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**INCOME AND HEALTH: THE TIME DIMENSION**

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**ABSTRACT**

It is widely recognised that poverty is associated with poor health even in advanced industrial societies. But most existing studies of the relationship between the availability of financial resources and health status fail to distinguish between the transient and permanent impact of poverty on health. Many studies also fail to address the possibility of reverse causation; poor health causes low income. This paper aims to address these issues by moving beyond the static perspective provided by cross-sectional analyses and focusing on the dynamic nature of people's experiences of income and health.

The specific objective is to investigate the relationship between income and health for adult participants in the British Household Panel Survey from 1991 to 1996/97. The paper pays particular attention to: the problem of health selection; the role of long term income; and, the effect of income dynamics on health.

The results confirm the general findings from the small number of longitudinal studies available in the international literature: long-term income is more important for health than current income; income levels are more significant than income change; persistent poverty is more harmful for health than occasional episodes; and, income reductions appear to have a greater effect on health than income increases. After controlling for initial health status the association between income and health is attenuated but not eliminated. This suggests that there is a causal relationship between low income and poor health.

Keywords: income; health; panel study; Britain; income dynamics; health selection

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## INTRODUCTION

It is a truism that poverty is bad for health. However, the precise links between various definitions and perceptions of financial circumstances and different measures of health status are not clearly understood. Moreover, much of the evidence about the association between income and health is based on cross-sectional data where the direction of causation cannot be known with any certainty. In addition, recent research findings make it increasingly clear that poverty is a dynamic not a static concept. Although some people face long periods of sustained financial hardship, a large number of others move in and out of poverty in various ways and for differing periods of time. Yet,

*. . . time seldom features in debates about poverty. . . . without taking time into account it is impossible fully to appreciate the nature and experience of poverty or truly understand the level of suffering involved. Equally, it is impossible to develop policies that successfully tackle the multiple causes of the problem or offer lasting solutions (Walker and Ashworth, 1994, p. 1).*

Such concerns are even more relevant to the debate about the relationship between poverty and health, as Walker and Ashworth argue:

*. . . a brief spell of poverty is not the same as a lifetime spent with resources outstripped by need and . . . neither is [it] the same as repeated bouts of poverty separated by time that may allow for some financial and emotional repair. [For example,] . . . during spells of poverty psychological well-being may well reflect a complex interplay between factors that change with time: frustrated expectations and stress caused by the need to budget on an exceptionally low income for long periods, contrasting with growing expertise in what may be relatively stable financial circumstances (1994, pp. 139; 38-9).*

Time, therefore, is a vital ingredient in any analysis of income or poverty and health.

Three key aspects of the association over time are important.

- First, establishing the temporal order of events will increase confidence about the direction of causation in a way that is not possible with data measured at one point in time.
- Secondly, there is a growing recognition of the importance of examining people's current health in light of their life-course experience (Kuh and Ben-Shlomo, 1997). This issue may be particularly important for the association between income and health because income measured at one point in time may be a poor marker for an

individual's access to material resources across their lifetime (Blundell and Preston, 1995).

- Finally, as highlighted above the contrasting experiences of poverty dynamics may have different consequences for health, which need to be explored.

The purpose of this paper, therefore, is to investigate the relationship between income and health over time for adults with respect to these three issues. Children have not been included in the analysis because the relationship in childhood is likely to be different to that in adulthood, being based on parents' income rather than the individual's own. However, a number of studies have been conducted on the consequences of income dynamics for child outcomes, including health (see, for example, Duncan *et al*, 1994; Miller & Korenman 1994; Duncan and Brooks-Gunning, 1997).

The paper begins by briefly summarising the findings from existing studies that take account of a time dimension in the relationship between income and health. It then goes on to present findings from analyses of the British Household Panel Survey (BHPS).

## **LITERATURE REVIEW**

We cannot claim to have conducted a comprehensive and systematic review of studies that investigate the relationship between income and health over time. However, we have tried to identify what appear to be significant English-language studies that might provide a scholarly context for this investigation. Sixteen studies are included in this review if they:

- focus on adult health outcomes;
- include monetary measures of income for more than one point in time;
- contain a measure of income that precedes the health outcomes.

The studies identified are based on eight different longitudinal datasets from four countries: the USA, Canada, West Germany and Sweden. Table 1 summarises the main characteristics and results of the studies. The authors and details of the survey, including the time period covered, are given in columns 1 and 2 respectively. Column 3 specifies the size and defining characteristics of the population studied. Column 4 lists the health

outcomes investigated and column 5 identifies the way in which both income levels and income change have been measured. Column 6 highlights any other confounding variables that have been included in the multivariate analyses. Column 7 explains both the statistical technique and modelling employed in the studies. Finally, column 8 describes the result of the study with respect to the income variables only.

<Insert table 1>

The surveys used for analyses of the relationship between income and health over time cover a very diverse set of populations, from a small group of women living in Berkeley in the 1930s followed until 1970 to 500,000 men registered in the Canadian Pension Plan. Most of the studies focus on specific sub-groups, in particular, men, older people, labour force participants and couples. The length of studies ranges from cross-sectional surveys with historical information on income, to a survey of families at two points in time forty years apart, to one with twenty-four consecutive years of data.

Approximately half of the study outcome measures are mortality rates. Nearly all of the remaining studies have a measure of psychosocial wellbeing, as well as variables based on subjective assessments of general health, lists of physical symptoms and activities of daily living.

Time has been incorporated into the income measures in a wide range of ways, which can be roughly grouped as: income level; income change; and, poverty experience. Ten studies include a measure of income level, with six of these being based on long-term income. Two studies include both long-term and current income, one of which also explores individual's income level measured at a number of different points in time. Ten studies include some measure of income change. Such studies are reasonably distributed between the two change measures - loss only and any change. Seven studies include measures of both income level and income change. Six studies have a measure of poverty experience, one of which attempts to assess the stability of the occurrence as well as its duration.

The most commonly employed confounders are demographic factors and prior health status. The latter is often employed as a method of controlling for the possibility of reverse causation or health selection. Other confounders include education, employment, family characteristics, living arrangements and behaviours.

The studies reviewed here employ a number of ways of controlling for health selection. First, virtually all of the studies highlight the value of using measures of income that precede the health outcomes. Secondly, many of the studies control for initial health status to take account of selection effects. Finally, a number of other studies only include in their analysis people who were in good health at the start of the survey, or stratify the sample by initial health status to identify possible selection effects.

All of the studies that include measures of income level find that it is significantly related to health outcomes. Using the various methods to control for health selection outlined above, all of the studies conclude that health selection is not a serious issue and the main direction of causation runs from income to health. There is some suggestion from the results that long term income may be more significant for health than short-run income, although one study finds little difference. In relation to income change, people whose income falls over time, in comparison to those whose income remains stable or increases, have poorer health outcomes. Income loss appears to have a much stronger effect on health than increases in income. In the majority of studies that contain both income level and income change variables, the former appears to be more significant. Finally, persistent poverty appears to be most damaging for health. Those people who are persistently poor, in comparison to those who experience poverty only occasionally or not at all, have the worst health outcomes.

## **DATA ANALYSIS**

The data analysis presented in this paper has two main aims. First, to investigate the effect on the association between income and health of including a time dimension. Much of the evidence about the relationship between income and health is based on cross-sectional analyses (Benzeval *et al.*, 2000a). Although such studies show a strong

negative correlation between increasing income and poor health, it is impossible to know in which direction the causation runs, i.e. does low income result in poor health, or poor health reduce an individual's earning ability and hence their income? Moreover, income measured at one point in time may be a poor reflection of the material resources available to the individual. The first part of the data analysis section, therefore, investigates the effect of including initial health and income over time on the cross-sectional association between income and health.

The second aim of the data analysis is to explore whether the broad pattern of findings, outlined above, about the relationship between income dynamics and health hold true for a British dataset in the 1990s. In particular, three key questions are considered:

- Is long term income more important for health than income measured at one point in time?
- Are persistent episodes of poverty more harmful than occasional ones?
- What is the effect of income change on health after controlling for income level?

This section begins by briefly describing the dataset. It assesses its representativeness and provides some information on the measures of health and income employed in the analysis. Next, it outlines the methods adopted to investigate the research questions identified above. Finally, it summarises the results of the multivariate models of income and health over time.

### **BHPS dataset**

The BHPS was begun in 1991 and this paper is based on information for the first six waves of the survey (1991-96/7). The initial sample was designed as a nationally representative sample of the population of Great Britain living in private households and covered approximately 5,000 households and 10,000 adults. The sample was based on a two-stage stratified clustered design. In the first stage, 250 postcode sectors were selected from an implicitly stratified listing of the small user Postcode Address File. The postcode sectors were stratified by region and socio-demographic data from the 1981 Census, and specific sectors were chosen on the basis of a probability selection proportionate to the size of the postcode sector. In the second stage, delivery points –

addresses – were sampled from the postcode sectors using an analogous systematic procedure. Up to three households were selected to participate in the sample (using random probability sampling if more than three households were resident at the address). All adults in the household are interviewed. For a fuller description of the sampling strategy see the BHPS user manual (Taylor, 1998).

Strenuous efforts have been made to follow up all of the initial members of the panel over time. In addition, new people who join panel households, for example new partners, babies, lodgers, are also included in the study. However, for most research purposes, including this paper, it is only the individuals who respond to all waves who are of interest. Sample attrition is therefore a considerable concern for the study. The survey has achieved year-on-year response rates of approximately 95 per cent. However, by Wave 6 only 72 per cent of those who gave full interviews in the first wave were included in the follow up. This paper is further complicated by the need to have complete income information for all adult respondents in each household to calculate a family income variable. With this selection criterion, only 5281 initial adult respondents had complete information for themselves and their household for each year.

The initial 1991 sample was under-represented in comparison to the Census in terms of households in rented tenures, with more than six people and without access to a car. Young adults and children were slightly over-represented and older people under. Post stratification weights successfully adjust for these problems. (Taylor, 1994). Attrition since the first wave has tended to occur among specific groups of the population, including those living in inner city conurbations, less affluent households, younger people particularly men, members of ethnic minority groups and the highly mobile. Longitudinal weights have been calculated based on the previous characteristics of those lost to the survey to correct for these biases (Taylor, 1994; 1998), and are employed in this paper.

### *Health questions*

The BHPS contains four sets of health questions that cover a range of different dimensions of health, including measures of both physical and mental health problems, psychological wellbeing (GHQ), limiting illness and subjective assessments of general



health. For the purpose of this analysis, each health question has been used to create a binary dependent variable, as shown in Box 1.

<Insert box 1>

In Wave 6 approximately one-third of the sample experience a higher than average number of health problems. A similar proportion assess their general health as being only fair, poor or very poor. Just over one-quarter of respondents have a GHQ score of 3 or more. Eighteen per cent of people report an illness that limits their daily activities.

The extent of change in health across the six years varies with the outcome considered. For example, just over two-thirds of respondents do not have a limiting illness throughout the six years, while the same is true for only just over forty per cent of respondents for poor subjective assessments of health and high GHQ scores. Despite this, only a small proportion of respondents is in poor health for every year of the survey. Again, this varies with the health outcome considered. Almost double the proportion of respondents are continually in poor health based on the experience of health problems than for the measure of limiting illness, and very few respondents have poor psychological health for all six years.

#### *Measuring income and poverty dynamics*

The BHPS collects income information from all sources - employment, benefits, pensions, investment and savings, maintenance payments - for all adults in the household. Unfortunately, the BHPS does not collect sufficient information on taxation to facilitate the calculation of an accurate measure of net income from the public dataset (Webb, 1995). It only asks employees about their net income for their main occupation. It does not collect information on the tax paid for second jobs nor for people who are self-employed or pensioners. In addition, information is not collected on local taxation. However, Jarvis and Jenkins (1995) have used tax and benefit simulation models to estimate net family income more accurately than one is able to do using the basic public dataset. Their measure of net family income has been deposited at the Data Archive and is used in this analysis (Jarvis and Jenkins, 1998).

Two adjustments have been made to this measure of net family income in order to create an indicator of comparable living standards for the respondents. First, given that the survey information was collected over six years, the income data are deflated by the retail price index to adjust for inflation (January 1996 = 100). Secondly, the income data are equivalised - using the McClements scale - to take account of differences in the size and composition of families.

In conducting these analyses we have been acutely conscious of the relatively short length of the panel and we have therefore wanted to maximise our use of the available data. However, in investigating the association between income levels and health, we felt it was inappropriate to link income and health in the same year. We have therefore employed income measures that precede our health outcomes. For example, we investigate the association between average income from waves 1 to 5 and health in wave 6. This helps to ensure that the association is not the result of health selection. However, the same problem does not apply when looking at changes in income over the time. For our measures of income change therefore we felt that we could exploit all six years of the data.

Following on from this, we used the measure of real net equivalent family income to create three types of income dynamics variables: income levels, poverty experience, and income change, as described below.

First, annual income data are calculated for each year of the survey. In addition, five-year (waves 1 to 5) average income has been calculated. From these measures variables are derived that identify in which quintile (fifth) of the income distribution people are located, in each specified time period.

The second set of income measures assesses people's experience of poverty over the first five years of the survey. Three distinct variables are employed. Two of these simply measure the duration of individual's poverty experience in terms of:

- the number of years that the respondent's family income has been less than half of the average for each specific year.
- the number of years that the respondent's family income has been in the bottom fifth of the income distribution.

The final measure attempts to combine information on poverty duration with some consideration of the stability of the experience, following the concept devised by McDonough and colleagues (1997). The variable devised for this analysis has five categories:

- 3 or more years in the bottom two income quintiles and no years in the top two income quintiles;
- 1-2 years in the bottom two income quintiles and no years in the top two quintiles;
- income in the middle quintile or a mixture of poor and affluent years (i.e. the residual category);
- 1-2 years in the top two income quintiles and no years in the bottom two-fifths of the income distribution;
- 3 or more years in the top two income quintiles and no years in bottom two quintiles.

The final set of variables derived from net family income assesses the extent of income change over the six years of the survey. A variety of measures from the literature were tested, but as a reasonably consistent pattern emerged only three are presented here.

- The simple monetary difference between income in Wave 6 and in Wave 1.
- Following Elder and Liker (1982) we constructed dummy variables which identified those people with large increases and decreases in income (> 30 per cent) across the six years, with the reference category being those who do not experience such large changes in their income.
- Income volatility measured by the standard deviation of each respondent's family income across the six years of the survey.

Analysis of the BHPS suggests that there is quite considerable income dynamics over the six-year period. For example, in any specific year approximately 16.5 per cent of the sample experience poverty (defined as having less than half of average income).

However, over the course of the six years of the survey, 37 per cent have experienced at least one year of poverty, while only 3 per cent are poor for all six years. Thus while

persistent poverty affects only a small minority of the population, a large proportion experience poverty during a relative short period of time.

## **Methods**

In order to explore the association between income and health in detail while controlling for other factors, multivariate analysis is employed. Since all of the health outcome measures are binary i.e. take the value 0 or 1, the most appropriate statistical technique is logistic regression (Hosmer and Lemeshow, 1989). The analysis has been conducted in STATA in order to adjust for the multistage sampling design of the BHPS. Survey estimation techniques are employed that take into account the clustering and stratification of the sample selection methods and the longitudinal probability selection and attrition weightings. This methodology also takes account of the non-independence of individual observations as a result of the analysis containing more than one adult from each household. These methods ensure that the point estimates are unbiased and that the standard errors are not inflated (Stata Press, 1997). Individual independent variables are considered statistically significant if their t-statistic is significant at the 10 per cent level. The overall significance of the model and groups of explanatory factors are assessed using the adjusted Wald F-statistic, which takes account of the sample design, and can be compared to the F-distribution with  $k$ ,  $N-k$  degrees of freedom (where  $k$  is the number of independent variables and  $N$  the number of observations).

Relatively simple models of the association between income and health have been constructed for this paper, which only control for age and sex. We recognise that the literature reviewed above also includes a wide range of other confounders. However, many of these ‘confounders’ are actually joint determinants of income and health, such as education and employment. Simply adding a range of such variables to models of income and health is likely to obscure rather than clarify the relationship (Benzeval *et al.*, 2000a). It is obviously important to explore these complex inter-relations, but this need to be done in detail within an appropriate theoretical framework (Benzeval *et al.* 2000b). In this paper, however, we wish to undertake a careful exploration of the direct relationship between income and health, and hence have only controlled for relatively straightforward confounders such as age and sex.

*Introducing a time dimension to the relationship between income and health*

The starting point for this part of the analysis is the traditional cross-sectional association between income and health, controlling for age and sex. Prior health status and income over time have then been added to these models to assess their effect on the cross-sectional association. At each stage the Wald F-statistic and odds ratios for current income are compared to develop a better understanding of the effect of past income and health on the current association.

*Replicating international findings*

Based on the literature reviewed in the first part of this paper, we identified three key questions to investigate using the BHPS data.

- *is long term income more important than income measured at one point in time?*

Models are developed for each health outcome with income measured at four points in time - current year (t), previous year (t-1), initial year (t-6) and the average over the first five years - controlling for age, sex and initial health status. The relative importance for contemporary health of each income measure is assessed by comparing the joint significance of each set of quintiles and the pattern of the odds ratios.

- *are persistent periods of poverty more harmful for health than occasional ones?*

The effect of poverty duration on health is investigated by adding the three measures of poverty experience described above to models containing age, sex, and initial health. The joint significance of the odds ratios for the poverty variables is assessed using the Wald F-statistic.

- *what is the effect of income change on health after controlling for income level?*

Finally, the analysis assesses the effect of income change on health over and above an individual's income level. It begins with a base model containing age, sex and initial health and initial income and then the three measures of income change described above are added. The significance and direction of the association of each of the measures of

income change is assessed and the Wald F-statistics associated with initial income and income change are compared to see which appears more important.

## Results

### *Multivariate models: introducing a time dimension to the cross-sectional relationship*

Table 2 shows the effect on the cross-sectional association between income and health of adding first prior health status and then income over time, for each of the four outcome measures. Column 1 shows the odds ratio for current income quintiles, having controlled for age and sex. An odds ratio indicates how much more likely a person in each of the income categories is to report poor health than someone in the reference category - in this case the top income quintile. For example, people in the bottom twenty per cent of the income distribution are about 2.4 times as likely to report poor subjective health or a limiting illness and 1.5 times as likely to report a high GHQ score or above average health problems as those in the top fifth. The association between income and health seems to be steepest and most significant for subjective health assessments and limiting illness.

Given the emphasis in the literature on the existence of a stepwise gradient between socioeconomic status and health (Macintyre, 1997), it is worth noting here the non-linear association we find between income and health. Although all of the other income quintiles have poorer health than the richest fifth, there is a particularly big increase in the odds of reporting poor health among the those in the bottom 40 per cent of the income distribution. This suggests that there is not a smooth linear relationship between income and health, but a non-linear one, which is steepest among low-income groups. This finding is consistent with a number of other studies (Backlund *et al.*, 1996; Mirowsky and Hu, 1996; Benzeval *et al.*, 2000a; Der *et al.* 2000).

<insert table 2>

Column 2 shows the effect of adding initial health status to the models. The odds ratios for initial health are large and significant, ranging from approximately 3.2 for GHQ to 10.5 for limiting illness. Adding initial income results in a substantial increase in the overall significance of the models for all of the health measures. At the same time, the

odds ratios for current income are reduced – on average by 14 per cent –but, in general, remain statistically significant. This suggests that while health selection effects account for a small part of the cross-sectional association between income and health, the main direction of causation runs from income to health.

Column 3 shows the effect on the cross-sectional association between current income and health of adding five-year average income to the models, controlling for age, sex, and initial health. For subjective assessments of general health and limiting longstanding illness, average income is statistically significant and its inclusion in the models makes current income insignificant. For health problems, both measures of income are significant, while for GHQ only current income is significant. However, it is important to remember that current and average income are closely related and are likely to be determined by the same factors, which makes it difficult to assess their independence in the same model.

#### *Replicating the international findings*

The second set of analyses explores the relevance of the findings from the international literature for Britain in the 1990s.

First, Table 3 compares the relative importance of income measured at four different points in time – current year, previous year, initial year and the five-year average. The results in column 1 are identical to those in column 2 of table 2 and are reproduced here to facilitate comparison between the income measures.

<insert table 3>

For subjective assessments of health and limiting illness, the steepest and most significant association is with five-year average income. This suggests that cross-sectional studies, which do not include a time dimension, may under-estimate the relationship between income and health. For both health measures, no matter when income is measured, people at the bottom of the distribution are 2-2.5 times as likely to report poor health as those in the top 20 per cent. For GHQ, current income is the only

significant variable, while for health problems there is little difference in the association with health between the income variables measured at different points in time.

The second finding from the literature explored here is the effect of poverty experience on health. Table 4 shows that having controlled for age, sex and initial health, poverty duration between waves 1 and 5 is significantly associated with health, for all of the health outcome measures except GHQ. The results show that people who experience persistent poverty have the worst health. There is a steady reduction in the risk of ill health as the duration of poverty decreases. The poverty measure based on the number of years people spend in the bottom 20 per cent of the distribution appears to be more strongly associated with health than the one based on the experience of having less than half of average income.

<insert table 4>

We also created a measure of poverty stability, as described above, which is significantly associated with all health outcomes, as shown in Table 5. As with the measures of poverty duration and income levels, there is a stronger association between poverty stability and subjective assessments of health and limiting illness than for the other health outcomes.

<insert table 5>

Finally, we explored the relationship between income change and health. Table 6 shows Wald F-statistic for initial income and the income change measures in models that also contain age, sex, and initial health. Having controlled for these factors there is a significant negative association between the linear measure of income change and poor health, for subjective assessments of health and limiting illness. This suggests that the greater the increase in income over the six years the less likely an individual is to report poor health controlling for their starting health and income level. However, with the exception of GHQ, where none of the income measures are significant, initial income appears to be much more strongly associated with health than income change.



In addition for the subjective assessment of health and limiting illness models, there also appears to be a negative association between the measure of income volatility and the probability of reporting poor health. This implies that the greater the amount of income change across the six years, the less likely an individual is to assess their health as poor. Although strictly speaking this measure of volatility is independent of the direction of change, there is a strong positive correlation between the standard deviation and large increases in income, which may explain this association. Nevertheless this is an interesting finding and requires further exploration when more years of data become available.

The continuous measure of income change described above assumes a linear relationship with health. However, since there is no *a priori* reason for such an assumption, we also tested a number of non-linear measures. The results are illustrated in Table 6 for a measure that identifies those respondents who had large increases or decreases in their income over the six year period (>30 per cent). Again the initial income variables appear more significant than those measuring income change. However, large falls in income are significantly associated with reporting poor health, but there is not a significant association between large increases in income and improvements in health. This result is consistent with the international literature, but clearly requires further investigation.

<insert table 6>

## **DISCUSSION**

The analysis of the BHPS supports the general findings in the international literature on income dynamics and health. Namely, that:

- average income appears more significant for health than current income;
- persistent poverty has a greater health risk than occasional episodes of poverty;
- income level and income change are both significantly associated with health although income level appears more important;
- falls in income appear more important for health than increases.

However, these results are much stronger for two of the health outcomes – subjective assessments of health and limiting illness - than for the others – GHQ and health problems. In addition, the BHPS analysis shows the strong association between initial health status and final health outcomes.

The strength of the association between income and limiting illness and subjective assessments of health is not surprising and reflects the results of a number of British studies of the cross-sectional association between income and health (Blaxter, 1990; Power *et al.* 1990; Benzeval *et al.*, 1999; Ecob and Davey Smith, 1999; Der *et al.* 2000). However, the results for GHQ and health problems are more unexpected. This may be a result of the way that the underlying questions, which produce count data, have been dichotomised here, and further work is required to investigate this. However, the weaker association with these health measures may also be consistent with other studies in the literature.

In general, although measures of psychosocial health appear to be related to access material and social resources (Power *et al.* 1990; Weich and Lewis, 1998a; Ecob and Davey Smith, 1999), this has not been a consistent finding, particularly in relation to minor psychiatric disorders (Stansfeld and Marmot, 1992). For example, Weich and Lewis (1998b), using GHQ-12 in the BHPS, found that financial strain and unemployment are associated with the maintenance but not onset of episodes of common mental disorder and even for this the longitudinal association is much weaker than the cross-sectional one. Stansfeld and Marmot (1992) suggest that the weaker socioeconomic association with minor psychiatric disorders might be a result of differential reporting. As part of the Whitehall Study of civil servant's health, they compared results from the GHQ-30 with clinical assessment of respondents. They found that individuals in lower employment grades consistently under-report psychiatric disorders with the GHQ relative to those in higher grades.

The health problems variable is based on a list of physical and mental health symptoms. It includes some items that the literature suggests should be associated with socioeconomic status (e.g. breathing problems), and others that are not (e.g. migraines). Overall, this variable is more highly associated with old age than the other measures.

For example, 63 per cent of people aged over 75 years experience above average health problems, while only 44 per cent report their subjective health as poor; 36 per cent have a limiting illness and 28 per cent have a high GHQ score. A range of other studies have shown that while there is a significant association between income and health at older ages, it is much weaker than that for people under retirement age (Benzeval *et al.* 1999; McDonough *et al.* 1997; Ecob and Davey Smith, 1999). A number of suggestions have been put forward to explain this phenomena. These include:

- the healthy survivor effect, i.e. the poorest and unhealthiest members of the population will die prematurely so that only healthier people reach old age;
- recent measures of income may less accurately reflect access to material resources in old age than at other periods of life, because this will be dependent on a lifetime of accumulation of wealth and assets.

Such explanations may explain the weaker association between income and reporting health problems. However, further work is required to explore the relationship between income and these two health measures in more detail for particular sub-groups of the population.

More generally, the results described above shed further light on the three key aspects of the relationship between income and health over time highlighted in the introduction:

- the direction of causation – health selection effects;
- the role of life course in determining health inequalities;
- income dynamics.

### **Health selection**

Given the various approaches described in the literature for controlling for health status, two were adopted in this paper. First, the analysis is based on income measures that precede the health outcomes of interest. Secondly, initial health status is included in all of the models. While this is the single most powerful predictor of final health outcomes, a persistent association between income and health remains. In addition, the inclusion of initial health in the models only reduces the odds ratios on the income variables by approximately 14 per cent. This implies that health selection only accounts for a small

part of the association between income and health. This is consistent with findings from studies in the literature which employ this technique (e.g. Lundberg and Fritzell, 1994; McDonough *et al.*, 1997). Moreover, as McDonough and colleagues (1997) point out adopting this approach to control for health selection may over adjust for the problem because it takes no account of the role of low income in determining initial health status. Taking all of these factors into account, therefore, these results provide convincing evidence that income and health are causally related.

These findings are consistent with the literature, where all of the studies conclude that the main direction of causation runs from income to health. This is true across the whole range of methods of controlling for health selection. For example, Elder and Liker (1982) conclude that ‘the long-term framework of this study [40 years] and the particular change variable, based on loss of the husband’s income, help to clarify the causal direction of influences that link Depression hardship to women’s health in old age’ (p. 249). Menchik (1983), having stratified by initial health state, reports ‘that even *within* health classes, mortality risks are lower for more affluent men; therefore, the economic status/mortality link appears to be causal’ (p. 434). Similarly Lynch and colleagues (1997) who only examine people in good health at the start of the survey, conclude that their findings show ‘very little evidence that reverse causation could explain the overall magnitude and pattern of the findings’ (p.1894).

Moreover, three of the studies investigate health selection directly by examining the effect of changes in health on changes in income. They all conclude that health selection is not a serious problem (Hirde *et al.*, 1986; Wolfson *et al.*, 1993; Thiede and Traub, 1997). ). For example, Hirde and colleagues (1986) show that while income changes over time are significant predictors of subsequent perceived health, initial perceived health is not a significant predictor of income changes. While Thiede and Traub (1997) conclude that ‘income changes certainly induce influences on health variables associated with functional status, whereas health status has little explanatory value as a determinant of income changes’ (p.876).

### **A life-course perspective**

The significance of initial health status and the greater importance of average income, at least for some of the health measures, reinforces the role of factors across the life course as determinants of health inequalities. For example, the significance of initial health could be seen a marker for individuals' cumulative socioeconomic life experiences up to that point, rather than an indication that health selection plays a role in the association between income and health. Five-year average income may be a much better marker for an individual's lifetime access to material resources, both past and future, than income measured at one point in time.

Elsewhere we have developed a conceptual framework for investigating the relationship between income and health in the BHPS within a lifecourse perspective. This shows the significance of measures of income potential (using education as a marker) and health capital at the start of the survey, as well as recent income, for final health (Benzeval *et al.*, 2000b). However, a panel dataset of six years only allows a small portion of an individual's life course to be investigated. So we have linked this work with analyses of the National Child Development Survey which have shown the independent significance of income both in childhood and in adulthood for adult health (Benzeval *et al.* 2000b). Moreover, this work highlights the importance of considering the role of childhood income in jointly determining adult income and health. One important implication is that the complex and inter-related development of health and income require further investigation to enable clear policies to be developed.

### **Income dynamics**

Income change, over and above income levels, plays a significant, if minor role, in determining adult health. What is surprising is that this association seems to be driven by falls in income harming health, rather than short term rises in income promoting health. Although this finding is consistent with the international literature, it is important to consider a number of caveats when thinking about the implications of these results. First, Jenkins (1999) has questioned the quality of some of the income data in the BHPS. In particular, he points to a significant number of implausible benefit increases that cannot be explained by changes in the

respondent's circumstances. The quality of the data therefore must urge caution in interpreting the results.

Secondly, the analysis is based on relatively short run changes in income.

Individuals may be able to maintain their living standards by drawing on savings or building up debts in periods of low income. As income increases they may pay off debts or build up reserves of savings rather than change their immediate standards of living. Moreover, this analysis has not taken into account the possibility of time lags between income change and consequent changes in health. The differential results for income increases and falls may be explicable by the operation of different kinds of time lags. Further work is required with longer runs of panel data to explore the effect of income dynamics on health in more detail.

In addition, one needs to consider the reason for the change in income and its timing (Duncan, 1996). For example, a predictable income change because of the birth of a child or retirement may be less harmful for health than a sudden and unpredictable loss of income associated with separation or unemployment, which in themselves may also be health damaging. Income instability or intense spells of poverty may be particularly damaging for children during their development; in adulthood they may be especially harmful for psychosocial health. Further work is required which explores both the quality of the income data in the BHPS and the nature and cause of the income change in more detail.

## **CONCLUSION**

Evidence from a recent British panel study supports the general findings in the literature that long run income and persistent poverty are key determinants of health, and that short term falls in income can have a detrimental effect on health. These findings suggest that two sets of policies need to be considered.

First, policies need to focus on reducing the risk of persistent poverty. In the long run, strategies to promote education and create work opportunities for people may be the most appropriate response. However, governments must not neglect the needs of those

adults currently experiencing poverty for whom the education route is too late, and the task of finding well-paid work difficult or problematic. For such people benefit levels need to provide an adequate standard of living.

Secondly, however, policies need to be devised that protect people from sudden drops in their income and/or ameliorate the health damaging effects that such events might have. Strategies in this area need to address the effects on income and health of transition from employment into unemployment or retirement, divorce and separation and becoming a parent. For all of these transitions the relationships between social change, income and health is likely to be very different for men and women, and this gender dimension needs to be explored further.

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**Table 1**      **Income and health: the time dimension**

Authors	Location	Sample	Outcome Measure	Income Measure	Confounders	Method	Results
Elder & Liker (1982)	Berkeley Guidance Study 1930-70	81 women born in 1890-1910	Psychosocial health at age 60-80	Dummy variable: husband's income loss between 1929 and 1933 greater than 30%	psychosocial health in 1930 Hollingshead index of SES in 1929	LISREL model to assess effects of income loss in two stratas: middle and working class	For middle class women, income loss in 1930s had a significant and positive effect on their health in 1970. For working class women the effect on health was negative but not significant
Elder <i>et al.</i> (1984)	Berkeley Guidance Study 1928-1945	211 families: parents born 1890-1910; children born 1928/30	Average score on 7 point scale of emotional stability 1933-35 1936-38 1939-45	Income loss- % difference between family income in 1929 & lowest income 1933 to 1934-35	initial emotional stability score 1930 marital support SES	LISREL	For all men effect of income loss weak (only significant in 1st time period), initial health and marital support are much more important. <i>'However, heavy income loss entailed very substantial health costs for initially unstable men, but not for unstable women'</i> p191. For initially stable women, there was a significant improvement in their health as a result of heavy income loss.
Hirdes <i>et al.</i> 1986	Ontario LS Aging, 1959-78	2000 men in labour force aged 45 in 1959, only 52% left in sample in 1978	1. Cross-sections subjective general health and subjective assessment of health change in last year 2. Panel a) good health in 1969 if good in 1959 b) good health in 1973 if good in 1969	1. Cross-sections 3 category variable individual income level; subjective assessment of income change over last year 2. Panel a) 59 individual income level change real individual income 59-69 b) ratio of 73/69 real individual Y		1. Cross-sections logistic regression both outcome variables, against income level, subj. income change and interaction 2. Panel a) logistic regression remain in good in relation to 59 income level & 59-69 income level b) logistic regression remain in good health against ratio of 73 to 69 real Y	1. Cross-sections Both income level and income change significant, interaction not significant 2. Panel a) prob remain in good health 59/69 related to 59 income level and income change b) income ratio significant predictor of remaining in good health 73/69 <i>'loss of income was strongly associated with a perceived loss of health and a weaker relationship was observed between an increased income and better health'</i> p201

**Table 1** Income and health: the time dimension (cont'd)

Authors	Location	Sample	Outcome Measure	Income Measure	Confounders	Method	Results
Hirdes & Forbes (1989)	Ontario LS Ageing, 1959 - 78, Canada	2000 men in labour force aged 45 in 1959, only 52% left in sample in 1978	Mortality by 1978	1969 individual income level - categorical (low medium high) individual income category change 59-69	education smoking subjective assessment of health, 1969	Logistic regression for people with good or excellent health in 1959	1969 income level significant (if exclude current health) but not income change
Kaplan & Haan (1989)	Alameda County Study, 1965-1983	7,000 people aged over 50 in 1965; 120,000 person years of follow-up  CHECK WAS IT LIMITED TO 59+	9 yr mortality (1974-83)	<ul style="list-style-type: none"> <li>Income fall of \$10,000 1965 – 74</li> <li>Income level 1965</li> </ul>	Age Sex Baseline health	Cox proportional hazards	<ul style="list-style-type: none"> <li>Income fall was significantly associated with mortality after controlling for baseline health and income.</li> <li>Income level was not significant</li> </ul> <i>'dynamics of socioeconomic position are more strongly related to risk of death in older persons than are single point estimates of socioeconomic position'</i> p.42
Tåhlin (1989)	Swedish Level of Living Survey, 1981, linked to tax records for income 1978-81?	2588 wage earners aged 25-64 who work for more than 18 hrs	factor analysis of list of illnesses to create three dimensions: only 2 relevant here; cardiovascular disease; mental health capacity	<ul style="list-style-type: none"> <li>Net adj. current family income</li> <li>Relative income (social) - difference in income from average for reference group</li> <li>Income change from aver income previous 3 years</li> </ul>	<i>economic</i> cash margin vacations <i>exogenous</i> age sex education <i>endogenous</i> working conditions wage level	LISREL structural equation models 1. net adj. income 2. social income and income change Aim to assess whether income level or relative income more important	<ul style="list-style-type: none"> <li>Net family income and social income both mental health and CHD;</li> <li>Income only significant for CHD</li> <li>Models with social &amp; income change fit better than income level</li> </ul> <i>'influence of economic resources on the state of health ... predominantly seems to be connected with relative income'</i> p. 126

**Table 1** Income and health: the time dimension (cont'd)

Authors	Location	Sample	Outcome Measure	Income Measure	Confounders	Method	Results
Zick & Smith (1991)	PSID 1968-84, USA	2,000 h/h & wives (all those who die plus quarter of rest appropriate sample converted into person year file	Mortality btwn 71 and 84	Dummy variable: ever poor between t-3 and t-1 (family income need ratio < 1)	<i>time invariant</i> race education <i>time varying</i> age, age <sup>2</sup> employment status t-2 marital status t-1 marital change t-2, t-1	Discrete time event history methods: logistic regression models die in year t or not ,separately for men and women	<i>'One or more spells of poverty between t-3 and t-1 significantly increases the hazard of dying for both sexes. However, the effects are somewhat stronger for women than for men' p.332</i>
Mullis (1992)	NLS Mature males 1966-81 USA	men aged 55 -69 in 1976	Psychological wellbeing (happiness with(six dimensions of life)	<ul style="list-style-type: none"> <li>Family income 1976</li> <li>Earnings 1976</li> <li>Net worth 1976</li> <li>Economic wellbeing (7 year average income + net worth/poverty income)</li> </ul>	age marital status family size education locus of control area unemployment rate	ANOVA OLS	Multivariate analysis all income measures are significantly associated happiness, strongest predictor is economic wellbeing <i>'...suggests that psychological wellbeing is more a function of the level of income patterns rather than the level of current income' p. 132</i>
Zick & Smith (1994)	PSID 1968-87 USA	1302 couples who married (1st time) in 68/69, husband between 35 and 64	mortality	<ul style="list-style-type: none"> <li>Household poverty – income /need ratio &lt; 1.5 - in 68 or 69</li> <li>Household poverty – income /need ratio &lt; 1.5 - in 68 and 69</li> </ul>	age disabled race partner's characteristics poor area smoking children divorce education risk avoidance	Paired proportional hazards (Cox's)	both poverty variables increase risk of mortality Poor in both years bigger effect

**Table 1**      **Income and health: the time dimension (cont'd)**

<b>Authors</b>	<b>Location</b>	<b>Sample</b>	<b>Outcome Measure</b>	<b>Income Measure</b>	<b>Confounders</b>	<b>Method</b>	<b>Results</b>
Wolfson <i>et al.</i> (1993)	Canadian Pension Plan begun 1969-88	500,000 men aged 65 after sept 1979	Survival probabilities until death between ages 65 and 74	Average annual earnings from 1966 until aged 65 (13+yrs)	Marital status and age at retirement (by stratification)	Weibull survival regression model Separate models run by marital status and by each age at retirement, excluding people who have ever received disability benefit	<i>'an extra dollar of income is beneficial for longevity at all incomes, but it offers decreasing 'protective effect' at higher incomes than at lower incomes'</i> p.S175
Menchik (1993)	NLS older men 1966-83 USA	approx 5,000 men	Mortality: failure to survive 17 yrs	<ul style="list-style-type: none"> <li>• Permanent income level - net household worth 1966 - average discounted individual earnings since 1966</li> <li>• Transitory income - number of years adj. family income below poverty threshold as ratio no years of data</li> </ul>	age parent's education no parents alive region marital status	stepped logistic regression all respondents Separate models for those with initial health good and not poor	Wealth, permanent income and transitory income are all significant after controlling other factors. Similar coefficients when sample split by initial health status, although permanent income slightly smaller coefficient and on margins of significance. <i>the greater the number of spells of poverty, given permanent income, the higher the death rate'</i> p. 436

**Table 1** Income and health: the time dimension (cont'd)

Authors	Location	Sample	Outcome Measure	Income Measure	Confounders	Method	Results
Lundberg and Fritzell (1994)	Survey of Swedish Living Standards 1991, linked to tax returns 1980 and 1990	6000 people aged 35-64 in 1991 excluding housewives and the self-employed	Two binary variables based on list of physical and psychosocial symptoms in 1991	<ul style="list-style-type: none"> <li>Initial individual income level in 1980 categorised into quintiles</li> <li>Categorical variable (fall, stable, increase) of mobility within income distribution               <ul style="list-style-type: none"> <li>- <i>relative change</i> income based on difference in decile position to self in past</li> <li>- <i>absolute change</i> income based on change in real income of at least half median change</li> </ul> </li> </ul>	age prior health status	Separate logistic regression models for men and women in four stages <ol style="list-style-type: none"> <li>age and income change</li> <li>1 plus prior health</li> <li>1 plus initial income</li> <li>all variables</li> </ol>	For men's psychosocial illness income change variables significant and not affected by confounders (slightly stronger when control initial income). For physical health income change is only significant after controlling initial income. For women income change was not significant for psychosocial but was for physical health when initial income controlled for. For both sexes and both health measures strong association between initial income and health outcome <i>'These analyses point to income changes, both absolute and relative, as clearly related to physical as well as mental health'</i> p.55
Duncan (1996)	PSID 1968-1992 USA	men aged 40+	mortality	<ul style="list-style-type: none"> <li>Average family income category over 5 yrs</li> <li>No of times income fell by 50% from one yr to next in previous 5yrs</li> </ul>	age race household size decade	logistic regression with Taylor-series approximation to adjust for individual and area clustering Data split into 14 10-year time periods income data are used for 1st five years, mortality for last five years	<i>'Average income level is found to have a powerful association with mortality ...Income losses are also significance predictors of mortality. Compared with individuals with relatively stable incomes, the relative risk of mortality for individuals who experience one and two or more sharp income drops [is higher] &amp; statistically significant'</i> p.459

**Table 1** Income and health: the time dimension (cont'd)

Authors	Location	Sample	Outcome Measure	Income Measure	Confounders	Method	Results
Lynch <i>et al</i> (1997)	Alameda County Study 1965-1994 USA	1081-1124 respondents with complete information 1965, 1974, 1983, 1994	physical functioning (ADLS) Psychological functioning (depression, cynical hostility, optimism) Cognitive functioning social isolation	<ul style="list-style-type: none"> <li>No of times family income below 200% federal poverty line (max. 3)</li> </ul>	age sex disability in 65,74,83 smoking alcohol exercise BMI	logistic regression separate analyses for a) people with no disability in 1965 b) people in good health in 1965 c) people in good health whose income source is not wages	<i>'strong consistent graded association between sustained economic hardship from 1965 to 1983 and reduced physical, psychological and cognitive functioning'</i> p. 1893 <i>'episodes of illness may affect ability to generate income but given the results of these analyses we find very little evidence that reverse causation could explain the overall magnitude and pattern of the findings'</i> p. 1894
McDonough <i>et al.</i> (1997)	PSID 1968-1989 USA	people aged 45 +	mortality	<ul style="list-style-type: none"> <li>Income <math>t_{-1}</math></li> <li>Income <math>t_{-5}</math></li> <li>Average family income category over 5 yrs</li> <li>Income stability (persistency of poverty or affluence)</li> <li>Year on year income loss of 50% interacted with income level</li> </ul>	age sex race household size work disability $t_{-4}$ education	logistic regression with SUDAN sampling error estimates for sampling and between period within person variability Data split into 14 10-year time periods income data are used for 1st five years, mortality for last five years	Little difference between income measures at different points in time Stronger association for 45-64 age group Persistent low income strong predictor of mortality Income loss had a persistent effect on mortality when income level was controlled Controlling for initial disability and education attenuated the association but did not make it insignificant <i>'Findings point to pronounced mortality disadvantage for those at low end of income hierarchy, income stability beginning to matter at mid-income levels'</i> p. 1481



**Table 1**      **Income and health: the time dimension (cont'd)**

<b>Authors</b>	<b>Location</b>	<b>Sample</b>	<b>Outcome Measure</b>	<b>Income Measure</b>	<b>Confounders</b>	<b>Method</b>	<b>Results</b>
Thiede and Traub (1997)	German Socio-Economic Panel 1984-92	8489 people aged 16+ in 1992	Physical functioning (ADLS) Impairment Emotional functioning (optimism) Social functioning (loneliness) Satisfaction with health	<ul style="list-style-type: none"> <li>Change in equivalent family income 92-94</li> </ul>		LISREL structural equation models for five dimensions of health and income change	<i>'income changes certainly induce influences on health variable assessed by functional status, whereas health status has little explanatory value as a determinant of income change'</i> p.876

**Box 1****Health Measures in the BHPS**

<b>Variable</b>	<b>Explanation</b>	<b>Sample prevalence in wave 6 %</b>
Limiting illness	Whether or not respondent has illness which limits their daily activities	18.3
Health problems	Respondents are asked whether they have any illnesses from list of various health problems - a binary variable is created by splitting the distribution at the average number of health problems (1.27)	34.4
Psychological well-being General Health Questionnaire (12 item)	The GHQ is scored by the caseness method and a binary variable is created by splitting the distribution at those with score of 3 or more. (Weich and Lewis, 1998a; b)	26.5
Subjective assessment of health	Five-category question about overall assessment of health as excellent, good, fair, poor or very poor. Binary variable created by comparing those with fair, poor and very poor health with excellent or good health	32.3

**Table 2 The effect of a time dimension on the association between current income and health**

Odds ratios for poor health*												
Current income quintile (wave 6)	Subjective health			GHQ			Health problems			Limiting illness		
	Current income	Plus initial health	Plus 5 year average income	Current income	Plus initial health	Plus 5 year average income	Current income	Plus initial health	Plus 5 year average income	Current income	Plus initial health	Plus 5 year average income
1 (poorest)	2.39	1.94	0.94 ns	1.46	1.21	1.24 ns	1.50	1.40	1.25 ns	2.37	2.03	1.13 ns
2	2.31	1.85	0.99 ns	1.49	1.28	1.29	1.39	1.20 ns	1.10 ns	2.52	2.10	1.36 ns
3	1.60	1.39	0.96 ns	1.22	1.08 ns	1.08 ns	1.49	1.45	1.51	1.91	1.64	1.32 ns
4	1.29	1.21	0.98 ns	0.93 ns	0.87 ns	0.85 ns	1.03 ns	0.98 ns	1.04 ns	1.38	1.23 ns	1.14 ns
5 (highest)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial health	-	5.09	5.00	-	3.19	3.20	-	7.97	7.95	-	10.49	10.42
F statistic for current income (4, 172)	26.4	12.2	0.1	6.6	3.5	2.4	5.5	4.6	3.8	12.3	7.2	0.9
<i>p value</i>	<i>0.0000</i>	<i>0.000</i>	<i>0.98</i>	<i>0.0001</i>	<i>0.0093</i>	<i>0.0515</i>	<i>0.0003</i>	<i>0.0016</i>	<i>0.0058</i>	<i>0.0000</i>	<i>0.0000</i>	<i>0.4730</i>

\* Model includes age and sex

All odds ratios are significant at the 10 per cent level unless indicated

**Table 3**      **Income over time and health**

Odds ratios for poor health*																
Income quintile	Subjective health				GHQ				Health problems				Limiting illness			
	Current income (t)	Income in previous year (t-1)	Initial income (t-6)	5 year aver income	Current income (t)	Income in previous year (t-1)	Initial income (t-6)	5 year aver income	Current income (t)	Income in previous year (t-1)	Initial income (t-6)	5 year aver income	Current income (t)	Income in previous year (t-1)	Initial income (t-6)	5 year aver income
1 (poor)	1.94	2.10	2.25	2.54	1.21	1.11 ns	1.02 ns	1.20 ns	1.40	1.31	1.29	1.31	2.03	2.14	2.19	2.53
2	1.85	1.63	1.71	2.34	1.28	1.15 ns	1.00 ns	1.21	1.20 ns	1.15 ns	1.05 ns	1.37	2.10	1.58	2.02	1.94
3	1.39	1.32	1.47	1.44	1.08 ns	0.99 ns	0.92 ns	1.08 ns	1.45	1.17 ns	1.03 ns	1.00 ns	1.64	1.49	1.70	1.45
4	1.21	1.04 ns	1.04 ns	1.27	0.87 ns	0.89 ns	0.82	1.06 ns	0.98 ns	0.86 ns	0.81	0.97 ns	1.23 ns	1.12 ns	1.78 ns	1.10 ns
5 (high)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
F – statistic for income quintiles (4,172)	12.2	15.3	19.2	28.9	3.5	1.3	1.5	0.8	4.6	3.8	3.4	3.9	12.3	8.3	8.9	13.2
<i>p value</i>	<i>0.0000</i>	<i>0.0000</i>	<i>0.0000</i>	<i>0.0000</i>	<i>0.0093</i>	<i>0.2648</i>	<i>0.2014</i>	<i>0.5058</i>	<i>0.0003</i>	<i>0.0055</i>	<i>0.0104</i>	<i>0.0047</i>	<i>0.0000</i>	<i>0.0000</i>	<i>0.0000</i>	<i>0.0000</i>

\* Model includes age, sex and initial health

All odds ratios are significant at the 10 per cent level unless indicated

**Table 4 Poverty duration and health**

Odds ratios for poor health*								
	Subjective health		GHQ		Health problems		Limiting illness	
Number of years spent in poverty	Less than half of average income	Bottom fifth of income distribution	Less than half of average income	Bottom fifth of income distribution	Less than half of average income	Bottom fifth of income distribution	Less than half of average income	Bottom fifth of income distribution
4 or 5	1.80	1.78	1.01 ns	0.99 ns	1.29	1.40	1.66	1.73
2 or 3	1.78	1.72	1.07 ns	1.24 ns	1.20 ns	1.08 ns	1.72	1.83
1	1.23	1.50	1.07 ns	1.02 ns	1.18 ns	1.26	1.30	1.44
None	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
F statistics for poverty variables (3,173)	15.1	17.6	0.2	1.7	1.7	2.9	8.8	10.6
<i>p value</i>	<i>0.0000</i>	<i>0.0000</i>	<i>0.8768</i>	<i>0.1689</i>	<i>0.1618</i>	<i>0.0363</i>	<i>0.0000</i>	<i>0.0000</i>

\* Model includes age, sex and initial health

All odds ratios are significant at the 10 per cent level unless indicated

**Table 5 Poverty stability and health**

Odds ratios for poor health*				
Poverty stability	Subjective health	GHQ	Health problems	Limiting illness
> 3 yrs poor, none affluent	2.21	0.98 ns	1.28	2.50
1-3 yrs poor, none affluent	2.58	1.35	1.17 ns	1.72
Middle income	1.43	0.99 ns	1.11 ns	1.55
1-3 yrs rich, none poor	1.07 ns	0.91 ns	0.80 ns	1.36 ns
> 3 yrs rich, none poor	1.00	1.00	1.00	1.00
F statistic for poverty stability (4,172)	21.8	2.2	2.1	11.3
<i>p value</i>	<i>0.0000</i>	<i>0.0737</i>	<i>0.0828</i>	<i>0.0000</i>

\* Model includes age, sex and initial health

All odds ratios are significant at the 10 per cent level unless indicated

**Table 6**      **Income change and health**

Income variables	F statistics for income variables							
	Subjective health		GHQ		Health problems		Limiting illness	
	F-stat	p value	F-stat	p value	F-stat	p value	F-stat	p value
Monetary difference (w6-w1)	6.6	0.0113	2.66	0.1048	1.27	0.2614	4.6	0.0341
Initial income	21.1	0.0000	1.7	0.1542	3.5	0.0085	9.7	0.0000
volatility (standard deviation)	3.26	0.0728	1.75	0.1882	0.63	0.4293	2.9	0.0925
Initial income	17.5	0.0000	1.55	0.1905	3.47	0.0093	7.71	0.000

Odds ratios for categorical income change (w1 to w6)

<i>Dummy variables for large changes in income</i>				
30 % increase	1.07 ns	0.98 ns	1.02 ns	1.04 ns
30% decrease	1.39	1.32	1.22 ns	1.59
stable income (base)	1.00	1.00	1.00	1.00
f-statistic (p value)	5.24 (0.0062)	3.35 (0.0373)	1.07 (0.3468)	4.62 (0.0111)
Initial income				
f-statistic (p value)	19.4 (0.0000)	1.63 (0.1689)	3.24 (0.0136)	9.54 (0.0000)

\* Model includes age, sex, initial health and initial income

All odds ratios are significant at the 10 per cent level unless indicated

