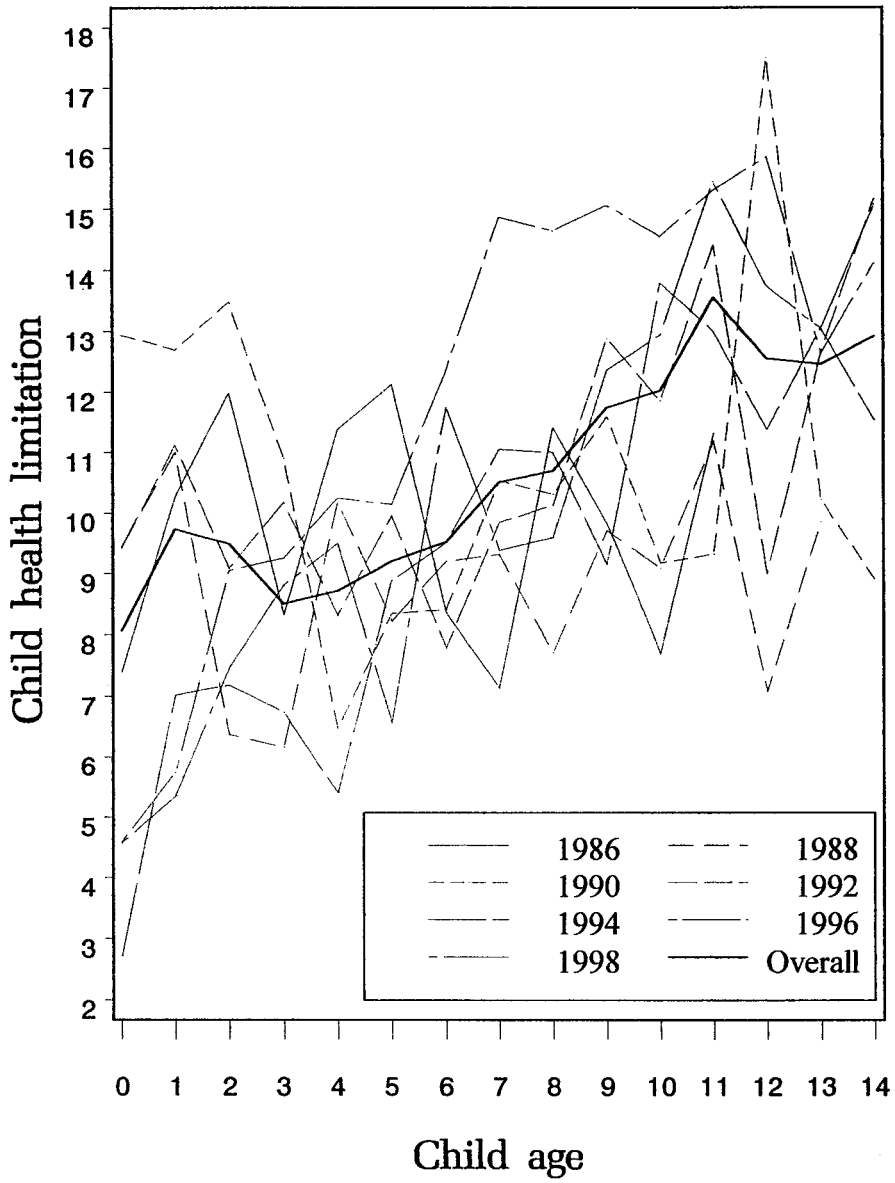


Table 17 Child health limitation profile, NLSY, 1986-98 (N=8305).

| Number of times participated in survey | Number of times child has chronic health limitation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | N |
| 1 | 91.8 | 8.2 | | | | | | | 945 |
| 2 | 83.1 | 12.2 | 4.7 | | | | | | 1156 |
| 3 | 78.7 | 15.4 | 4.6 | 1.3 | | | | | 1351 |
| 4 | 74.7 | 15.2 | 4.9 | 3.9 | 1.2 | | | | 1601 |
| 5 | 68.5 | 18.8 | 6.2 | 3.8 | 1.6 | 1.1 | | | 1587 |
| 6 | 67.5 | 16.9 | 7.1 | 4.2 | 2.1 | 1.5 | 0.7 | | 1194 |
| 7 | 67.1 | 16.6 | 7.0 | 3.4 | 3.0 | 1.3 | 1.5 | 0.2 | 471 |

Note: Rows may not add up to 100% due to rounding

proportion do not have a health limitation relative to the number of children experiencing a medically attended accident or injury (67.1% versus 53.4%). Second, while the proportion of children with more than two instances of a medically attended accident or injury is extremely low, the drop in the proportion of children with a health limitation in multiple time periods is more gradual, and there is a small but consistent percentage of children who have a health limitation in every wave they are observed, regardless of how long they are observed. Thus, as might be expected, medically attended accidents/injuries are generally more common than health limitations, but due to the chronic nature of some health limitations, multiple episodes of a health limitation are observed more frequently in the sample compared to the very few children experiencing more than two episodes of medically attended accident or injury.

This is further elaborated in the transition table for child health limitation presented in Table 18. The percentage of transitions characterized by the absence of a child health limitation in two consecutive periods is higher than what is observed for two consecutive periods for child medically attended accident or injury (93.1% versus 89.8%). Although only 4.5% (1066/23799) of all transitions are characterized by consecutive experiences of a child health limitation, nearly half of those experiencing a health limitation in the prior observation period continued to have a health limitation in the following observation period (44.7%).

The profiles of children's medically attended accident or injury and health limitation offer insight into patterns of stability and change in children's health status over

Table 18 Conditional percentages for absence/presence of a child health limitation at a subsequent observation given previous observation, NLSY, 1986-98 (N=23799).

| | | Previous Observation: Absence | Previous Observation: Presence | Total |
|---|---|---|---|---|
| Current Observation | Absence | 19933<br>93.1% | 1317<br>55.3% | 21520<br>89.3% |
| | Presence | 1483<br>6.9% | 1066<br>44.7% | 2549<br>10.7% |
| | Total | 21416<br>90.0% | 2383<br>10.0% | 23799<br>100.0% |

the course of childhood. Both physical health measures can be characterized as having non-absorbing boundaries (Dwyer & Feinleib, 1991) in that, unlike mortality where a change in health status is always final, children can, and do, experience movement in and out of health categories over time. However, the patterns of change are remarkably different for the two health conditions. A greater proportion of children experience a medically attended accident or injury during the course of childhood than experience a health limitation, but the proportion of children who consistently report a health limitation is higher than the proportion of children experiencing multiple episodes of medically attended accidents or injuries.

These findings seem consistent with the nature of these two health conditions. Although some children might be accident-prone, or at least, live in environments which consistently put them at higher risk, the occurrence of multiple or consecutive episodes of accident or injury is unusual. The experience of a health limitation is more infrequent than the experience of a medically attended accident or injury, but given that some of these health limitations are likely to be chronic or even permanent, recovery from a health limitation in a previous observation is slightly more than 50%, and there is a small but visible minority of children who consistently report a health limitation, regardless of how many times they are observed.

While these profiles contribute to an understanding of patterns of childhood morbidity over time, there is much that cannot be discerned. For those children with a health limitation at multiple points in time, there is no way to ascertain the degree of

change, that is, whether the health limitation is becoming more severe or improving over time. Moreover, it cannot even be assumed that the limitation is the same condition at each point in time. Similarly, the permanence of the effects of any accident or injury are unknown, so that it becomes impossible to distinguish the relatively untroubling incidents from which children quickly rebound from those more serious situations which will leave some children emotionally traumatized or physically or mentally disabled. The ability to clarify the specific characteristics of children's health limitations and the consequences of their medically attended accidents or injuries would enable researchers to gauge more precisely the extent to which health status in childhood can be considered self-limiting. Indeed, neglecting to sort out these characteristics in a meaningful way may underestimate the strength of the causal pathways through which poor health in childhood impacts future socioeconomic position and future health. Although this is an acknowledged limitation of the current work, one goal of this dissertation is to focus attention on the need for a longitudinal perspective on children's health, and as such, represents a preliminary attempt to find useful methods of profiling children's health over time.

Profiles for Child Mental Health

Table 19 reproduces the child and household characteristics presented in Table 11 with the difference that the current table is applicable to children between the ages of 4 and 14. The sample reported in Table 19 is relevant specifically for child/anxiety depression, as missing information resulted in a slightly smaller sample for child antisocial behaviour (from 22,474 to 22,383). A careful reader will note that there is a discrepancy

Table 19 Child and household characteristics, children ages 4 - 14, NLSY, 1986-98 (N=22474).

| | 1986 | 1988 | 1990 | 1992 | 1994 | 1996 | 1998 | Overall |
|---|---|---|---|---|---|---|---|---|
| **Child Characteristics** | | | | | | | | |
| Male | 51.9 | 50.7 | 50.8 | 49.7 | 50.8 | 50.0 | 50.9 | 51.3 |
| Age | | | | | | | | |
| 1st quartile | 5 | 5 | 5 | 6 | 6 | 6 | 7 | 6 |
| Median | 6 | 7 | 8 | 8 | 9 | 9 | 9 | 8 |
| 3rd quartile | 8 | 9 | 10 | 11 | 11 | 11 | 12 | 9 |
| Race | | | | | | | | |
| Black | 42.3 | 39.3 | 35.2 | 33.3 | 30.6 | 28.9 | 27.7 | 33.3 |
| Hispanic | 21.1 | 21.7 | 21.7 | 22.9 | 22.0 | 21.0 | 18.8 | 21.6 |
| White | 36.6 | 39.0 | 43.1 | 43.8 | 47.4 | 50.1 | 53.5 | 45.1 |
| Biological father in household | 46.5 | 48.5 | 51.7 | 55.0 | 57.8 | 60.3 | 63.3 | 55.7 |
| N (children) | 1773 | 2557 | 3325 | 3947 | 3928 | 3653 | 3291 | 7143 |
| **Household Characteristics** | | | | | | | | |
| Geographic region | | | | | | | | |
| North east | 13.1 | 13.7 | 13.7 | 13.7 | 14.1 | 14.4 | 15.8 | 15.1 |
| North central | 22.6 | 23.7 | 25.0 | 24.7 | 25.6 | 26.3 | 26.2 | 24.7 |
| West | 18.1 | 20.1 | 20.6 | 20.7 | 19.7 | 19.8 | 19.1 | 19.4 |
| South | 46.2 | 42.4 | 40.7 | 41.0 | 40.7 | 39.5 | 38.9 | 40.8 |
| Urban | 77.8 | 77.5 | 77.8 | 79.2 | 79.6 | 79.4 | 79.2 | 79.6 |
| Household size | 4.29 | 4.25 | 4.26 | 4.28 | 4.26 | 4.27 | 4.29 | 4.17 |
| | (1.70) | (1.51) | (1.45) | (1.44) | (1.29) | (1.27) | (1.27) | (1.21) |
| Family structure | | | | | | | | |
| Mother only household | 41.7 | 39.4 | 35.4 | 34.7 | 32.0 | 30.2 | 29.9 | 33.9 |
| Mother and partner household | 4.7 | 5.3 | 5.5 | 4.8 | 5.4 | 5.2 | 4.3 | 5.2 |
| Mother and spouse household | 53.5 | 55.3 | 59.2 | 60.5 | 62.6 | 64.6 | 65.8 | 60.9 |
| Mother's age birth of first child | 18.49 | 19.33 | 20.25 | 20.93 | 21.81 | 22.59 | 23.49 | 22.13 |
| | (2.23) | (2.63) | (3.02) | (3.43) | (3.90) | (4.26) | (4.57) | (4.51) |
| Household income (1998$) | | | | | | | | |
| 1st quartile | 11 | 13 | 16 | 16 | 18 | 21 | 22 | 19 |
| Median | 21 | 26 | 32 | 33 | 36 | 40 | 43 | 35 |
| 3rd quartile | 37 | 44 | 50 | 52 | 56 | 62 | 68 | 55 |
| Received welfare previous year | 38.1 | 31.8 | 26.2 | 26.6 | 25.6 | 18.5 | 14.4 | 24.0 |
| Mother's education (in years) | 11.41 | 11.77 | 12.06 | 12.24 | 12.53 | 12.80 | 13.04 | 12.48 |
| | (1.97) | (1.99) | (2.06) | (2.19) | (2.29) | (2.32) | (2.40) | (2.34) |
| Mother currently working | 50.9 | 55.9 | 59.3 | 56.7 | 61.7 | 66.7 | 71.1 | 61.3 |
| Mother has health limitation | 5.6 | 6.0 | 5.5 | 9.6 | 10.1 | 10.2 | 9.6 | 8.7 |
| N (mothers) | 1224 | 1630 | 1959 | 2262 | 2277 | 2149 | 1982 | 3351 |

percentages and mean (standard deviation in parentheses)

in the sample size for the 1992 survey year in Table 19 and the sample size reported for the mental health measures for that year in the previous chapter. Since the mother's mental health is not a variable in longitudinal analysis, there was no longer a need to exclude cases that were missing on this variable, resulting in a slightly larger available sample.

The pattern of increasing socioeconomic position with each successive wave, as noted in Table 11, is once again evident in Table 19. Additionally, the differences in socioeconomic position and family structure between the two samples (comparing the households of children ages 0-14 with children ages 4-14) is larger in the early waves of the survey and almost imperceptible in the later waves of the survey. This reinforces the earlier conclusion that women who had older children in the earliest waves of the NLSY survey, and thus became mothers at a very young age, were much more disadvantaged economically relative to women participating later in the survey. For example, 38.1% of women with children ages 4 to 14 reported welfare as a source of income in 1986 (Table 19), which is much higher than the 32.9% of women with children between the ages of 0 and 14 who report welfare as a source of income in 1986 (Table 11). By 1998, the women reporting welfare for the two age ranges of children is 14.4% and 13.7% respectively. These differences underscore the need to take into account the year in which the child first began participating in the NLSY survey.

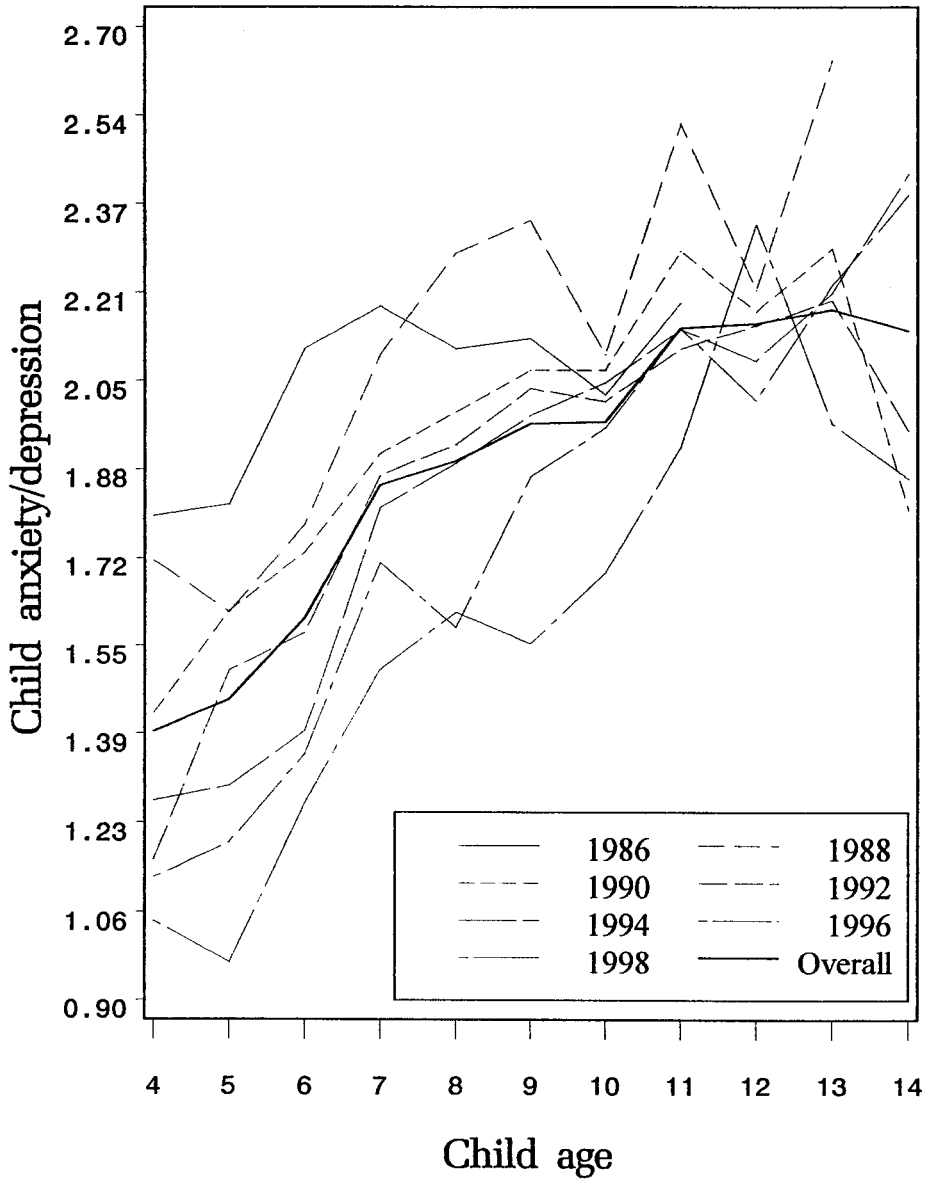
Table 20 displays the mean and standard deviation for child anxiety/depression by survey year and age. The same information is presented in graphical form in Figure 7, although as with the physical health conditions, estimates based on cells with fewer than

Table 20 Mean (s.d.) child anxiety/depression, by survey year and age, NLSY, 1986-98 (N=22474).

| Age | 1986 | 1988 | 1990 | 1992 | 1994 | 1996 | 1998 | Overall | N |
|---|---|---|---|---|---|---|---|---|---|
| 4 | **1.79** | **1.71** | **1.42** | **1.16** | **1.27** | **1.13** | **1.05** | **1.39** | 2481 |
| | (1.51) | (1.60) | (1.50) | (1.29) | (1.33) | (1.36) | (1.36) | (1.46) | |
| 5 | **1.82** | **1.62** | **1.62** | **1.51** | **1.29** | **1.19** | **0.97** | **1.45** | 2571 |
| | (1.53) | (1.48) | (1.54) | (1.61) | (1.38) | (1.28) | (1.38) | (1.49) | |
| 6 | **2.10** | **1.78** | **1.73** | **1.58** | **1.39** | **1.35** | **1.26** | **1.60** | 2527 |
| | (1.74) | (1.62) | (1.63) | (1.56) | (1.52) | (1.43) | (1.40) | (1.58) | |
| 7 | **2.18** | **2.09** | **1.91** | **1.87** | **1.81** | **1.71** | **1.51** | **1.85** | 2472 |
| | (1.69) | (1.74) | (1.65) | (1.76) | (1.80) | (1.59) | (1.58) | (1.70) | |
| 8 | **2.10** | **2.28** | **1.99** | **1.93** | **1.89** | **1.59** | **1.62** | **1.89** | 2359 |
| | (1.77) | (1.87) | (1.76) | (1.81) | (1.71) | (1.66) | (1.59) | (1.75) | |
| 9 | **2.12** | **2.34** | **2.06** | **2.03** | **1.98** | **1.87** | **1.56** | **1.97** | 2237 |
| | (1.88) | (1.83) | (1.93) | (1.81) | (1.88) | (1.82) | (1.73) | (1.85) | |
| 10 | **2.02** | **2.09** | **2.06** | **2.01** | **2.04** | **1.96** | **1.69** | **1.97** | 2058 |
| | (1.73) | (1.79) | (1.87) | (1.82) | (1.87) | (1.73) | (1.72) | (1.80) | |
| 11 | **2.19** | **2.52** | **2.29** | **2.10** | **2.14** | **2.14** | **1.92** | **2.14** | 1874 |
| | (1.66) | (1.95) | (1.85) | (1.92) | (1.87) | (1.82) | (1.86) | (1.87) | |
| 12 | **2.04**[a] | **2.21** | **2.17** | **2.15** | **2.08** | **2.01** | **2.34** | **2.15** | 1658 |
| | (1.55) | (1.81) | (1.90) | (1.93) | (1.82) | (1.82) | (2.14) | (1.91) | |
| 13 | **2.10**[a] | **2.64** | **2.29** | **2.19** | **2.21** | **2.22** | **1.97** | **2.18** | 1464 |
| | (2.13) | (2.00) | (1.87) | (1.85) | (1.96) | (2.01) | (1.82) | (1.92) | |
| 14 | **2.67**[a] | **2.54** | **2.81** | **1.95** | **2.43** | **2.39** | **1.86** | **2.14** | 773 |
| | (3.78) | (1.91) | (1.83) | (1.73) | (2.20) | (2.05) | (1.90) | (1.98) | |
| Overall | **1.98** | **2.01** | **1.88** | **1.83** | **1.83** | **1.76** | **1.64** | **1.83** | |
| | (1.66) | (1.74) | (1.74) | (1.76) | (1.78) | (1.73) | (1.75) | (1.75) | |
| N | 1773 | 2557 | 3325 | 3947 | 3928 | 3653 | 3291 | | 22474 |

[a] estimates based on fewer than 25 subjects

Figure 7 Mean child anxiety/depression score, by survey year and age, NLSY, 1986-98 (N=22474).



25 observations, representing the small number of mothers with older children in the first wave of the survey, have been omitted. The grand mean for child anxiety/depression for the entire sample of 22,474 child observation periods is 1.83, with a standard deviation of 1.75. The child observation periods represent 7143 children. Across the waves of the survey, child anxiety/depression increases slightly between 1986 and 1988, then gradually declines. Child anxiety/depression increases steadily with age, although the rate of increase appears higher at earlier ages. This is consistent with patterns of age-related child anxiety/depression reported in the previous chapter.

Table 21 describes the mean and standard deviation for child antisocial behaviour by survey year and age, with its graphical equivalent appearing in Figure 8. As previously, estimates based on fewer than 25 observations for a given cell are noted in the table and omitted in the graph. The grand mean for the 22,383 child observation periods is 1.33, with a standard deviation of 1.43. The child observation periods represent 7141 children. There is a consistent decrease in child antisocial behaviour across the seven waves of the survey, with the largest decrease occurring between 1988 and 1990. In contrast, the pattern in child antisocial behaviour by age appears nearly flat.

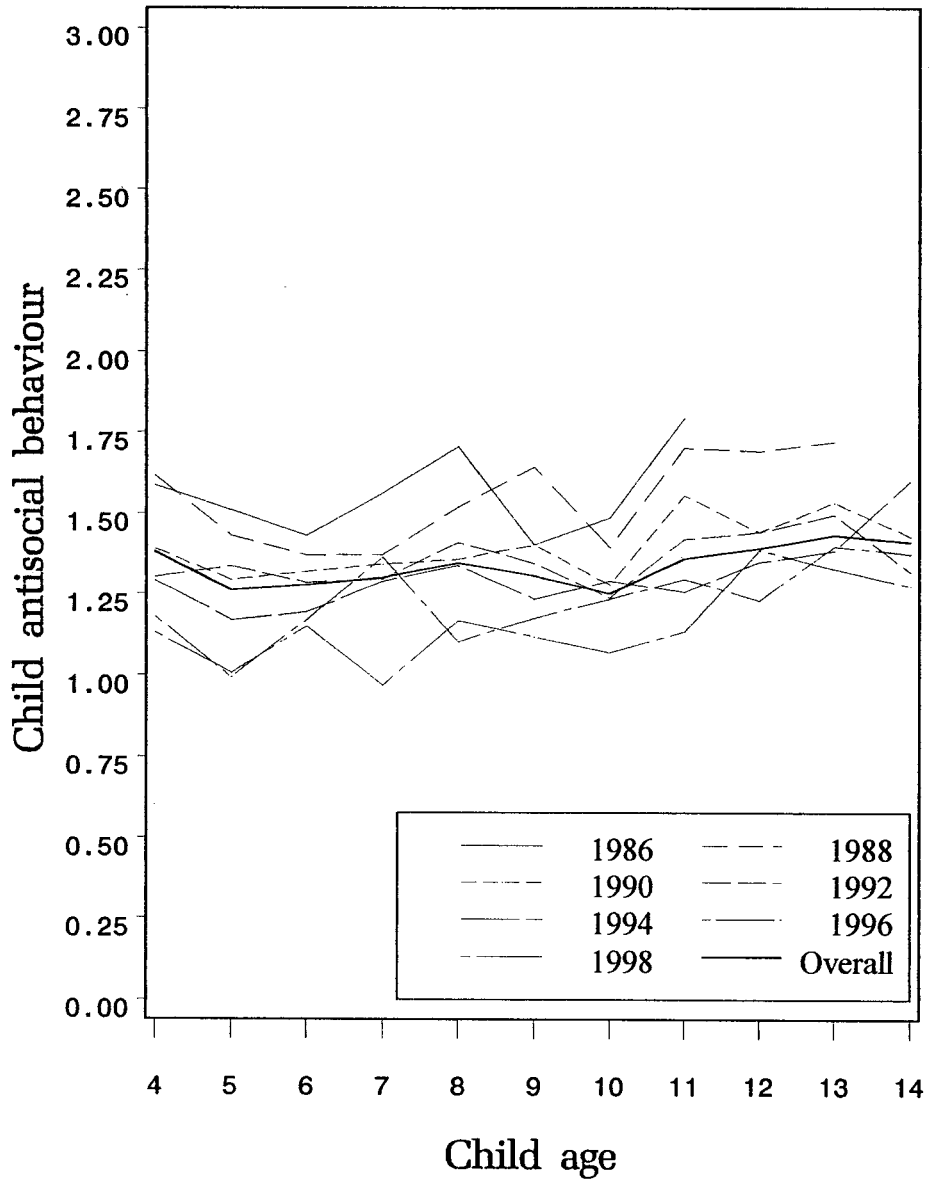
Unlike the physical health conditions, where the occurrence of an event (medically attended accident or injury or a health limitation) is discrete, the mental health measures do reveal the degree of change over time. As such, they will be more sensitive instruments for detecting variability in child mental health as a function of dynamic changes in parental socioeconomic position and family structure.

Table 21 Mean (s.d.) child antisocial behaviour, by survey year and age, NLSY, 1986-98 (N=22383).

| Age | 1986 | 1988 | 1990 | 1992 | 1994 | 1996 | 1998 | Overall | N |
|---|---|---|---|---|---|---|---|---|---|
| 4 | **1.58** | **1.62** | **1.39** | **1.30** | **1.29** | **1.18** | **1.13** | **1.38** | 2473 |
| | (1.38) | (1.52) | (1.47) | (1.32) | (1.34) | (1.28) | (1.41) | (1.40) | |
| 5 | **1.51** | **1.43** | **1.29** | **1.33** | **1.17** | **0.99** | **1.01** | **1.26** | 2556 |
| | (1.34) | (1.35) | (1.27) | (1.41) | (1.32) | (1.19) | (1.28) | (1.32) | |
| 6 | **1.43** | **1.37** | **1.32** | **1.28** | **1.19** | **1.17** | **1.15** | **1.28** | 2518 |
| | (1.35) | (1.41) | (1.44) | (1.31) | (1.36) | (1.27) | (1.35) | (1.36) | |
| 7 | **1.56** | **1.37** | **1.34** | **1.29** | **1.29** | **1.36** | **0.97** | **1.30** | 2464 |
| | (1.37) | (1.31) | (1.42) | (1.36) | (1.43) | (1.47) | (1.20) | (1.38) | |
| 8 | **1.70** | **1.52** | **1.36** | **1.41** | **1.34** | **1.10** | **1.17** | **1.34** | 2351 |
| | (1.60) | (1.50) | (1.42) | (1.55) | (1.51) | (1.26) | (1.34) | (1.46) | |
| 9 | **1.40** | **1.64** | **1.40** | **1.34** | **1.23** | **1.18** | **1.12** | **1.31** | 2229 |
| | (1.35) | (1.60) | (1.50) | (1.44) | (1.48) | (1.36) | (1.40) | (1.46) | |
| 10 | **1.48** | **1.39** | **1.28** | **1.24** | **1.29** | **1.23** | **1.07** | **1.25** | 2047 |
| | (1.31) | (1.48) | (1.40) | (1.36) | (1.49) | (1.41) | (1.33) | (1.40) | |
| 11 | **1.79** | **1.70** | **1.56** | **1.42** | **1.26** | **1.29** | **1.13** | **1.36** | 1866 |
| | (1.29) | (1.66) | (1.67) | (1.55) | (1.33) | (1.47) | (1.31) | (1.48) | |
| 12 | **1.87**[a] | **1.69** | **1.44** | **1.44** | **1.34** | **1.23** | **1.38** | **1.39** | 1649 |
| | (1.33) | (1.61) | (1.40) | (1.49) | (1.49) | (1.39) | (1.53) | (1.48) | |
| 13 | **3.20**[a] | **1.72** | **1.53** | **1.49** | **1.38** | **1.40** | **1.33** | **1.43** | 1460 |
| | (1.68) | (1.56) | (1.67) | (1.55) | (1.47) | (1.50) | (1.49) | (1.53) | |
| 14 | **2.00**[a] | **1.55** | **1.43** | **1.32** | **1.60** | **1.37** | **1.27** | **1.41** | 770 |
| | (1.00) | (1.48) | (1.64) | (1.52) | (1.69) | (1.61) | (1.69) | (1.62) | |
| Overall | **1.55** | **1.50** | **1.37** | **1.34** | **1.29** | **1.22** | **1.15** | **1.33** | |
| | (1.39) | (1.47) | (1.45) | (1.43) | (1.44) | (1.38) | (1.39) | (1.43) | |
| N | 1771 | 2539 | 3321 | 3931 | 3889 | 3645 | 3287 | | 22383 |

[a] estimates based on fewer than 25 subjects

Figure 8 Mean child antisocial behaviour score, by survey year and age, NLSY, 1986-98 (N=22383).



Profiles of Household Income

The final segment of this chapter briefly describes the changes in household income over the course of the NLSY survey period. While Tables 11 and 19 describe average changes in household income and family structure between 1986 and 1998, they obscure the amount of change that occurs within families. In the generalized linear mixed models, household income will be separated into a stable component and time-varying component. The stable component reflects the average household income over all the waves the child participates in the survey. The time-varying component is the deviation from that average at each data collection point. Thus, children can be described both in terms of their mean household income, and the magnitude and direction of the difference from that average at any point in time.

Since I have been using a logarithmic transformation of household income, the interpretation of the deviation of logged household income at any point in time from the natural logarithm of the average household income over time is necessarily changed. The law of logarithms states that the difference in two logged values with the same base is equivalent to its proportion. More formally stated:

$$\log_b X - \log_b Y = \log_b (X/Y) \quad \text{where } X>0 \text{ and } Y>0$$

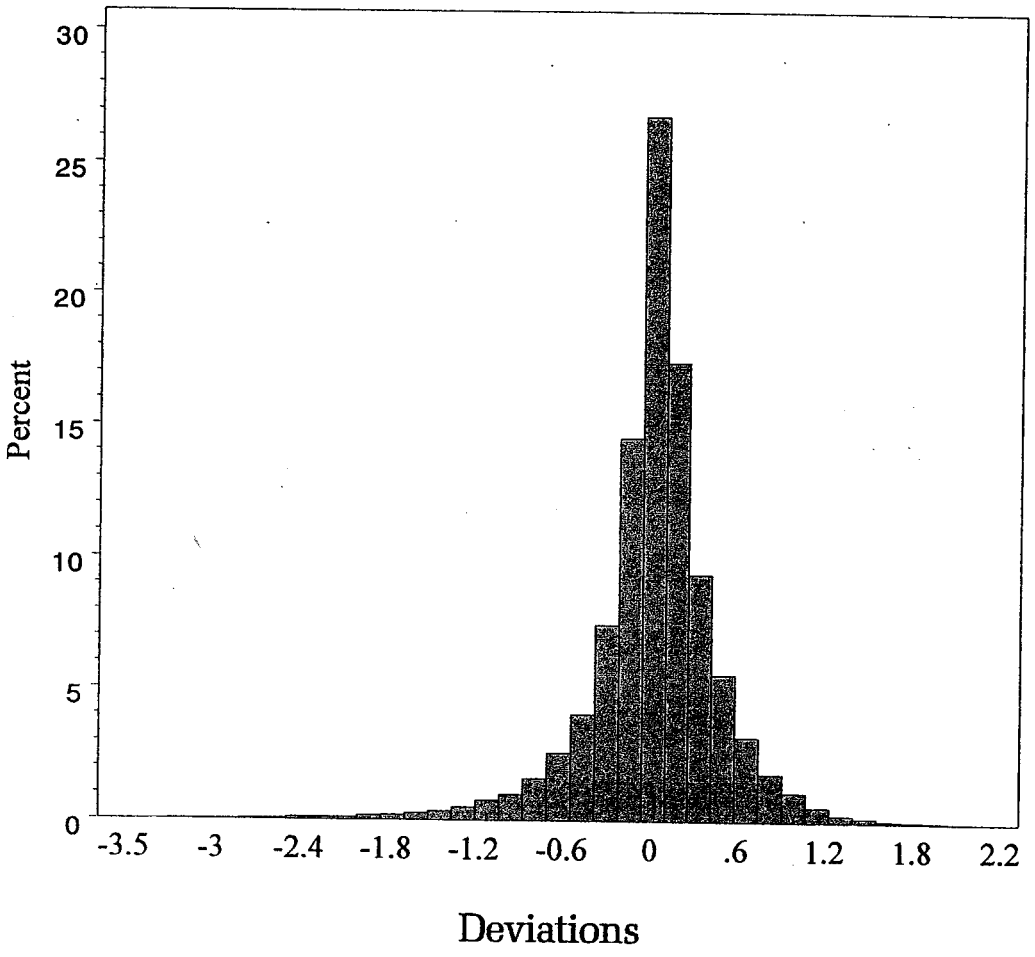
For example, if the average household income across all of a child's observation periods is $60,000 and at a given point in time it is $30,000, then the respective logged values (4.094 and 3.401) give a difference of -.693, which, when taking exponents ($e^{-.693}$) equals .50. This represents the proportional difference, that is, that $30,000 is half of the average

$60,000 household income reported by the child's family.

Figure 9 graphs the distribution of deviations from the natural logarithm of average household income using the sample pertaining to the child health limitation file (N=32,104). The average difference is 0 with a standard deviation of .42. The high frequency of zero values partially reflects the number of children who are only observed once; they will only contribute information to the stable component of income. Values range from -3.31 which translates into a drop to approximately four percent of mean household income, to 2.14 representing an increase nearly eight and a half times greater than the average household income.

This chapter serves as a descriptive summary of the immense variability that is experienced in the lives of children, both in their own health status and in their family situations. As such, it emphasizes the importance of taking more than a single snapshot of children's health as a function of the households in which they live at any given moment in time. This is what is embodied in a life course perspective of socioeconomic inequalities in health: the ability to capture the stable and dynamic aspects of children's lives in a way that provides insight into their health trajectories as they unfold over time.

Figure 9 Distribution of deviations in logged household income from each child's logged average household income, NLSY, 1986-98 (N=32,104).



# CHAPTER 8

## STABLE AND DYNAMIC EFFECTS OF HOUSEHOLD INCOME ON CHILD HEALTH

I now turn to analysis of the longitudinal dataset to address the main research question, which is to determine whether the physical and mental health of children is associated with both the stable and the dynamic aspects of household income. I hypothesize that the stable aspect of household income, defined as the average household income over the length of time in which an age-eligible child participates in the survey, will exert strong effects on the physical and mental health of children. Specifically, the higher the average level of household income, the lower the risk of child medically attended accident or injury and child health limitation, and the lower the level of child anxiety/depression and child antisocial behaviour. Consistent with the work of others, I anticipate that this measure of long-term income will have larger effects on child health than a measure reflecting only current income (Benzeval & Judge, 2001). I also hypothesize that because child physical health conditions are less likely than emotions or behaviours to be as immediately malleable or responsive to large changes in income, the dynamic aspects of household income will have a greater effect on child mental health measures than physical health measures. I define dynamic measures of household income as the difference in household income at each point in time from its average. Since both

variables have been transformed on the logarithmic scale, this difference is actually the proportional difference (see Chapter 7 for more detailed discussion).

I employ generalized linear mixed models (GLMMs) to test the statistical significance of the effect of stable and dynamic components of household income after adjusting for control variables. To estimate the models, I chose a method implementing numerical integration which is considered superior to the more commonly used pseudo-likelihood approaches.[4] PROC NLMIXED in SAS directly maximizes an approximate integrated likelihood through numerical integration. Approximations to the integral are adaptive Gaussian quadrature, with a dual-quasi-Newton algorithm as the optimization technique (Wolfinger, 1996). One drawback of this estimation method is that I can only incorporate one level of clustering; instead of modeling observations of children over time within families, I am only able to model observations of children over time.

To improve convergence and interpretation of coefficients, I center the stable component of household income around the mean value for all children, as I do all of the child level quantitative variables (the time-varying quantitative variables are centered

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[4] Appendix I presents identical models to those described in this chapter using a pseudo-likelihood approach so that the interested reader may compare results.

around the mean for all observations). Centering changes the meaning of the intercept. Instead of referring to the average level of the response associated with having an average household income of zero logged dollars, the intercept is now interpreted as the average level of the response associated with having a logged average household income that is at the average for all children in the sample. I do not center the dynamic aspect of household income because the value zero meaningfully represents no change in income from the average household income. As a further step to facilitate convergence, I trimmed from the model those effects that had been found to be unimportant in the cross-sectional models. These include the geographic variables, which were likely so broad as to be meaningless, and the urban variable, which failed to reach statistical significance in any of the cross-sectional models.

As with the cross-sectional analysis, I subsequently test interactions of race with the stable and dynamic components of household income (presented only if the interactions are significant), and the extent to which welfare recipiency and maternal health limitation attenuate the effect of household income. I add both of these variables simultaneously because results from the cross-sectional analysis indicate that there was minimal attenuation of the relationship between household income and child health with the addition of maternal health limitation. If both welfare recipiency and logged average household income are statistically significant, one may conclude that welfare recipiency captures an aspect of disadvantage that is different from low income. If logged average household income is no longer significant after adjusting for welfare recipiency, then the

effects of economic disadvantage operate mostly at the lower end of the distribution of household income. The last task of this chapter is to determine the extent to which selective attrition from the sample distorts results.

Child Physical Health

Table 22 presents fixed effects and variance components for random effects for the generalized linear mixed models for child medically attended accident or injury. The first model includes the control variables, and the stable and dynamic aspects of household income. Many of the control variables are significant. The later a child enters the survey, the lower the odds of experiencing a medically attended accident or injury. Males are at greater risk than females, while the segmented regression line indicates increasing risk by age for children between the ages of zero and two, but no further risk for medically attended accident or injury by age after the age of two. Relative to white children, black and Hispanic children are at significantly lower risk, while children from single-parent families are at higher risk relative to two-biological-parent families. The odds of a medically attended accident or injury decrease as household size increases. The higher the level of education of the mother, the greater the odds of a medically attended accident or injury, while increasing age of mother at birth of first child translates into a marginally significant lower risk. Neither average logged household income nor the proportional differences in household income are statistically significant.

Turning to the random effects, the only significant term in the model was the variance of the random intercept. The random intercept serves as a child-specific

correction to the average predicted probability for a child medically attended accident or injury across all observations. At average levels of the explanatory variables, the overall predicted probability across all observations for a medically attended accident or injury is 8.1% [$e^{-2.43} = .088$, $e^{-2.43}/ (1 + e^{-2.43}) = .081$]. However, the variance component suggests that there is significant variation in risk from child to child. Calculating two standard deviations above and below the average log odds [$-2.43 \pm 2(\sqrt{.45}) = e^{-3.77}$ and $e^{-1.09}$] means that 95 percent of children experience an average predicted probability of medically attended accident or injury that ranges from two percent to 34 percent. Thus, even accounting for explanatory variables in the model, there is still considerable variability in risk for medically attended accident or injury among children.

The residual intra-class correlation represents the proportion of variance that is accounted for by differences among children, after controlling for explanatory variables in the model. Stated differently, it is the correlation between two randomly selected observations from a randomly selected child, controlling for the explanatory variables. For a model with a binary outcome, the intra-class correlation is as follows:

$$\rho = \sigma_u^2 / (\sigma_u^2 + \sigma_e^2)$$

where u indexes the variance for random variation at the child level, e indexes the variance for the level one random effect and $\sigma_e^2 = \pi^2/3$, which is the variance of the standard logistic distribution. Following this formula, approximately 12 percent [.45/(.45 + 3.29)] of the variation in risk for medically attended accident or injury is explained by differences among children.

Table 22 Generalized linear mixed models for child medically attended accident or injury, using PROC NLMIXED, NLSY, 1986-98 (N=32082).

| | Model 1 | | Model 2 | | Model 3 | |
|---|---|---|---|---|---|---|
| | b (s.e.) | Odds | b (s.e.) | Odds | b (s.e.) | Odds |
| **Fixed Effects** | | | | | | |
| Year entered survey | -.09 | .91 **** | -.09 | .91 **** | -.09 | .91 **** |
| | (.02) | | (.02) | | (.02) | |
| Male | .48 | 1.62 **** | .48 | 1.62 **** | .48 | 1.62 **** |
| | (.04) | | (.04) | | (.04) | |
| Age | .57 | 1.77 **** | .56 | 1.76 **** | .56 | 1.76 **** |
| | (.06) | | (.06) | | (.06) | |
| Age (older than 2) | -.57 | .56 **** | -.57 | .56 **** | -.57 | .56 **** |
| | (.06) | | (.06) | | (.06) | |
| Race (ref=white) | | | | | | |
| Black | -.81 | .44 **** | -.77 | .46 **** | -.77 | .46 **** |
| | (.06) | | (.06) | | (.06) | |
| Hispanic | -.53 | .59 **** | -.56 | .57 *** | -.56 | .57 **** |
| | (.06) | | (.06) | | (.06) | |
| Family Structure (ref=two bio parents) | | | | | | |
| Blended family | .09 | 1.09 | .07 | 1.07 | .04 | 1.04 |
| | (.07) | | (.07) | | (.07) | |
| Single parent family | .16 | 1.17 * | .18 | 1.19 ** | .16 | 1.17 * |
| | (.07) | | (.07) | | (.07) | |
| Household size | -.05 | .95 ** | -.04 | .96 * | -.05 | .95 ** |
| | (.02) | | (.02) | | (.02) | |
| Mother's education (in years) | .04 | 1.04 *** | .04 | 1.04 *** | .04 | 1.04 *** |
| | (.01) | | (.01) | | (.01) | |
| Mother's age at birth of first child | -.02 | .98 * | -.02 | .98 * | -.02 | .98 * |
| | (.01) | | (.01) | | (.01) | |
| Logged average household income | .00 | 1.00 | -.13 | .88 * | -.04 | .96 |
| | (.04) | | (.05) | | (.06) | |
| Proportion income change | -.03 | .97 | -.02 | .98 | .00 | 1.00 |
| | (.05) | | (.05) | | (.05) | |
| Interactions | | | | | | |
| Black * Logged average income | | | .33 | 1.40 **** | .35 | 1.42 **** |
| | | | (.08) | | (.08) | |
| Hispanic * Logged average income | | | .14 | 1.15 | .16 | 1.17 |
| | | | (.09) | | (.09) | |
| Welfare recipiency | | | | | .23 | 1.26 *** |
| | | | | | (.06) | |
| Maternal health limitation | | | | | .41 | 1.51 **** |
| | | | | | (.07) | |
| Intercept | -2.43 | | -2.39 | | -2.48 | |
| **Random effects** | | | | | | |
| Intercept | .45 **** | | .45 **** | | .43 **** | |
| | (.06) | | (.06) | | (.05) | |
| -2 Log Likelihood | 20394 | | 20375 | | 20322 | |

* p<.05 ** p<.01 *** p<.001 **** p<.0001

The second model in Table 22 presents the best fit after testing the interaction between race and the two components of household income. The interactions of race with the proportion of income change were not significant; the model presented only includes the significant interaction of race with logged average household income over time. A comparison of the fit of the main-effects model and the model with the interactions between race and logged average household income indicates the latter model provides a better fit (L.R. $\chi^2$=19, 2 df, p<.0001). The model suggests that higher than average levels of logged average household income decrease marginally the odds of medically attended accident or injury for white children, have no effect on Hispanic children, but increase the odds for black children. A test of the slopes of average logged household income for black and Hispanic children indicate that the slope is not significantly different from zero for Hispanic children (t=.27, p<.78), but is significantly positive for black children (t=2.86, p<.004).

A final model adds welfare recipiency and maternal health limitation. Welfare recipiency increases the odds of a medically attended accident or injury by 26%, while children whose mother has a maternal health limitation increase their odds of a medically attended accident or injury by more than 50%. Adding these terms to the model reduces to nonsignificance the effect of logged average household income for white children. However, the effect of logged average household income on black children becomes even stronger (t=4.25, p<.0001), suggesting that, after controlling for welfare recipiency and maternal health limitation, the higher the level of average household income, the higher the

odds of a medically attended accident or injury for black children. In further analysis (not shown), the attenuation of the effect of logged average household income for white children is due solely to the addition of welfare recipiency to the model, indicating that the effects of economic disadvantage for white children are contained to those at the lower end of the income distribution.

Table 23 presents generalized linear mixed models for child health limitation. Model 1 includes control variables as well as the stable and dynamic aspects of household income. Boys are more likely than girls to have a health limitation; the odds of having a health limitation increase with age. Relative to white children, black and Hispanic children are significantly less likely to have a health limitation. Children from single-parent families have a marginally increased risk relative to two-biological-parent families, while each additional family member decreases the odds of a health limitation by 6%. Each one percent increase in average household income reduces the risk of a child health limitation by nearly .28%, while proportional differences from average household income over time are not significant.

Turning to the random effects, the only significant term in the model was the variance of the random intercept. As with medically attended accident or injury, the random intercept serves as a child-specific correction to the average predicted probability for a child health limitation across all observations. At average levels of the explanatory variables, the overall predicted probability across all observations for a health limitation is 2.8% [$e^{-3.53} = .029$, $e^{-3.53}/(1 + e^{-3.53}) = .028$]. However, there is significant variation in risk

from child to child such that 95 percent of children experience an average predicted probability of a health limitation that ranges from less than one percent to 60 percent [$-3.53 \pm 2(\sqrt{3.87}) = e^{-7.46}$ and $e^{.40}$]. Thus, even accounting for explanatory variables in the model, there is immense variability in risk for a health limitation among children.

The residual intra-class correlation represents the proportion of variance that is accounted for by differences among children, after controlling for explanatory variables in the model. Using the formula given above, the residual intra-class correlation is estimated to be .54 [3.87/(3.87 + 3.29)], indicating that much of the risk for a child health limitation occurs because of child-specific factors.

A test of the interaction between race and the two components of household income reveals that only the effect of average logged household income differs by race (Model 2). The model with interactions provides a better fit ($\chi^2$=12, 2 df, p<.001) relative to the main-effects model. The model suggests that increasing levels of average household income exerts a more strongly negative effect on the odds of a health limitation for white children than for black or Hispanic children. A test of the slope of income for black and Hispanic children indicates that the slope for average household income is not significantly different from zero (t=.-50, p<.62) for black children, but that the negative slope for Hispanic children is highly significant (t=-3.28, p<.0011). In other words, the higher the average level of household income over time, the lower the odds of a child health limitation for white and Hispanic children, but not for black children.

The third model adds welfare recipiency and maternal health limitation to the

Table 23 Generalized linear mixed models for child health limitation, using PROC NLMIXED, NLSY, 1986-98 (N=32104).

| | Model 1 | | Model 2 | | Model 3 | |
|---|---|---|---|---|---|---|
| | b (s.e.) | Odds | b (s.e.) | Odds | b (s.e.) | Odds |
| **Fixed Effects** | | | | | | |
| Year entered survey | -.03 | .97 | -.03 | .97 | -.04 | .96 |
| | (.03) | | (.03) | | (.03) | |
| Male | .55 | 1.73 **** | .55 | 1.73 **** | .55 | 1.73 **** |
| | (.07) | | (.07) | | (.07) | |
| Age | .06 | 1.06 **** | .06 | 1.06 **** | .05 | 1.05 **** |
| | (.01) | | (.01) | | (.01) | |
| Race (ref=white) | | | | | | |
| Black | -.46 | .63 **** | -.40 | .67 **** | -.41 | .66 **** |
| | (.09) | | (.10) | | (.09) | |
| Hispanic | -.32 | .73 *** | -.37 | .69 *** | -.36 | .70 *** |
| | (.10) | | (.10) | | (.10) | |
| Family Structure (ref=two bio parents) | | | | | | |
| Blended family | .21 | 1.23 | .19 | 1.21 | .15 | 1.17 |
| | (.11) | | (.11) | | (.10) | |
| Single parent family | .22 | 1.25 * | .24 | 1.27 ** | .21 | 1.23 * |
| | (.09) | | (.09) | | (.09) | |
| Household size | -.06 | .94 ** | -.05 | .95 * | -.06 | .94 ** |
| | (.02) | | (.02) | | (.02) | |
| Mother's education (in years) | .03 | 1.03 | .03 | 1.03 | .03 | 1.03 |
| | (.02) | | (.02) | | (.02) | |
| Mother's age at birth of first child | .01 | 1.01 | .01 | 1.01 | .01 | 1.01 |
| | (.01) | | (.01) | | (.01) | |
| Logged average household income | -.28 | .75 **** | -.44 | .64 **** | -.33 | .71 *** |
| | (.07) | | (.09) | | (.09) | |
| Proportion income change | .05 | 1.05 | .06 | 1.06 | .09 | 1.09 |
| | (.06) | | (.06) | | (.06) | |
| Interactions | | | | | | |
| Black * Logged average income | | | .39 | 1.48 *** | .42 | 1.52 *** |
| | | | (.12) | | (.12) | |
| Hispanic * Logged average income | | | .08 | 1.08 | .11 | 1.12 |
| | | | (.14) | | (.13) | |
| Welfare recipiency | | | | | .28 | 1.33 *** |
| | | | | | (.08) | |
| Maternal health limitation | | | | | .57 | 1.77 **** |
| | | | | | (.08) | |
| Intercept | -3.53 | | -3.49 | | -3.58 | |
| **Random effects** | | | | | | |
| Intercept | 3.87 **** | | 3.86 **** | | 3.73 **** | |
| | (.21) | | (.20) | | (.20) | |
| -2 Log Likelihood | 18976 | | 18964 | | 18903 | |

* p<.05 ** p<.01 *** p<.001 **** p<.0001

previous model. Welfare recipiency increases the odds of a child health limitation by 33%, while a maternal health limitation increases the odds by 77%. Average logged household income is slightly attenuated for white children, although it is still highly significant. The effect of average household income remains just significant for Hispanic children ($t=-1.96$, $p<.05$) and continues to be nonsignificant for black children ($F=.91$, $p<.36$).

In sum, there is sufficient evidence to support the hypothesis that higher levels of average income are associated with lower risk for medically attended accident or injury and health limitation. As expected, the effect of proportional change in income was not significant. I should note that I tested a variety of nonlinear adjustments to the proportion income change variable, including a quadratic term and a piecewise segmented regression line with a knot at zero. None of these effects were significant, nor did they improve the overall fit of the model. I also tested an interaction between average household income and the proportional difference, with the supposition that income changes might have larger effects on families with a low average household income, but I did not find any statistically significant relationships.

These results also support the differential effect of household income on child health by race. The cross-sectional models suggest that it is only for white children that higher levels of household income were associated with lower risk for medically attended accident or injury in 1992 and health limitation in 1998. This differs slightly from the results discussed here. Although the risk for both physical health conditions is still negatively associated with average household income for white children, the effect of

increasing average household income for black children elevates their risk of medically attended accident or injury, but has no effect on their risk for health limitation. For Hispanic children, the effect of higher levels of average household income decreases their risk for health limitation, but has no effect on risk for medically attended accident or injury.

Finally, welfare recipiency and maternal health limitation were both significantly associated with poorer levels of child physical health. The small effect of average household income on medically attended accident or injury for white children disappears when welfare recipiency and maternal health limitation are added to the model, but strengthens the positive relationship for black children. This suggests that severe disadvantage better accounts for the relationship between household income and child health. For health limitation, the effect of average logged household income continues to be strong and direct, even after adjusting for welfare recipiency and maternal health limitation.

Child Mental Health

I now turn to the child mental health outcomes which are modeled in GLMMs assuming a Poisson distribution. Models for child anxiety/depression are displayed in Table 24. The first model describes fixed effects for control variables as well as the stable and dynamic aspects of household income, and variances for the random effects. The later the year in which the child entered or was age-eligible to participate in the survey, the significantly lower the expected value of anxiety/depression. Males exhibit lower levels of

anxiety/depression than females, while the effect of age across all observations indicates that anxiety/depression increases with age up until the age of nine, then flattens out at older ages. Black children score significantly lower on anxiety/depression than white children, while children from blended and single-parent families have higher levels of anxiety/depression relative to children from two-biological-parent families. Higher levels of maternal education are associated with lower levels of child anxiety/depression, while older age of mother at birth of first children is associated with a higher level of child anxiety/depression. The higher the average logged household income over time, the lower the level of child anxiety/depression. For example, a child from a household whose average income over time was one percent lower than the average household income increases his or her expected anxiety/depression score by approximately .19%, adjusting for other explanatory variables in the model. There is also a marginally significant effect for the proportional change in household income. At average levels of the explanatory variables, changes in income at any point during the period of observation that are higher than their average decrease levels of child anxiety/depression; conversely, income levels that are lower than their average level of household income over time increase child anxiety/depression.

Significant random effects in the model include the variance of the intercept and random coefficient for age. The quadratic term for age was entered into the random part of the model, but was dropped because it failed to reach statistical significance. Adjusted for explanatory variables, the average expected value for child anxiety/depression is 1.52

Table 24 Generalized linear mixed models for child anxiety/depression, using PROC NLMIXED, NLSY, 1986-98 (N=22474).

| | Model 1 | | Model 2 | |
|---|---|---|---|---|
| | b (s.e.) | exp | b (s.e.) | exp |
| **Fixed Effects** | | | | |
| Year entered/eligible for survey | -.11 | .90 **** | -.11 | .90 **** |
| | (.01) | | (.01) | |
| Male | -.05 | .95 ** | -.05 | .95 ** |
| | (.02) | | (.02) | |
| Age | .03 | 1.03 **** | .03 | 1.03 **** |
| | (.00) | | (.00) | |
| Age squared | -.01 | .99 **** | -.01 | .99 **** |
| | (.00) | | (.00) | |
| Race (ref=white) | | | | |
| Black | -.09 | .91 *** | -.09 | .91 *** |
| | (.02) | | (.02) | |
| Hispanic | -.03 | .97 | -.03 | .97 |
| | (.03) | | (.03) | |
| Family Structure (ref=two biological parents) | | | | |
| Blended family | .10 | 1.10 **** | .10 | 1.10 **** |
| | (.02) | | (.02) | |
| Single parent family | .07 | 1.07 ** | .06 | 1.06 ** |
| | (.02) | | (.02) | |
| Household size | .01 | 1.01 | .01 | 1.01 |
| | (.01) | | (.01) | |
| Mother's education (in years) | -.02 | .98 **** | -.02 | .98 **** |
| | (.01) | | (.00) | |
| Mother's age at birth of first child | .01 | 1.01 **** | .01 | 1.01 *** |
| | (.00) | | (.00) | |
| Logged average household income | -.19 | .83 **** | -.17 | .85 **** |
| | (.02) | | (.02) | |
| Proportion income change | -.03 | .97 * | -.02 | .98 |
| | (.01) | | (.01) | |
| Welfare recipiency | | | .05 | 1.05 ** |
| | | | (.02) | |
| Maternal health limitation | | | .07 | 1.07 ** |
| | | | (.02) | |
| Intercept | .42 | | .41 | |
| **Random effects** | | | | |
| Age | .002 **** | | .002 **** | |
| | (.000) | | (.000) | |
| Intercept | .38 **** | | .38 **** | |
| | (.01) | | (.01) | |
| -2 Log Likelihood | 74871 | | 74853 | |

* p<.05 ** p<.01 *** p<.001 **** p<.0001

across all observations ($e^{.42}$), but the random intercept suggests considerable variability across children. Controlling for other variables in the model, 95% of children have average scores ranging from .44 to 5.22 [$.42 \pm 2(\sqrt{.38}) = e^{-.81}$ and $e^{1.65}$]. The random effect for age also denotes statistically significant variability by age, such that 95% of children will have slopes that range between -.07 to .11 [$.02 \pm 2(\sqrt{.002})$]. Thus, the adjusted effect of age on child anxiety/depression can change by a factor of .93 to 1.12 depending on the child. The covariance between the random effects for intercept and age is not significant and the correlation is -.04, indicating that child anxiety/depression at the average age of the sample is unrelated to the trajectory of change with age in child anxiety/depression scores. I do not present an intra-class correlation because the correlation between randomly selected observations on a randomly selected child now depends on the age of the child.

Interactions between race and the stable and dynamic measures of household income are not significant, so I retain the main-effects model. The second model in Table 26 adds welfare recipiency and maternal health limitation to the main-effects model. Both welfare recipiency and maternal health limitation have the effect of significantly increasing levels of child anxiety/depression. The effect of average logged household income is only slightly attenuated and remains highly significant. However, the proportional change in household income is no longer significant.

Table 25 presents generalized linear mixed models for child antisocial behaviour. As with child anxiety/depression, the later the child entered or was age-eligible to participate in the survey, the lower the level of child antisocial behaviour. Male children

exhibit higher levels of antisocial behaviour relative to female children, and the expected antisocial behaviour score decreases significantly with age. Levels of antisocial behaviour are significantly higher among black children compared to white children. Relative to two-biological-parent families, children from blended and single-parent families have significantly higher levels of antisocial behaviour. There is a significant positive relationship between family size and child antisocial behaviour, while each additional year of maternal education decreases antisocial behaviour by approximately five percent.

Higher levels of average household income translate into lower levels of child antisocial behaviour, with each one percent increase in average household income reducing the expected value for child antisocial behaviour by approximately .17%. Stated in the original metric of thousands of dollars, increasing the average household income by a factor of 2.718 reduces child antisocial behaviour scores by 15%. Proportion income change is not related to child antisocial behaviour. A model testing interactions between race and average levels of household income and proportional change in household income did not improve the fit of the model, so I retain the main-effects model.

In terms of random effects, variances for the random intercept and the coefficient for age were entered into the model. Although the random slope variance fell just short of statistical significance (p=.07), I retain the term in the model because of the significant covariance between the random intercept and the random slope for age. The random intercept variance suggests that, controlling for other variables, 95% of children have average scores ranging from .21 to 3.26 [$-.19 \pm 2(\sqrt{.47}) = e^{-1.56}$ and $e^{1.18}$]. Variation in the

Table 25 Generalized linear mixed models for child antisocial behaviour, using PROC NLMIXED, NLSY, 1986-98 (N=22383).

| | Model 1 | | Model 2 | |
|---|---|---|---|---|
| | b (s.e.) | exp | b (s.e.) | exp |
| **Fixed Effects** | | | | |
| Year entered/eligible for survey | -.04 | .96 **** | -.03 | .97 ** |
| | (.01) | | (.01) | |
| Male | .21 | 1.24 **** | .21 | 1.23 **** |
| | (.02) | | (.02) | |
| Age | -.02 | .98 **** | -.02 | .98 **** |
| | (.00) | | (.00) | |
| Race (ref=white) | | | | |
| Black | .09 | 1.10 *** | .10 | 1.11 *** |
| | (.03) | | (.03) | |
| Hispanic | .00 | 1.00 | .00 | 1.00 |
| | (.03) | | (.03) | |
| Family Structure (ref=two biological parents) | | | | |
| Blended family | .14 | 1.15 **** | .12 | 1.13 **** |
| | (.03) | | (.03) | |
| Single parent family | .12 | 1.13 **** | .11 | 1.12 **** |
| | (.02) | | (.02) | |
| Household size | .03 | 1.03 **** | .03 | 1.03 **** |
| | (.01) | | (.01) | |
| Mother's education (in years) | -.05 | .95 **** | -.05 | .95 **** |
| | (.01) | | (.01) | |
| Mother's age at birth of first child | .00 | 1.00 | .00 | 1.00 |
| | (.00) | | (.00) | |
| Logged average household income | -.17 | .85 **** | -.14 | .87 **** |
| | (.02) | | (.02) | |
| Proportion income change | -.01 | .99 | -.01 | .99 |
| | (.01) | | (.01) | |
| Welfare recipiency | | | .08 | 1.08 **** |
| | | | (.02) | |
| Maternal health limitation | | | .03 | 1.03 |
| | | | (.02) | |
| Intercept | -.19 | | -.21 | |
| **Random effects** | | | | |
| Age | .0008 + | | .0008 + | |
| | (.0005) | | (.0005) | |
| Intercept | .47 **** | | .46 **** | |
| | (.01) | | (.01) | |
| -2 Log Likelihood | 64880 | | 64853 | |

+ p<.10 * p<.05 ** p<.01 *** p<.001 **** p<.0001

slope for age suggests that 95% of children will have slopes that range between -.08 to .04 [$-.02 \pm 2(\sqrt{.0008})$]. Thus, the adjusted effect of age on child antisocial behaviour can change by a factor of .92 to 1.04 depending on the child. The covariance between the random effects for intercept and age is highly significant ($\tau_{01}$=.15 with a standard error of .03, $p<.0001$), with a correlation of .21. This suggests that the trajectory of changes in child antisocial behaviour with age is positively related to that child's level of antisocial behaviour when they are at the average age of the sample.

The second model in Table 25 adds welfare recipiency and maternal health limitation to the previous model. Welfare recipiency is associated with a child antisocial behaviour score that is eight percent higher than the expected value, while maternal health limitation is not significant. The addition of these terms has almost no effect on other variables in the model, including average household income. It appears that welfare recipiency exerts an effect on child antisocial behaviour that is largely independent of household income.

In sum, the hypotheses tested for the mental health outcomes were only partially supported. Higher average household income over time is significantly associated with lower levels of child anxiety/depression and antisocial behaviour, even after adjusting for control variables, and for the effect of welfare recipiency and maternal health limitation. What failed to reach statistically significant levels was the proportional change in household income for any given point in a child's observation period. There was a marginally significant effect for child anxiety/depression, but it disappeared after adjusting

for welfare recipiency and maternal health limitation. Although I did test for nonlinear transformations of the proportional income change in household income including a quadratic term and a piecewise segmented line with a knot at zero, none of these specifications was significant. I also tested but failed to find a significant interaction between average household income and proportional change in household income. Thus, contrary to my hypothesis, I do not find evidence to suggest that changes in household income over time have a significant influence on children's mental health.

The addition of welfare recipiency and maternal health limitation did little to change the effect of average household income on child mental health. Welfare recipiency significantly increased levels of both child anxiety/depression and antisocial behaviour, but maternal health limitation was only predictive of child anxiety/depression. That the effect of welfare recipiency operates independently of household income on child mental health suggests that there is an additional effect of deprivation that is not adequately captured by measures of household income alone.

Attrition Bias

The final issue to resolve in this dissertation is the extent to which selective attrition from the survey over time biases the results of the longitudinal analyses. I undertake this analysis without the ability to resolve in a satisfactory way any biases that may arise from selective attrition, since the methods to do this in a generalized linear mixed model environment are still in progress (Foster & Bickman, 1996).

Selective attrition occurs when the characteristics of those who drop out of the

survey while they are still age-eligible are different from those who participate in all age-eligible waves of the survey. Attrition from the NLSY survey for the children in my sample was approximately 21 percent. Dropouts did differ significantly from those who stayed in the survey: they were more likely to be black or Hispanic, had parents with lower average levels of household income and were more likely to have ever received welfare, but they were also less likely to have experienced a medically attended accident or injury or to have had a health limitation.

As discussed by Foster and Bickman (1996), significant differences in characteristics between attriters and non-attriters contribute less to attrition bias when those characteristics are added as controls to the analytic models, as I have done. What must now be considered are differences that exist between the two groups of children that are not specified in the model, for they become part of the error. If attrition from the survey is correlated with unobserved causes of child health, then the resulting correlation of the error term with the regressors in the model will produce inconsistent coefficient estimates (Foster & Bickman, 1996). One way to determine whether this is indeed the case, is to take attrition status out of the error term by adding it as an indicator variable to the model. If attrition is a significant effect in the model, then attrition bias is likely a problem.

Table 26 presents final models for child physical health conditions with an added variable for attrition status. In the model for medically attended accident or injury, the effect of dropping out of the survey early is not significant, nor are there any changes in

Table 26 Effect of attrition on generalized linear mixed models for child medically attended accident or injury and health limitation, NLSY, 1986-98.

| | Medically attended accident or injury | | Health limitation | |
|---|---|---|---|---|
| | b (s.e.) | Odds | b (s.e.) | Odds |
| **Fixed Effects** | | | | |
| Year entered survey | -.09 (.02) | .91 **** | -.03 (.02) | .97 |
| Male | .47 (.04) | 1.59 **** | .54 (.07) | 1.72 **** |
| Age | .56 (.05) | 1.75 **** | .06 (.01) | 1.06 **** |
| Age (greater than 2) | -.57 (.05) | .56 **** | | |
| Race (ref=white) | | | | |
| Black | -.77 (.06) | .46 **** | -.40 (.09) | .67 **** |
| Hispanic | -.56 (.06) | .57 **** | -.36 (.10) | .70 *** |
| Family Structure (ref=two biological parents) | | | | |
| Blended family | .04 (.07) | 1.04 | .15 (.10) | 1.16 |
| Single parent family | .16 (.07) | 1.17 * | .20 (.09) | 1.22 * |
| Household size | -.05 (.02) | .95 ** | -.06 (.02) | .94 ** |
| Mother's education (in years) | .04 (.01) | 1.04 *** | .04 (.02) | 1.04 |
| Mother's age at birth of first child | -.02 (.01) | .99 * | .01 (.01) | 1.01 |
| Logged average household income | -.04 (.06) | .96 | -.32 (.09) | .72 *** |
| Proportion income change | .01 (.05) | 1.01 | .08 (.06) | 1.08 |
| Interactions | | | | |
| Black * Logged average income | .35 (.08) | 1.42 **** | .41 (.12) | 1.51 *** |
| Hispanic * Logged average income | .16 (.09) | 1.17 | .11 (.13) | 1.11 |
| Welfare recipiency | .23 (.06) | 1.26 *** | .28 (.08) | 1.33 *** |
| Maternal health limitation | .41 (.07) | 1.51 **** | .57 (.08) | 1.77 **** |
| Attrition (ref=participated in all age-eligible waves) | -.06 (.06) | .94 | .20 (.09) | 1.22 * |
| Intercept | -2.47 | | -3.61 | |
| **Random effects** | | | | |
| Intercept | .43 **** (.05) | | 3.71 **** (.20) | |
| -2 Log Likelihood | 20321 | | 18898 | |
| N | 32082 | | 32104 | |

* p<.05 ** p<.01 *** p<.001 **** p<.0001

the size of the coefficients from the previous model (Table 22, Model 3). For health limitation, the effect of leaving the survey early is marginally significant, suggesting that children who drop out are more likely to have a health limitation relative to children who participate in all age-eligible waves. Adding attrition status to the model does not markedly change the effects of other variables in the model (see Table 23, Model 3). Although the model suggests that attrition bias may exist, it does not reveal the direction nor the extent of bias. However, given that its effect is only marginally significant, it is unlikely that the amount of bias is great. Nonetheless, some caution may be warranted in interpreting models for health limitation.

Table 27 presents models for the effect of attrition status on child mental health conditions. Attrition from the survey is not significantly associated with level of child anxiety/depression, nor are the coefficients in the model substantially different from the previous model (Table 24, Model 2). Similarly, there is no significant effect of attrition on child antisocial behaviour, and the coefficients are also unchanged from the previous model (Table 25, Model 2).

The lack of a significant effect for dropping out of the survey in three of the four child health models suggests that attrition is unlikely to have produced substantial amounts of bias in the models presented in this chapter. For child health limitation, the marginally significant effect of attrition suggests there is the possibility that some bias might exist due to selective attrition from the survey, but I am unable to determine the extent or the seriousness of the problem. Therefore, some caution may be warranted in interpreting

Table 27 Effect of attrition on generalized linear mixed models for child anxiety/depression and antisocial behaviour, NLSY, 1986-98.

| | Anxiety/depression | | Antisocial behaviour | |
|---|---|---|---|---|
| | b (s.e.) | exp | b (s.e.) | exp |
| **Fixed Effects** | | | | |
| Year entered or became age eligible | -.11 (.01) | .89 **** | -.04 (.01) | .96 **** |
| Male | -.05 (.02) | .95 ** | .21 (.02) | 1.23 **** |
| Age | .03 (.00) | 1.03 **** | -.02 (.00) | .98 **** |
| Age squared | -.01 (.00) | .99 **** | | |
| Race (ref=white) | | | | |
| Black | -.09 (.02) | .91 *** | .09 (.03) | 1.09 *** |
| Hispanic | -.03 (.03) | .97 | -.01 (.03) | .99 |
| Family Structure (ref=two biological parents) | | | | |
| Blended family | .10 (.02) | 1.10 **** | .13 (.03) | 1.14 *** |
| Single parent family | .06 (.02) | 1.06 ** | .11 (.02) | 1.12 **** |
| Household size | .01 (.01) | 1.01 | .03 (.01) | 1.03 **** |
| Mother's education (in years) | -.02 (.01) | .98 **** | -.05 (.01) | .95 **** |
| Mother's age at birth of first child | .01 (.00) | 1.01 *** | .00 (.00) | 1.00 |
| Logged average household income | -.16 (.02) | .85 **** | -.14 (.02) | .87 **** |
| Proportion income change | -.02 (.01) | .98 | -.01 (.02) | .99 |
| Welfare recipiency | .05 (.02) | 1.05 ** | .09 (.02) | 1.09 **** |
| Maternal health limitation | .06 (.02) | 1.06 ** | .04 (.03) | 1.04 |
| Attrition (ref=participated in all age-eligible waves) | .02 (.02) | 1.02 | -.03 (.03) | .97 |
| Intercept | .40 | | -.21 | |
| **Random effects** | | | | |
| Age | .002 **** (.000) | | .00 + (.00) | |
| Intercept | .38 **** (.01) | | .46 **** (.01) | |
| -2 Log Likelihood | 74853 | | 64856 | |
| N | 22474 | | 22383 | |

+ p<.10 * p<.05 ** p<.01 *** p<.001 **** p<.0001

the effects from these models.

Overall, the results of the GLMMs provide strong evidence for the effect of average household income over time on the physical and mental health of children. There was less evidence to show that changes in income over a child's observation period affect their physical or mental health, with marginally significant effects only appearing for child anxiety/depression. Although the effects of average household income over time on child mental health are the same for all children regardless of race, differential effects of average household income by race occur for both medically attended accident or injury and child health limitation. For both physical health outcomes, the effect of average household income over time is more sharply negative for white children compared to black or Hispanic children. Specifically, for black children, higher levels of average household income over time increase their risk for medically attended accident or injury, but do not influence their risk for health limitation. For Hispanic children, the effect of average household income over time does not affect their risk for a medically attended accident or injury, but increasing levels of average household income do significantly reduce their risk for a health limitation.

Welfare recipiency and maternal health limitation were significant predictors for both measures of child physical health and child anxiety/depression, while only welfare recipiency was a significant predictor of child antisocial behaviour. Attenuation of the coefficients for average household income, after adjusting for welfare recipiency and maternal health limitation, occurs only for medically attended accident or injury. Once

adjusted for welfare recipiency and maternal health limitation, the relationship between average household income and medically attended accident or injury becomes even stronger for black children, indicating even greater risk with increasing levels of average household income, while for white children, the effect of average household income on medically attended accident or injury becomes nonsignificant. With the exception of medically attended accident or injury, it appears that welfare recipiency has independent effects on child well-being. As already argued, this suggests that welfare recipiency reflects an aspect of disadvantage that is not adequately captured in measures of household income alone. Given that this is found both in cross-sectional models and longitudinal models, more attention should be directed to the ways in which different aspects of parental socioeconomic position impact on child health.

# CHAPTER 9

# DISCUSSION

This dissertation extends knowledge on the effects of parental socioeconomic position on child health by examining the relationship across time. While cross-sectional studies clearly document deleterious health effects for children living in low income households, there have been relatively few longitudinal studies in this area, and there are no studies with repeated measures spanning the entire childhood period. Conducting longitudinal research on the childhood period has acquired considerable significance in health inequalities research. As researchers increasingly incorporate a life course perspective into their work, conflicting theories have emerged about the relative importance of childhood conditions for socioeconomic inequalities in health during adulthood. Yet resolving these issues is likely to be insurmountable unless researchers first understand dynamics operating within the childhood period itself. That is, it may be overly simplistic to assume that parental socioeconomic position, or even health in childhood, can be reduced into single snapshot descriptions. Awareness of the volatility of household income during childhood not only further justifies the need for longitudinal methods, but also raises interesting and important questions about the short and long-term effects of the timing and duration of economic hardship during childhood. Further, the assumption that

childhood illnesses are self-limiting and therefore unsuitable for analysis has been challenged, with the result that more researchers are calling for measures of child health that are developmentally appropriate and define more accurately the health status of children.

I specifically identified three gaps in knowledge about the relationship between parental socioeconomic position and child health over time. I treated household income over the childhood period as a trajectory, by distinguishing between its stable and dynamic components, in order to determine the relative impact of continuity and change in household income on child health. I placed as much emphasis on physical health conditions as mental health conditions in childhood, for the express purpose of demonstrating that physical health conditions in childhood are linked to parental socioeconomic position over time, and thus warrant the same careful attention paid to child mental health conditions. This position reflects a more expansive view of health than what is typically considered by child poverty researchers, whose interest in children's life chances often reflects a greater preoccupation with 'well-becoming' than well-being (Earls & Carlson, 2001). Because there are no established ways of describing variations or trajectories of child health over time, I have utilized a variety of techniques to capture patterns of stability and change in child health, and anticipate that these preliminary techniques will make a modest contribution to ongoing work into a more thorough methodology.

Addressing the above issues resulted in the formulation of three linked steps in the dissertation. First, I demonstrated the cross-sectional relationship between parental

socioeconomic position and child physical and mental health using two different waves of the NLSY. Second, I described patterns of child physical and mental health for this sample of children across the entire period of childhood. Finally, I used generalized linear mixed models to analyze the effects of stable and dynamic components of household income on child physical and mental health.

The results of this dissertation support a statistically significant relationship between parental socioeconomic position and the physical and mental health of children. This relationship was found in the cross-sectional models, although mental health measures were more consistently associated with household income than measures of physical health. There was also evidence to suggest that the effects of household income depend on the race of the child, such that increasing levels of household income improved the health of white children to a greater extent than for black or Hispanic children. In all cross-sectional models, welfare recipiency is strongly associated with child physical and mental health, and for the most part, the effects of welfare recipiency and household income operate independently. Maternal health limitation was consistently associated with child health limitation in 1992 and 1998, marginally associated with medically attended accident or injury in 1992, but unrelated to the child mental health measures. Higher levels of maternal depression, measured only in 1992, translated into higher levels of child anxiety/depression and antisocial behaviour. Although maternal depression did account for some of the relationship.between household income and child mental health, the relationship between household income and child health exhibited little change when

adjusted for maternal health limitation, suggesting it plays a minimal role in the pathways linking these variables.

Descriptive analyses of patterns of child health over the entire childhood period paint different stories for child medically attended accident or injury and child health limitation. A greater proportion of children experience a medically attended accident or injury during the course of childhood than experience a health limitation. However, multiple experiences of child health limitation are more common than multiple episodes of medically attended accident or injury, suggesting that once children have a health limitation, they are more likely to have it in the future. Obviously, what is being captured in the measure of child health limitation covers the full range of transitory, chronic and permanent conditions, with some children experiencing considerable movement in and out of these categories, and other children consistently in poorer health. The patterning of child medically attended accident or injury by age is consistent for all cohorts, with increases by age seen between zero and two years of age, and very little change with age thereafter. Child health limitation is successively higher with age.

For the mental health conditions, the relationship with age suggests higher levels of anxiety/depression with age up until 10 or 11 years, with a gradual flattening out at older ages. Child antisocial behaviour appears unrelated to age, but the average level of child antisocial behaviour decreases steadily in each year of the survey. The pattern of decreasing levels in both measures of mental health highlights the importance of including in analytic models the year in which a child began participating in the survey.

In longitudinal analyses, the stable component of household income, that is, the average household income for a given child over the period in which he or she is observed, exerts a strong influence on risk for health limitation, anxiety/depression and antisocial behaviour, and to a lesser extent, medically attended accident or injury. Moreover, longitudinal analyses confirms the differential effect of average household income on child physical health by race such that white children experience the positive effects of average household income on health to a greater extent than black or Hispanic children. Further, in virtually all models, welfare recipiency is significantly associated with lower levels of child health, and this effect, as in the cross-sectional models, appears to operate independently of household income. Interestingly, maternal health limitation was only significantly associated with child health limitation in the cross-sectional models; in the longitudinal models, maternal health limitation is related to all of the child health conditions except for child antisocial behaviour. Nonetheless, maternal health limitation appears to have little influence on the relationship between average household income and child health.

Not all hypotheses of the dissertation were supported. I had predicted that the dynamic components of household income, assessed in this analysis as the proportional change in household income from the average household income for that child over their time in the survey, would impact to a greater extent on child mental health conditions because behaviours and emotions are more malleable and thus more susceptible to short-term changes. In fact, there was only a marginally significant effect for the dynamic component of household income on child anxiety/depression, and no statistically

significant effects for the other child health outcomes.

I had also anticipated that the multi-year measure of household income would prove to have stronger effects on child health relative to a single-year measure of household income, as has been documented in other studies. While coefficients for average household income over time in the longitudinal models for both child health limitation and antisocial behaviour appeared somewhat larger than coefficients for current household income in the cross-sectional models, there was no clear and overwhelming evidence for stronger effects for the multi-year measure of household income. Thus, contrary to the findings of others, this work suggests that long-term measures of household income may not provide any additional information, or may not be more accurate, in specifying the effects of household income on child health. However, it is premature to conclude that these findings show that multi-year measures of household income are irrelevant to socioeconomic inequalities in health during childhood. Indeed, there may be other ways of conceptualizing income trajectories over time that might better portray the physical and mental health consequences of economic deprivation on children. For example, one may speculate that since the potential maximum range of household income spans a 14 year period, representing this average may be less meaningful than a measure of household income that reflects average income levels during particular periods of childhood development. Alternately, one could track the longitudinal consequences of a large drop in household income, with the idea that traumatic events may have consequences beyond their immediate future. It is these aspects of household income that are the least

understood, yet may hold the most promise.

The last task of this dissertation was to assess the extent to which selective attrition from the survey over time might distort results from the longitudinal analysis. I utilize a method discussed by Foster and Bickman (1996) which involves adding an indicator variable for attrition status to the final models. The results suggest that attrition bias is not an issue for child medically attended accident or injury, child anxiety/depression or child antisocial behaviour. A marginally significant effect for attrition status in the model for child health limitation suggest that selective attrition may bias results, but provides no further information as to the extent of the bias. For this reason, some caution in interpreting this model may be warranted.

Explaining Racial Differences in the Effect of Household Income on Child Health

As already noted, racial differences in the effect of household income on child health have been reported in the literature. These differences span a wide variety of child health outcomes including asthma, (Miller, 2000), chronic health limitation (Newacheck & Taylor, 1992; Newacheck and Halfon, 1998), activity limitation (Pamuk et al., 1998), stunting (Korenman & Miller, 1997), and emotional/behavioural problems (McLeod & Nonnemaker, 2000). It is possible that racial differences in the effect of household income on child health are not more widely reported because few studies contain sizeable numbers of children in each racial category, thereby limiting power to detect interactions between race and household income if, and where, they do exist.

Few explanations have been presented for racial differences in the effect of

household income on child health. McLeod and her colleagues (McLeod & Shanahan, 1993; McLeod & Nonnemaker, 2000) argue that racial differences are plausible because poverty is likely to be different for various racial groups, citing that black children's greater risk for persistent disadvantage and their greater likelihood of living in areas of concentrated poverty, and the greater ability of poor black families to take advantage of social resources relative to poor white families are all contributing explanations as to why low levels of household income are more health-damaging for white than for black children. These explanations imply that it is the social and structural contexts in which economic disadvantage occurs that create the intersection of race and socioeconomic differences in child health

Another avenue of exploration might be to determine if children's perceptions of their social location play a role in their own health. Do the pathways between socioeconomic position and health become forged as children make comparative assumptions about their own relative position in society, and attend to social messages that being poor is devalued and disparaged? There is some research that confirms that children do make subjective evaluations of themselves and others based on socioeconomic position, and that they do incorporate messages about the undesirability of being poor (Weinger, 1998), but it has yet to be demonstrated that these appraisals do indeed affect their health. Still, it may be worth investigating whether children of different races have unique perceptions and interpretations of their own social location that arise out of their own cultural and structural experiences. That is, what children learn about social

differences is likely to depend on other socially relevant factors, including gender and race, and it may be that these differences moderate the health effects of being economically disadvantaged. As argued at the beginning of this dissertation, it is not just the fact of disadvantage that is purported to affect health, but the meaning that is attributed to the experience of disadvantage and the context in which it occurs. Greater attention to the existence of racial differences in the effect of household income on child health and plausible explanations for such relationships are important areas for further research.

One might conjecture that lower rates of medically attended accident or injury and health limitation among poor black and Hispanic children are caused by lack of access to health care and inability to pay for medical care. If this were true, then one would expect to see the lowest rates of medically attended accident or injury for the racial group with the lowest rates of medical insurance. In fact, Hispanic children are by far the most under-insured group in the United States (Weinick, Weigers, & Cohen, 1998), yet the results of this dissertation reveal that it is poor black children who are the least likely to experience a medically attended accident or injury. Moreover, lack of health insurance is associated with higher use of emergency hospital care (Starfield, 2000), suggesting that it is not that poor children receive no care, but that lack of insurance either delays help-seeking and thus results in more serious health problems, or that care is inappropriately given in a hospital setting when a doctor's office would have been more suitable. Still, it is the case that, as adults, blacks and Hispanics are in considerably worse health. Given that blacks and Hispanics are less likely than whites to have health insurance and that uninsured

children have fewer well-child visits, and receive less routine health care and less preventive care (Starfield, 2000), it may be that a history of inadequate medical care culminates in their poorer health status as adults. However, the evidence is not compelling for explaining race differences in the effect of household income on health in childhood.

This leads more generally into the question of whether socioeconomic differences in health should be remedied through adjustments to the health care system, that is, by increasing access to health care for those who are poor. Again, the evidence is quite clear. First, socioeconomic differences in child health have been reported in countries around the world, where the mix of private and public health policies spans the entire spectrum of possibilities. Further, it is apparent that those who are economically disadvantaged make greater use of medical services than their more advantaged counterparts, a finding which has been demonstrated both in Canada (Roos & Mustard, 1997) and the United States (Pincus, 1998). Finally, in a longitudinal study of American adults, Ross and Mirowsky (2000) have shown that, controlling for initial health status, the relationship between household income and health does not attenuate when adjusted for medical coverage. Together, this evidence suggests that socioeconomic differences in health operate outside of the health care system.

Policies that directly transfer income to the poor are also unlikely to reduce socioeconomic differences in health. As the magnitude of the income effect was small, it would take an excessive amount of money to bring economically disadvantaged children to the same level of health as their middle-class counterparts. More importantly, this

dissertation has tried to emphasize the importance of understanding the context and the meaning of household income, insinuating that the effect of parental socioeconomic position on child health is more than its monetary return on health. The results of this dissertation make the point in two ways. First, it is not just the amount of household income, but the source of income that makes a difference in child health. In the longitudinal analysis, welfare recipiency exerts effects that are distinct from average household income for all child health measures, except medically attended accident or injury. Regardless of whether welfare recipiency is indexing the effects of accumulated deprivation or the stigma of belonging to a deviant social group, there is something about being a welfare recipient that creates risks to child health over and above the effect of household income, and this means that improving child health can't simply come about through giving the poor more money. Second, as argued above, evidence of race differences in the effect of household income on child health underscores the importance of understanding the context in which economic disadvantage occurs and the meaning it may have for children of different races.

While I have argued that social inequalities in health are unlikely to diminish until there is greater effort to challenge the social arrangements that differentially reward and restrict access to power and resources in society, major changes in the social ordering of society should not be the only proposed solution. Rather, more modest strategies that focus on educating individuals and enhancing their coping skills can improve the quality of their lives and provide the impetus for larger social change (Syme, 1998). Thus, learning

more about the pathways which mediate the relationship between socioeconomic position and health can be an important step towards devising attainable policies to improve the health of the population and may eventually serve to eliminate socioeconomic inequalities in health.

Limitations

While comprehensive, this study does suffer from a few limitations. Most importantly, the longitudinal statistical methods to address these research questions are undoubtedly still in the preliminary stages of development, and more refined analyses in the future could potentially alter some of the findings reported here. I attempted to overcome the methodological barriers to this analysis by using two different estimation methods to fit models. Although results do not differ substantially, and thus provide greater support for my conclusions, these findings await confirmation pending future advances in statistical methodology.

Statistical limitations also prevented me from accommodating a further level of clustering in the data, that is the clustering of children within families. Although initial models in the cross-sectional data did not reveal any bias between generalized linear models and the generalized linear mixed models, the longitudinal data collects information on each child born to the mothers of the NLSY, and as such, will yield greater clustering than what would occur in a one year sample.

A further limitation of this dissertation was the way in which I handled missing data. In both the cross-sectional and the longitudinal analysis, missing data were treated

through list-wise deletion. Missing data resulted in sample sizes that were reduced by approximately 12 to 14 percent, depending on the child health measure. Although this is not a large loss of sample size, results may be biased if information is not missing completely at random (MCAR). Subsequent work on this dataset should take advantage of the sophisticated imputation methods that are now available to handle these problems.

Measurement error is always a concern in observational studies, and all the usual caveats apply. The measures of child physical health may simply be too crude to adequately represent child health status. As already discussed, these measures are uninformative regarding the level of severity and/or impairment they entail. For example, child medically attended accident or injury treats as equivalent a skiing accident, where a child breaks a leg but fully recovers, with a traumatizing motor vehicle accident, where a child loses a leg and is disabled for life. The distinction is likely to be important because advantaged families are more likely to engage in recreational activities, including skiing, cycling, owning a pool, that increase their risk for injury. This may explain the inconsistent findings for household income and child medically attended accident or injury, both in my own work, and in the general literature (Cubbin & Smith, 2002). Similarly, a child health limitation does not indicate the severity of the condition, merely that it exists. Future measures of child physical health will require more subtle differentiation to more clearly track the relationship between parental socioeconomic position and child health.

Failure to take into account measurement error in socioeconomic position is also problematic, for unless household income is a perfect representation of socioeconomic

position, which it is not, estimates of household income and any other terms in the model that are correlated with household income will be biased (Bollen, Glanville & Stecklov, 2001). As discussed previously, researchers need to think carefully about the ways in which they assess the differential allocation of resources and power in society. Conceptual ambiguity surrounding the measurement of socioeconomic position results in inconsistent and unreliable findings, and this problem will continue until sociologists are better able to articulate theoretical concepts into empirically sound measures.

Another methodological issue is the assumption that, by simply controlling for all other variables that might be associated with a particular child health outcome, the models I have estimated represent true causal relationships. Specifically, the method of partialling out the effects of other variables to estimate causal relationships assumes that the real causes of physical and mental health problems in childhood are fully known and can be controlled for (Turner, 1997). Consequently, significant net effects cannot be offered as proof that a causal mechanism is operating. In defense of research on socioeconomic differences in health, I would argue that socioeconomic position is likely to be a fundamental cause (Link & Phelan, 1995), that is, it is likely to be a cause of causes of poor health in childhood, and therefore, any cause of child health that one might wish to include in a causal model is likely to play a mediating, or possibly a reciprocal, role.

Finally, this study only includes biological children born to a nationally representative cohort of mothers who were between the ages of 14 and 21 in 1979. Thus, it is not possible to examine the effects of parental socioeconomic position on the health of

adopted children or of children whose household contains only the biological father. The lack of adopted children in the survey may be a notable drawback because research has shown that adopted children are at higher risk for certain mental disorders (Lipman, Offord, Racine & Boyle, 1992) and it is therefore meaningful to explore how socioeconomic conditions intersect with the experience of being an adopted child.

Steps for the Future

There are several directions to pursue for researchers who are interested in elucidating the relationship between parental socioeconomic position and child health over time. First, the growing call for measures of child health that are developmentally appropriate to this unique stage in the life course must be answered. Effort must be invested into making distinctions between the relatively untroubling health conditions that children encounter as they mature, and those that are serious, debilitating and potentially life-changing. Such information would not only provide more meaningful analysis of the effects of parental socioeconomic position on child health, but would also illuminate the pathways through which child health conditions affect their own mobility as they journey into adulthood.

Secondly, the consistently significant effect of welfare recipiency in analytic models, even when adjusted for two common measures of parental socioeconomic position, namely maternal education and household income, suggests that there is an additional component of economic disadvantage reflected in welfare recipiency. I was not able to distinguish whether welfare recipiency captures the effects of severe or

accumulated deprivation, or whether the psychosocial impact of belonging to a socially stigmatized group is responsible for this effect. However, it is important to discern the reasons for what does underlie welfare recipiency as a strong predictor of child physical and mental health.

Researchers should also continue to investigate racial differences in the effect of socioeconomic position on child health, and seek more systematic explanations to account for their existence where they are found. Finally, an understanding of the mediating pathways through which household income influences child health represents an opportunity to learn more about the complex causal links in this relationship, and to develop useful and attainable policies to improve child health.

Contribution to Knowledge

By engaging the three major theoretical perspectives on socioeconomic inequalities in health, this dissertation furthers knowledge about the social distribution of health. First, by its grounding in an established tradition of research on socioeconomic inequalities in health, this dissertation is able to rely on a strong theoretical foundation with which to interpret observed effects of parental socioeconomic position on child health. A lack of theoretical clarity in other studies has created considerable confusion in discerning how the effects of parental socioeconomic position on child health could and should be interpreted. Second, this study moves beyond the limitations of cross-sectional research by utilizing longitudinal methods to track the stable and dynamic influences of parental socioeconomic position on child health. The application of sophisticated statistical analyses to the study of

outcomes which take time to develop is an important step in understanding the long-term processes underlying the relationship between socioeconomic position and health, a step that further reinforces the relevance of a life course approach to socioeconomic inequalities in health research. Third, while most studies explore the effects of parental socioeconomic position on either the physical or mental health of children, few studies examine physical and mental health simultaneously. An advantage of utilizing diverse measures of health is that researchers can distinguish between general susceptibility to the health effects of socioeconomic position and the unique causal processes involved in particular health outcomes (Aneshensel et al., 1991; Link & Phelan, 1995; Vågerö, 1991).

Conclusion

The three perspectives discussed in this dissertation represent different entry points into the field of socioeconomic inequalities in health: together, they provide the backdrop against which knowledge can progress. By establishing health inequalities as a sociological endeavour, the first perspective resonates with some of the central concerns of the discipline: theorizing the body as simultaneously biological and social (Shilling, 1993), and disentangling the intricacies of human agency and social structure (Turner, 1995; Williams, 1995, 1998). An organized explanatory framework elucidates the precise causal mechanisms underlying socioeconomic inequalities in health and allows researchers to conceptualize how these processes operate singly and in tandem with one another. Finally, a life course approach to health inequalities captures the dynamic interplay of individual lives and social contexts so that the impact of socially significant events can be tracked

over time and linked to long term processes underlying the social distribution of health.

This dissertation has shown that household income does affect child physical and mental health, despite the immense variability that occurs in both household income and child health over the childhood period. These findings, taken in conjunction with other research on socioeconomic inequalities in health research, provide further evidence that different social locations in a hierarchically organized society are intricately associated with health status, and thus renew the call for social change.

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## APPENDIX I

This Appendix contains a discussion of statistical methods for generalized linear mixed models, and an alternate set of models using a different method of estimation than what is presented in the body of the dissertation. I include these models as a means of demonstrating that results are fairly consistent between the two methods, which gives me greater confidence that the estimates I obtain are unbiased and accurate.

Methods for analyzing hierarchically clustered data for normally distributed outcomes have developed rapidly over the past decade and are now a standard feature in most statistical software packages. However, generalized linear mixed models (GLMM) for Bernoulli or Poisson distributed responses, continue to be nearly intractable for all but the most simple models (Rodriguez & Goldman, 2001). Given my own difficulties in model specification and convergence, I present in this appendix an alternate set of models using the GLIMMIX macro available in SAS.

The GLIMMIX macro uses a pseudo-likelihood approach which involves a first-order Taylor series expansion to achieve approximation. Users can specify several different methods including marginal quasi-likelihood (MQL) and penalized quasi-likelihood (PQL). The difference between the two methods is that MQL estimation expands only around the fixed predictors of the model, while PQL expands around both the fixed and random parts of the model, making it superior to MQL (Zhou, Perkins &

Hui, 1999). MQL is also less preferable to PQL for models with a binary outcome because it underestimates coefficients when random effects are large (Breslow & Clayton, 1993). However, estimation is more computationally challenging for PQL, making convergence elusive. I was able to use PQL for the mental health outcomes, but only MQL for the physical health outcomes. One major drawback of pseudo-likelihood approaches is that model comparisons cannot be conducted using log-likelihood tests because they are approximate, not exact (Snijders & Bosker, 1999).

Table A1 Generalized linear mixed models for child medically attended accident or injury, using GLIMMIX macro, NLSY, 1986-98 (N=32082).

| | Model 1 | | Model 2 | | Model 3 | |
|---|---|---|---|---|---|---|
| | b (s.e.) | Odds | b (s.e.) | Odds | b (s.e.) | Odds |
| **Fixed Effects** | | | | | | |
| Year entered survey | -.08 (.02) | .92 **** | -.08 (.02) | .92 **** | -.09 (.02) | .91 **** |
| Male | .46 (.04) | 1.58 **** | .46 (.04) | 1.58 **** | .46 (.04) | 1.58 **** |
| Age | .55 (.05) | 1.73 **** | .54 (.05) | 1.72 **** | .54 (.05) | 1.72 **** |
| Age (older than 2) | -.55 (.05) | .58 **** | -.55 (.05) | .58 **** | -.55 (.05) | .58 **** |
| Race (ref=white) | | | | | | |
| Black | -.78 (.06) | .46 **** | -1.57 (.20) | .21 **** | -1.63 (.20) | .20 **** |
| Hispanic | -.50 (.06) | .61 **** | -.88 (.23) | .42 *** | -.92 (.23) | .40 **** |
| Family Structure (ref=two bio parents) | | | | | | |
| Blended family | .08 (.07) | 1.08 | .07 (.07) | 1.07 | .04 (.07) | 1.04 |
| Single parent family | .15 (.06) | 1.16 * | .16 (.06) | 1.18 ** | .15 (.06) | 1.16 * |
| Household size | -.04 (.02) | .96 ** | -.04 (.02) | .96 * | -.05 (.02) | .95 ** |
| Mother's education (in years) | .04 (.01) | 1.04 *** | .04 (.01) | 1.04 *** | .04 (.01) | 1.04 *** |
| Mother's age at birth of first child | -.02 (.01) | .98 * | -.02 (.01) | .98 * | -.02 (.01) | .98 * |
| Logged average household income | .00 (.04) | 1.00 | -.10 (.05) | .91 * | -.01 (.05) | .99 |
| Proportion income change | -.03 (.05) | .97 | -.10 (.05) | .90 * | -.09 (.05) | .91 |
| Interactions | | | | | | |
| Black * Logged average income | | | .25 (.06) | 1.28 **** | .26 (.06) | 1.30 **** |
| Hispanic * Logged average income | | | .10 (.07) | 1.11 | .12 (.07) | 1.13 |
| Welfare recipiency | | | | | .22 (.06) | 1.24 *** |
| Maternal health limitation | | | | | .39 (.06) | 1.48 **** |
| Intercept | -2.25 | | -2.23 | | -2.32 | |
| **Random effects** | | | | | | |
| Intercept | .68 (.04) | **** | .68 (.04) | **** | .67 (.04) | **** |
| Extra-dispersion parameter | .95 | | .95 | | .95 | |
| Intra-class correlation | .17 | | .17 | | .17 | |

* p<.05 ** p<.01 *** p<.001 **** p<.0001

Table A2 Generalized linear mixed models for child health limitation, using GLIMMIX macro, NLSY, 1986-98 (N=32104).

| | Model 1 | | Model 2 | | Model 3 | |
|---|---|---|---|---|---|---|
| | b (s.e.) | Odds | b (s.e.) | Odds | b (s.e.) | Odds |
| **Fixed Effects** | | | | | | |
| Year entered survey | -.03 | .97 | -.03 | .97 | -.03 | .97 |
| | (.02) | | (.02) | | (.02) | |
| Male | .39 | 1.48 **** | .39 | 1.48 **** | .39 | 1.48 **** |
| | (.05) | | (.05) | | (.05) | |
| Age | .04 | 1.04 **** | .04 | 1.04 **** | .04 | 1.04 **** |
| | (.01) | | (.01) | | (.01) | |
| Race (ref=white) | | | | | | |
| Black | -.32 | .72 **** | -.28 | .76 **** | -.29 | .75 **** |
| | (.07) | | (.07) | | (.07) | |
| Hispanic | -.22 | .81 ** | -.25 | .78 *** | -.25 | .78 *** |
| | (.07) | | (.07) | | (.07) | |
| Family Structure (ref=two bio parents) | | | | | | |
| Blended family | .13 | 1.13 | .12 | 1.13 | .10 | 1.10 |
| | (.08) | | (.08) | | (.08) | |
| Single parent family | .16 | 1.17 * | .17 | 1.19 ** | .15 | 1.16 * |
| | (.07) | | (.07) | | (.07) | |
| Household size | -.04 | .96 ** | -.04 | .96 ** | -.05 | .95 ** |
| | (.02) | | (.02) | | (.02) | |
| Mother's education (in years) | .02 | 1.02 | .03 | 1.03 | .03 | 1.03 * |
| | (.01) | | (.01) | | (.01) | |
| Mother's age at birth of first child | .01 | 1.01 | .01 | 1.01 | .01 | 1.01 |
| | (.01) | | (.01) | | (.01) | |
| Logged average household income | -.21 | .81 **** | -.31 | .74 **** | -.23 | .79 *** |
| | (.05) | | (.07) | | (.07) | |
| Proportion income change | .04 | 1.04 | .04 | 1.04 | .06 | 1.06 |
| | (.04) | | (.04) | | (.04) | |
| Interactions | | | | | | |
| Black * Logged average income | | | .26 | 1.30 ** | .28 | 1.33 ** |
| | | | (.09) | | (.09) | |
| Hispanic * Logged average income | | | .01 | 1.01 | .04 | 1.04 |
| | | | (.10) | | (.10) | |
| Welfare recipiency | | | | | .20 | 1.21 *** |
| | | | | | (.06) | |
| Maternal health limitation | | | | | .38 | 1.46 **** |
| | | | | | (.06) | |
| Intercept | -2.61 | | -2.61 | | -2.74 | |
| **Random effects** | | | | | | |
| Age | .19 **** | | .19 **** | | .20 **** | |
| | (.01) | | (.01) | | (.01) | |
| Intercept | 1.72 **** | | 1.72 **** | | 1.70 **** | |
| | (.03) | | (.03) | | (.03) | |
| Extra-dispersion parameter | .68 | | .68 | | .69 | |

* p<.05 ** p<.01 *** p<.001 **** p<.0001

Table A3 Generalized linear mixed models for child anxiety/depression, using GLIMMIX macro, NLSY, 1986-98 (22474).

| | Model 1 | | Model 2 | |
|---|---|---|---|---|
| | b (s.e.) | exp | b (s.e.) | exp |
| **Fixed Effects** | | | | |
| Year entered/eligible for survey | -.10 | .90 **** | -.10 | .90 **** |
| | (.01) | | (.01) | |
| Male | -.05 | .95 ** | -.05 | .95 ** |
| | (.02) | | (.02) | |
| Age | .03 | 1.03 **** | .03 | 1.03 **** |
| | (.00) | | (.00) | |
| Age squared | -.01 | .99 **** | -.01 | .99 **** |
| | (.00) | | (.00) | |
| Race (ref=white) | | | | |
| Black | -.08 | .92 *** | -.09 | .91 *** |
| | (.02) | | (.02) | |
| Hispanic | -.02 | .98 | -.02 | .98 |
| | (.03) | | (.03) | |
| Family Structure (ref=two biological parents) | | | | |
| Blended family | .09 | 1.09 **** | .09 | 1.09 *** |
| | (.02) | | (.02) | |
| Single parent family | .07 | 1.07 *** | .07 | 1.07 ** |
| | (.02) | | (.02) | |
| Household size | .01 | 1.01 | .01 | 1.01 |
| | (.01) | | (.01) | |
| Mother's education (in years) | -.02 | .98 **** | -.02 | .98 **** |
| | (.01) | | (.00) | |
| Mother's age at birth of first child | .01 | 1.01 *** | .01 | 1.01 *** |
| | (.00) | | (.00) | |
| Logged average household income | -.18 | .83 **** | -.16 | .85 **** |
| | (.02) | | (.02) | |
| Proportion income change | -.02 | .98 | -.02 | .98 |
| | (.01) | | (.01) | |
| Welfare recipiency | | | .05 | 1.05 ** |
| | | | (.02) | |
| Maternal health limitation | | | .06 | 1.06 ** |
| | | | (.02) | |
| Intercept | .46 | | .44 | |
| **Random effects** | | | | |
| Age | .08 **** | | .08 **** | |
| | (.00) | | (.00) | |
| Intercept | .65 **** | | .65 **** | |
| | (.01) | | (.01) | |
| Extra-dispersion parameter | .71 | | .71 | |

* p<.05 ** p<.01 *** p<.001 **** p<.0001

Table A4 Generalized linear mixed models for child antisocial behaviour, using GLIMMIX macro, NLSY, 1986-98 (22383).

| | Model 1 | | Model 2 | |
|---|---|---|---|---|
| | b (s.e.) | exp | b (s.e.) | exp |
| **Fixed Effects** | | | | |
| Year entered/eligible for survey | -.03 | .97 ** | -.03 | .97 ** |
| | (.01) | | (.01) | |
| Male | .21 | 1.23 **** | .21 | 1.23 **** |
| | (.02) | | (.02) | |
| Age | -.02 | .98 **** | -.02 | .98 **** |
| | (.00) | | (.00) | |
| Race (ref=white) | | | | |
| Black | .10 | 1.11 *** | .10 | 1.11 *** |
| | (.03) | | (.03) | |
| Hispanic | .00 | 1.00 | .00 | 1.00 |
| | (.03) | | (.03) | |
| Family Structure (ref=two biological parents) | | | | |
| Blended family | .13 | 1.14 **** | .12 | 1.13 **** |
| | (.03) | | (.03) | |
| Single parent family | .12 | 1.13 **** | .11 | 1.12 **** |
| | (.02) | | (.02) | |
| Household size | .03 | 1.03 **** | .03 | 1.03 **** |
| | (.01) | | (.01) | |
| Mother's education (in years) | -.05 | .95 **** | -.05 | .95 **** |
| | (.01) | | (.01) | |
| Mother's age at birth of first child | .00 | 1.00 | .00 | 1.00 |
| | (.00) | | (.00) | |
| Logged average household income | -.16 | .85 **** | -.14 | .87 **** |
| | (.02) | | (.02) | |
| Proportion income change | -.01 | .99 | -.01 | .99 |
| | (.01) | | (.01) | |
| Welfare recipiency | | | .08 | 1.08 **** |
| | | | (.02) | |
| Maternal health limitation | | | .03 | 1.03 |
| | | | (.02) | |
| Intercept | -.17 | | -.18 | |
| **Random effects** | | | | |
| Age | .08 **** | | .08 **** | |
| | (.00) | | (.00) | |
| Intercept | .71 **** | | .71 **** | |
| | (.01) | | (.01) | |
| Extra-dispersion parameter | .68 | | .68 | |

* p<.05 ** p<.01 *** p<.001 **** p<.0001