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Original article

Do income effects mask social and behavioural factors when looking at universal health care provision?

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Summary

Objectives: To investigate whether permanent and transitory income effects mask the impact of unobservable factors on the uptake of health check-ups in Britain.

Methods: We used a secondary data representative of the British population, the British Household Panel Survey. Outcome variables included uptake of dental health check-ups, eyesight tests, blood pressure checks, cholesterol tests, mammograms and cervical smear tests. Transitory income was measured as monthly household income and permanent income as average income over 13 years. Estimation method applied dynamic random effect probit model.

Results: Results showed the absence of permanent and transitory effects on the uptake of eyesight tests, cholesterol tests, mammograms and cervical smear tests. Permanent income was associated with dental check-ups and transitory income with uptake of blood pressure tests.

Conclusions: The presence of income effects on the uptake of blood pressure checks may be due to factors associated with income, such as stress or lifestyles, rather than income *per se*. A permanent income effect on dental health care in Britain, which is not free of charge, could indicate the possibility of economic constraints to service uptake, but it does not guarantee that income is the only factor that matters as there may important cultural and behavioural barriers.

Keywords: Health check-ups – Income – Britain.

Recent evidence from the USA, Canada, and Australia has shown that individuals living in income poverty are less likely to take-up regular services for preventative health care, including screening tests for cervical and breast cancer [1–5], screening for prostate cancer [8], screening for colorectal cancer [7–8], HIV Aids tests [9–10], and cholesterol tests [11]. Furthermore, evidence mainly from the USA suggests that the take-up of these services could be improved by granting affordable medical insurance to low income families so that economic constraints to service uptake can be removed [11–14].

Some studies, however, have shown that income remains a significant predictor of uptake of screening tests even after conditioning out the impact of medical insurance [1, 6–9]. This is the case, not only in the USA, but also in Canada where insurance coverage is uniform, universal, and requires no patient cost-sharing and in Australia where Medicare covers 75 % of medical costs [4, 15–16]. These findings suggest that income may be capturing the impact of other factors which are related to both income and screening uptake.

There are two possible explanations for the association between income and service uptake. First, a real effect of income as the provision of preventative health care is costly so individuals living in poverty are constrained, by low income, from utilisation of the service, i.e. economic barriers. Even under free universal public provision, such as in the UK, or where insurance provision is uniform, such as in Canada, income effects may be capturing real economic barriers, for example transportation costs, child care costs, or forgone income for individuals self-employed or paid by hours worked. A second explanation suggests that income may be capturing the effect of other unobserved individual characteristics which affect both access to resources and income itself, such as self-confidence, motivation, patience and self-efficacy, i.e. behavioural barriers [17–18]. A self-confident individual may be more likely to achieve higher income and also to demand her rights for service utilisation. Motivation can also affect education, income and health. Motivated individuals achieve higher levels of education and income and maintain better

health through positive attitudes in life and regular health check-ups.

These two explanations of income effects have different implications for public policy. If the problem is related to economic constraints, then improving access to services can be achieved by increasing individuals' income through better opportunities in the labour market, access to affordable health insurance, or in-cash payments for health check-ups. But if the problem is related to behavioural constraints, then programs aimed at increasing income alone will not necessarily increase service uptake unless they are accompanied by raises in individuals' motivation, understanding, self-esteem or self-efficacy. Furthermore, behavioural constraints may be linked to cultural factors in which case educational programs may be better able to improve the uptake of preventative health care.

Estimating the effect of income exclusive of any confounding factors requires extremely good data. It would be necessary to include measures of all those factors that affect access to services. However, when income constraints are naturally removed through universal public provision, as in the UK, a policy setting provides the opportunity to investigate income effects. In theory, individuals in the UK should not face income constraints since the National Health Service (NHS) offers free universal provision for nearly all preventative health care services. Therefore, there are two possible hypotheses that we can test for the role of income on uptake of health check-ups.

First, a positive association between transitory income and service uptake would indicate that becoming richer or poorer affects the uptake of health check-ups. However, under the assumption that universal provision eliminates economic barriers, transitory income may be capturing the impact of unobservable factors that can change over time, for example, stress, motivations, awareness, self-esteem.

Second, a positive association between permanent income and service uptake would capture a positional aspect of income. In other words, service uptake is higher for rich than for poor individuals. This measure of income is also associated with measurements of education and social class. Under free universal public provision, a positive impact of permanent income could confound the effects of unobservable factors that do not change over time, for example social class.

In order to test these hypotheses, we use a range of self-reported health check-ups available in the British Household Panel Survey (BHPS), among which we have dental health care, eyesight tests, blood pressure checks, cholesterol tests, screening for breast cancer and for cervical cancer.

Most of these services are provided free of charge by the NHS, except for dental health care and eyesight tests. For dental care, most of the adult population are charged a fee for this service [19]. This makes the case of dental health care of particular importance to investigate income effects as these may capture economic constraints as well as behavioural constraints on service uptake. For eyesight tests, individuals over the age of 60 are entitled to free tests every 2 years and so for this group the presence of income effects is likely to indicate behavioural constraints [20].

Blood pressure checks are part of a general health screening provided free of charge by general practitioners (GPs) or nurses. Guidelines for monitoring the blood pressure regularly depends on individual's age, health condition, nutrition, health behaviours and lifestyle, and physician's advice. Cholesterol tests are also provided free of charge by the NHS. In order to have cholesterol test, individuals' have to be referred by their GP. Once referred, individuals have to make an appointment at the clinic or hospital for the blood sample to be taken. The periodicity of the tests depends on the family history of high cholesterol, age, health conditions, health behaviours and lifestyle, and physician's advice.

The NHS Cancer Screening Programme invites all women between the ages of 20 to 64 for a free cervical smear test every three to five years. It also invites all women between the ages of 50 to 64 years for a mammogram every three years, which takes place in specialised screening units [21]. Women may be invited for consecutive screening depending on the results from their previous smear test.

Methods

Data

We used data from the BHPS, an annual survey of each adult (16+) member of a nationally representative sample of more than 5,000 households, making a total of approximately 10,000 individual interviews. The first wave of the survey was conducted in 1991. The same individuals were re-interviewed in successive waves and, if they split-off from original households, all adult members of their new households were also interviewed. We used 13 years of information, from 1991 to 2003.

The sample selected for estimation purposes depended on whether individuals reported service uptake by the NHS and whether they were entitled to receive this service free of charge, except for dental health care. For eyesight tests, our estimation sample included individuals over the age of 60, for blood pressure checks and cholesterol tests all individuals over the age of 16, for mammograms all women between the ages of 50 to 65 and for cervical smear tests all women between the ages of 20 to 65. For dental check-ups, we included all individuals over the age of 19.

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Outcome variables: uptake of regular health check ups

Information on the uptake of regular health check-ups came from the following question: *would you please tell me whether you had any of the health check-ups and tests listed on this card (dental, eyesight test, chest or other X-rays, blood pressure, cholesterol test, and for women cervical smear and breast screening) since September of the previous year?* Furthermore, for each test individuals responded whether provision was by the NHS, privately, or both.

From these questions, we generated indicator variables of uptake of regular health check-ups, provided by the NHS, in each interview period. Each indicator variable takes the value of 1 if a health check-up occurred and was obtained through the NHS. We excluded private provision as well as provision provided both privately and publicly.

Table 1 indicates that about 54% of individuals over the age of 19 had a dental check-up with a NHS dentist, 43% of individuals over the age of 16 had a blood pressure check, and 10% had a cholesterol test. For eyesight tests, 39% of all adults over the age of 60 had a check-up, which was below what would be expected (50%) given its recommended periodicity (every two years). For cancer screenings, about one-third of women had taken these services, which was expected given its recommended periodicity (every three years).

Income and confounding variables

We investigated the effects of transitory and permanent income. Transitory income was calculated monthly, including all labour and non-labour income, and was estimated using equivalence scale to allow for household size and needs in making income comparisons. Transitory income was included to capture the impact that the change in income has on the change in the probability to uptake health check-ups. This variable was hypothesised to be related to unobserved time-variant factors. Permanent income was measured as the average per-capita income over the 13 years of information, between 1991 and 2003. Permanent income was included to capture the positional aspect of income, and hypothesised to be related to unobserved time-invariant factors.

Confounding variables in the analysis included socio-economic variables as well as age, ethnicity, health controls, household size, regional variations in service delivery, and period effects as main predictors of the uptake of regular health check-ups. Not all these factors were included in the models, as we allowed for some modifications according to each service.

We included parental socio-economic occupation (SES) as a background socio-economic factor. Parental SES was obtained using the Registrar General's Social Classification (RGSC) of information from the main employment of the father or mother if father was absent, when the respondent was 14 years old. We re-categorised the RGSC variable as: high parental SES for professional, managerial and technical; medium parental SES for skilled labour and armed forces; and low parental SES for semi-skilled and unskilled labour.

Other socio-economic variables included were education and employment. We introduced two indicators for education, previous educational qualifications and continuing adult learning (not for eyesight tests or mammograms as continuing adult learning was only available for the working aged population). Prior educational qualifications were converted into an equivalent UK National Vocational Qualification (NVQ) level. We differentiated between 4 levels of qualifications, level 1 to level 4, which are roughly equivalent to lower secondary, upper secondary, high school, and college education, or no qualifications. Adult learning was measured year-on-year by enrolment in general training or training leading to qualifications. Employment was included to capture the impact of individual's involvement in the labour market on uptake of regular health check-ups. This variable was re-classified into full-time employment, part-time employment, retired, family care, or unemployment.

Age and age squared were included to capture possible non-linear associations between age and service uptake. Cultural

Table 1 Descriptive statistic for self-reported regular health check-ups

Check-up	Average	Between Individuals SD	Within Individuals SD	No. Individuals	No. Obs.
Dental	0.54	0.37	0.33	9,541	88,796
Eyesight	0.39	0.30	0.40	3,019	22,043
Blood pressure	0.43	0.32	0.38	10,643	100,914
Cholesterol	0.10	0.18	0.24	10,648	102,525
Mammograms	0.29	0.23	0.41	1,674	12,591
Cervical smear	0.32	0.24	0.41	3,390	21,358

Source: BHPS, 1991–2003. Dental health care includes all individuals over the age of 19; eyesight tests all individuals over the age of 60; blood pressure checks and cholesterol test all individuals over the age of 16; mammograms only women between the ages of 50 and 65; and cervical smear test only women between the ages of 20 and 65.

factors may be stronger for certain types of regular tests, for example breast or cervical screening. To capture this issue we included ethnicity classified into four categories: white, black (mainly African and Caribbean), Asian (Pakistani, Indian, Bangladeshi, and Chinese) and other ethnic origin.

The next set of variables included measures of personal health and health behaviour. Individuals may receive a health check-up in response to illnesses or poor health conditions. This could be particularly the case for blood pressure checks. Health factors included self-reported health status (from excellent to poor health), the General Health Questionnaire (GHQ) measure of well-being using the Caseness scale, which ranges from 0 (less distressed) to 36 (most distressed), experiences of sight problems (for eyesight tests only), experiences of high blood pressure (for blood pressure checks or cholesterol tests only), diabetes (for blood pressure checks or cholesterol tests only), and being registered as disabled. Health behaviours per se are indicators of general attitudes towards health which affects the uptake of preventative health care [18]. As indicator of health behaviour we used tobacco smoking.

Household size was introduced to capture the impact of time constraints. For example, children may reduce time available for regular health check-ups, or may create an incentive for prevention, as individuals may be more likely to care for their health since they care for their children.

There are regional variations in service delivery. To capture these variations we introduced eight NHS Regional Offices (West Midlands, Eastern, Northern and Yorkshire, North West, Trent, South West, South East and London) as covariates. Similarly, individuals from inner and outer London, South East, East Anglia, Merseyside, South Yorkshire, Tyne and Wear, and the Region of the North expected waiting times higher than the average for England. We hypothesised that individuals living in these areas may be less likely to take up regular health check-ups due to the higher than average cost of time. Finally, moving location may be an important determinant of access as individuals need to register to clinics or find dentists in their new location in order to receive these services.

Estimation method

We utilised dynamic random effects probit models to estimate the effects of income on the uptake of regular health check-ups. The estimation included previous uptake of health check-ups to capture state dependence, individual random effects to control for individual time-invariant unobserved heterogeneity, and other variables that may confound the relationship between income and uptake of regular health check-ups.

For each health check-up, the probability of taking up the service is explicitly defined by:

$$P(y_{it} = 1 \mid y_{it-1}, ..., y_{i1}, x_i, \eta_i) = \phi(\alpha y_{it-k} + x_{it}\beta + \eta_i) \quad (1)$$

where i denotes individuals and t stands for time. y denotes uptake of the health check-up, which is a function of previous histories of service uptake lagged k periods (y_{it-k}), transitory income and other covariates (x_{it}), and the individual time-invariant unobserved random effect (η_i). Under a probit model specification, the probability to uptake health services is evaluated at the cumulative density function of the normal distribution (ϕ), and α, β and σ_η are estimated by the model.

There are three important requirements for the random effect model. First, we needed to specify the relationship between the observed confounders and the unobserved time-invariant individual effect, otherwise η_i could not be estimated consistently (a problem known in the literature as the incidental parameter problem). Second, we had to specify the distributional assumption on the initial conditions of the process [22]. Finally, the minimum number of repeated observations for each individual in the panel had to be four in order to identify the parameters in the model [22].We followed Wooldridge's specification to deal with these issues [23]. Specifically, the individual random effect is described by the function:

$$\eta_i = \delta_1 y_{i1} + ... + \delta_k S_{ik} + \bar{x}_i\gamma + e_{\eta i} \quad (2)$$

where $y_{i1},\ldots, y_{ik}$, represent the uptake of services in each of the first k periods, depending on the periodicity of the tests; $\bar{x}_i$ is the average value of the time-varying explanatory variable, which is key as it explicitly captures the effect of permanent income as well as other measures of health and well-being; δ and γ are parameters to be estimated; and $e_{\eta i}$ is the error term assumed normally distributed with zero mean and standard deviation σ_η.

The inclusion of initial conditions does not guarantee that estimated parameters are unbiased. For this to hold, we also assumed that unobserved check-ups that happened prior to the first sweep of information in the BHPS were uncorrelated with observed screening. This was a strong assumption and, if violated, could induce a bias in our estimates. Wooldridge proposes to use a normal density for the random effect which can be replaced into the probit model [23]. This means that the parameters of the model (α, β, δ, γ and σ_η) can be estimated using standard random effect models.

Estimated coefficients for the random effect probit model were utilised to calculate marginal effects. For continuous variables, such as income, the marginal effect was obtained by taking the derivative of the probability of taking up check-ups with respect to the continuous variable. For discrete variables, such as ethnicity, the marginal effect was the change in the probability. In both cases, the probability was evaluated at

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the average value of the confounding variables and adjusted by the individual random effect [23].

Results

Results indicated the absence of permanent and transitory income effects on eyesight tests, cholesterol tests, screening for cervical and for breast cancer (Tab. 2). We found the presence of permanent income effects on the uptake of dental check-ups. The marginal effects for permanent income indicated an increase of 4.1 percentage points in the uptake of dental check-ups for individuals over the age of 19. We found transitory income effects for the uptake of blood pressure checks for individuals over the age of 16. The marginal effects showed that one percent increase in income was associated with 1.8 percentage points increase in the probability to have a blood pressure check.

History of health check-ups was a key predictor for the take up of health check-ups. For individuals over the age of 19, uptake of dental check-ups in the previous year were associated with an increase in current uptake by 23.7 percentage points and uptake two years in the past were associated with an increase of 4.4 percentage points in current uptake. For individuals over the age of 60, uptake of an eyesight test two years in the past increased the likelihood of current uptake by 5.1 percentage points.

For individuals over the age of 16, current uptake of blood pressure checks was associated with an increase of 20.7, 8.6 or 8.4 percentage points depending on previous check-ups, one, two and three years in the past. Furthermore, for these individuals having a cholesterol check-up one year in the past was associated with an increase in current uptake of 13.2 percentage points, two years in the past increased current uptake by 2.2 percentage points and three years in the past by 2.0 percentage points.

For women between the ages of 50 and 65, a mammogram three years in the past increased current screening by 29.4 percentage points and for women between the ages of 20 to 65, a cervical smear test three years in the past was associated with an increase in current screening of 16.0 percentage points whereas a smear test in previous period increased uptake by 9.0 percentage points.

From all the estimations, the variance of the random effect was significant (σ_η). We also found that the proportion of the total variance contributed by the panel structure of the data (ρ) was significant in all estimations except for the uptake of mammograms.

Discussion

This paper investigated the presence or absence of income effects on the uptake of health check-ups in Britain. Our hypothesis was that free universal public provision should eliminate transitory and permanent income effects on the uptake of health check-ups. In other words, individuals should access health services regardless of whether they are rich or

Table 2 Parameter estimates (standard errors) of uptake of health check-ups in Britain provided by the NHS

Variable	Dental	Eyesight test	Blood pressure	Cholesterol test	Mammogram	Cervical smear
Transitory income	0.014 (0.018)	–0.014 (0.035)	0.046 (0.017)**	0.013 (0.030)	–0.015 (0.035)	–0.010 (0.020)
Permanent income	0.106 (0.034)**	0.045 (0.063)	0.020 (0.030)	0.072 (0.050)	0.058 (0.054)	0.004 (0.031)
Check-up 1 year ago	0.613 (0.024)**	0.011 (0.039)	0.522 (0.023)**	0.824 (0.044)**	0.032 (0.037)	0.289 (0.026)**
Check-up 2 years ago	0.113 (0.024)**	0.144 (0.038)**	0.217 (0.022)**	0.137 (0.046)**	–	–
Check-up 3 years ago	–	–	0.211 (0.022)**	0.124 (0.047)**	0.752 (0.033)**	0.517 (0.023)**
σ_η	0.637 (0.019)**	0.489 (0.032)**	0.382 (0.023)**	0.513 (0.037)**	0.110 (0.079)*	0.198 (0.030)**
ρ	0.289 (0.013)**	0.192 (0.021)**	0.128 (0.014)**	0.208 (0.024)**	0.012 (0.017)	0.038 (0.011)**
No. Obs.	29,869	8,124	33,869	33,532	7,128	21,358
No. Indiv.	4,947	1,464	6,047	5,959	1,330	3,390

Source: BHPS. Asterisks, (**), (*) indicate significant at 1 and 5 percent level, respectively. σ_η is the standard deviation for the random effect and ρ is the proportion of the total variance contributed by the panel structure. Estimation samples include individuals with over 3 years of information. Estimations include education, adult learning (except eyesight tests and mammograms), age, parental SES, ethnicity, health status, health problems (sight for eyesight tests, high blood pressure and diabetes for blood pressure checks and cholesterol tests), well-being, smoking, household size, employment status, own SES, moving residence, waiting times, regional controls, time controls and gender (except mammograms and cervical smear test).

poor, or whether they become richer or poorer. In our view, the presence of transitory income effects would be related to unobserved time-varying factors that affect income and health service uptake. The presence of permanent income effects would indicate that differential access to service is positional and would be related to unobserved time-invariant factors such as social class.

For all health check-ups investigated here, provided free of charge by the NHS, which included eyesight tests, blood pressure checks, cholesterol tests, screening for breast and cervical cancer, we only found evidence of transitory income effects for blood pressure check-ups. For dental care, which is not provided free of charge by the NHS, we found evidence of permanent income effects.

It is possible that the permanent income effects found for dental health care truly represent economic barriers for service uptake. What is interesting here is that we did not find evidence of transitory income effects. Therefore, while uptake was associated with the level of income, it was not associated with changes in income. A pure economic interpretation of this finding is that rich individuals are able to pay for this service and poor individuals are not. Furthermore, changes in income are not large enough to remove economic barriers to dental health services for most poor people and may only affect some individuals at the margin. A second economic explanation is that NHS supply of services is lower than the current demand, which implies a high disequilibrium price only affordable for high income individuals. Another explanation, however, is that rich individuals are more aware of the importance of dental care and thus are more willing to pay for the service than poor individuals. For the second of these explanations, removing NHS fees to dental care would not be enough to increase uptake unless accompanied by changes in attitudes towards uptake.

Blood pressure checks are free of change, easy to access and typically obtained during a consultation with a GP. The finding of transitory income effects on the uptake of blood pressure checks would be capturing the impact of unobserved time-variant factors. One possible explanation from the epidemiological literature is that income may induce stress which increases cardiovascular markers, generating sudden changes in blood pressure [24]. Adda et al. did not find significant effects of permanent income on the proportion of individuals with blood pressure condition in England [25]. They also suggested that this set of disease could be linked to changes in socioeconomic position due to stress, which is in accordance with our findings.

For all check-ups investigated here, we found that history of previous health check-ups was a very important predictor of current uptake. This was demonstrated by the positive and significant association of all lagged dependent variables. The experience of previous screenings on health check-ups has been found to be a key factor in the literature [26]. It seems that there is an important distinction between individuals who have never accessed health services and those with previous experiences. The former group is perhaps the hardest to reach and policy efforts should be focussed on enhancing their demand for services while also removing possible supply side barriers.

Important for our research on income effects was the inclusion of demographic and socioeconomic factors as covariates. Income and service uptake vary over the lifecourse. For example, Batchelor found that uptake of dental care in Britain between 1991 and 2000 had important variations according to age and gender [27], Rimer suggested that employment status has important time constraints for service uptake [3] and Sabates and Feinstein found that adult learning was an important determinant of the uptake of cervical screening in Britain [28]. Our results conditioned out the impact of age, employment status, household size, ethnicity, as well as gender and adult learning (where appropriate).

Research in this area has also suggested that income may be having an impact on service uptake via its effects on health [25, 29–30]. For this reason, our analysis incorporated measurements of health problems and health behaviours. It is also possible that health affects the income generating capacity of individuals so what is believed to be the impact of income on service uptake is the impact of previous health [31–33]. Similarly, previous education has important effects on income and health [18, 28–34]. Our estimation dealt with these issues by incorporating measurements of average health and well-being from 1991 to 2003 as well as previous educational qualifications.

In all the estimations, the proportion of the total variance contributed by the variance of the panel structure of the data was significant, except for the uptake of mammograms. What this means is that the variance attributed to the panel structure was unimportant for the case of uptake of mammograms and that results obtained by random effects are no different to the ones ignoring the panel structure of the data. Perhaps this is not a surprising result, as we found that after conditioning out for the impact of previous mammograms, current uptake was only associated with age. Therefore, uptake of mammograms among the British population was relatively homogenous, although Chiu points to some differences in uptake with respect to health beliefs, which unfortunately we were not able to address [35].

One of the limitations of our research was the inability to establish reasons for service uptake. In other words, we are unsure whether uptake was preventative, in response to an ill

health condition, or followed medical advice. This limitation should be kept in mind for the interpretation of findings in that one cannot assume that these services were preventative check-ups. Nonetheless, results are important in that some individuals, regardless of their reasons, were more likely to take up these services than others. Hence, even under universal public provision, uptake of services was not homogenous.

Our research has also important advantages over past research in this area. First, we differentiated between transitory and permanent income effects on the uptake of health check-ups. Other research has also investigated the impact of permanent and transitory income effects on smoking behaviour [30], on self-reported health [29, 36], on health outcomes [25], but not on the uptake of health check-ups. Moreover, we included a history of 13 years of information and conditioned out the impact of previous uptake on current service demand. This is important as results based on cross-sectional data do not contain information on previous experiences of service uptake. Finally, the BHPS contains significant information on socio-economic status, education, and employment, factors that were incorporated in the model when estimating the impact of income. Most health surveys contain very broad measures of socioeconomic status and so it is difficult to isolate the impact of the different dimensions of socio-economic status on the demand for health services.

Conclusion

The provision of health services in Britain provides important insights for future policies in the USA and other countries aimed at targeting under-served individuals. These results suggest that the apparent income constraints in the USA for cervical screening, mammograms, cholesterol tests and eyesight tests are real. Unlike the US, Canada and Australia, the uptake of these tests in the UK under free and universal provision of health care should not depend on income. Thus, universal provision removes economic constraints to service utilisation. Affordable medical insurance for low income families can have a real and substantive impact on the uptake of preventative care with long-run benefits for parents and their children.

The analysis of the uptake of dental check-ups in Britain is of particular relevance as this service is not free of charge. Uptake of dental check-ups in Britain seemed to be positional (related to permanent income) but not influenced by transitory income. A policy aimed to remove economic constraints might increase service uptake if permanent income is capturing real economic constraints to the poor. However, it might also be the case that permanent income is capturing more qualitative differences between the rich and the poor in terms of class, attitudes, beliefs and motivations. In this case, income alone would not solve the problem of health inequalities in access to this service.

The provision of blood pressure checks in Britain was associated with changes in income. This is a clear case where income could be capturing the impact of other factors such as stress, motivations, self-esteem, and awareness. However, more analysis is required to unpack this result.

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