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ScienceDirect
Journal of Health Economics 27 (2008) 801–807
JOURNAL OF HEALTH ECONOMICS
www.elsevier.com/locate/econbase

Comments and replies

The income gradient in children's health: A comment on Currie, Shields and Wheatley Price☆

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Received 1 October 2007; accepted 12 October 2007
Available online 8 January 2008

Abstract

This paper re-examines differences found between income gradients in American and English children's health, in results originally presented by [Case, A., Lubotsky, D., Paxson, C., 2002. Economic status and health in childhood: the origins of the gradient. American Economic Review 92, 1308–1334] for the US, and by [Currie, A., Shields, M.A., Wheatley Price, S., 2007. The child health/family income gradient: evidence from England. Journal of Health Economics 26, 213–232] for England. We find that these differences are reduced when English and American data from the same time period are compared. In addition, Currie, Shields and Wheatley Price's measures of chronic conditions from the Health Survey of England were incorrectly coded. Corrected data indicate that income plays a larger role in buffering children's health from the effects of chronic conditions in England.

Keywords: Children; Health; Income; United States; England

1. Introduction

A growing empirical literature examines the relationship between family income and child health. An article by Case et al. (2002) (CLP) shows that, in the United States, the socioeconomic gradient in adult health has its origins in childhood. Using data from 1986 to 1994, they find that poor children are reported by their parents to be in worse health than wealthy children, and this gradient becomes larger as children grow older. These results suggest that the relationship between income and health that is observed in adulthood has its roots in childhood. Currie and Stabile (2003) present evidence on income gradients in the health of Canadian children at different ages. The Canadian and American results are strikingly similar, and suggest that the adoption of a Canadian-style universal health insurance program in the US would do nothing to reduce the differences in health status between poor and rich children.

A recent article in this journal, "The child health/family income gradient: evidence from England" (Currie et al., 2007) argues that income gradients in the health of English children differ from those observed in either the US or Canada. Using data from the 1997 to 2002 Health Survey for England (HSE), Currie, Shields and Wheatley Price (CSW) conclude that English health gradients in income are small and increase little as children grow older. These findings are consistent with other research from England, which indicates that SES gradients in health that are present

☆ We acknowledge support from NIH grant R01 HD41141 for this research.
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doi:10.1016/j.jhealeco.2007.10.005

in earlier childhood flatten or disappear in adolescence, and reappear in adulthood (West, 1997; West and Sweeting, 2004). CSW suggest that the British National Health Service, with its focus on free services and equal access, may prevent the association between health and income from becoming more pronounced as children grow older.

CSW also follow CLP by investigating the role of chronic conditions in the gradient in health. The American evidence indicates that poor children are more likely than wealthy children to experience some (although not all) chronic health conditions; these differences in the prevalence of chronic conditions across income groups can explain part of the association between income and health status. In addition, among US children with the same health conditions, those who are richer are reported to be in better health than those who are poorer, suggesting that the chronic conditions of wealthier children are less severe, or are better managed. The results in CSW differ from CLP in that a number of the chronic conditions they examine are not associated with worse health status. For example, they find that asthma—a relatively common chronic condition in both countries—is positively, although not significantly, associated with better health in the HSE. CSW also find little evidence that income buffers health status from the adverse effects of chronic conditions.

These cross-country differences may provide information on the effectiveness of national health systems. However, they may also reflect other factors—such as differences in research methods, sample sizes, sample periods and variable definitions. This paper re-examines differences between American and English income gradients in children's health, paying careful attention to these issues. We find that, when the English sample is expanded by adding 3 years of data, and is compared to American data from the same time period, the income gradient in children's health increases with age by the same amount in the two countries. It is still the case that the income gradient in children's health is smaller in England than in the United States. This may be due to genuine differences in the gradient, or differences in how health status is reported. Finally, we note that the CSW's measures of chronic conditions were incorrectly coded. We present and discuss results based on correctly coded data from the HSE. These indicate that the effects of chronic conditions on health status are larger in the English sample than in the American sample, and that income plays a larger role in buffering children's health from the effects of chronic conditions in England.

2. Data

Our results from England are based on the 1997–2005 Health Surveys for England (HSE). The HSE comprises a series of annual surveys designed to provide information on the nation's health. Starting in 1995, up to two children per household, aged 2–15, were included in the survey. In 2001, the survey was extended to include infants and toddlers (under 2 years old). In addition to the general population sample, each year the HSE has a special focus on a different demographic group, such as ethnic groups, children and young people or older people.

Following CSW, we use only observations from the general population sample, which provides a sample of 22,077 children aged 15 and under. We drop the observations for which parents' data cannot be matched to that of their children, or parental responsibility lay solely with grandparents or siblings. In addition, we drop observations for which income data are not provided by a parent and those for which self-assessed general health variable is not reported, resulting in a sample of 19,567 children. Our sample for the years 1995–2002—the time period CSW use—contains 13,781 observations, very close to the 13,745 observations used in CSW. Adding the 2003–2005 years to CSWs dataset increases the sample size most dramatically for children under 2 years of age, who were not covered by the HSE until 2001.

Results for the United States are based on the National Health Interview Study (NHIS). This survey collects annual data on health for children and adults from large nationally representative samples. We use samples from two time periods: 1986–1995 and 1998–2005. The earlier NHIS sample is identical to that used for CLP with the exception that, to make our results comparable to those in CSW, we exclude children ages 16 and 17. This yields a sample of 206,640 children between the ages of 0 and 15. For the 1998–2005 period, we adopted sample selection criteria that matched those of CSW as closely as possible: we excluded those children for whom parent information could not be matched to that of their children; those who were not cared for by a parent; and those for whom income data were missing. The NHIS was redesigned between 1996 and 1997. We did not use the 1997 NHIS because the variables needed to link children to their parents' records were not included in this year. After the redesign, the NHIS collected a limited amount of health information for all family members, and more detailed information for a randomly selected "sample adult" and (if relevant) "sample child". We use data on children from the "family" files, since they contain all the variables we need and yield a larger sample of 142,326 children between the ages of 0 and 15.

Table 1
The distribution of health status

	1997–2005 HSE		1998–2005 NHIS	
Health status code	Definition	Percent	Definition	Percent
1	Very good	57.4	Excellent	56.9
2	Good	36.1	Very good	27.3
3	Fair	5.7	Good	14.1
4	Bad	0.7	Fair	1.5
5	Very bad	0.1	Poor	0.2
Observations		19,567		142,326

Notes: the tabulations are for children ages 0–15. The percentages are calculated using weights.

The key health measure we use is an ordinal rating of the child's health, referred to as "health status." It is important to note that the response categories for health status differ across the two countries. In the HSE, the response categories are 1 = very good, 2 = good, 3 = fair, 4 = bad and 5 = very bad. In the United States, the response categories are 1 = excellent, 2 = very good, 3 = good, 4 = fair and 5 = poor. The distributions of health status for children ages 0–15 from the 1997 to 2005 HSE and the 1998 to 2005 NHIS are shown in Table 1.

The difference in the wording of the categories makes it impossible to draw conclusions about differences in the *levels* of health status between English and American children. If respondents in the two countries interpreted the wording of the response categories literally and identically, these numbers suggest that American children are in better health than English children: 84.2% of American children are in "very good" or "excellent" health whereas only 57.4% of English children were in the top category of "very good" (which, if the categories are taken literally, should include children in "excellent" health). If, instead, respondents answer the question so that a response of 1 in England means the same as a response of 1 in the United States, and so on, then these distributions imply that the health status of English children exceeds that of Americans. Another feature of the data that make comparisons difficult is that, in the HSE, children ages 13–15 reported their own health status. In the NHIS, children under the age of 17 were not given the option of reporting on their own health. If children ages 13–15 use different criteria, or weight criteria differently, when assessing their health than do their primary care givers, this could have an effect on the gradients estimated for them. For this reason, we highlight the differences in English and American results among children ages 0–12.

Our focus is on the relationship between health status and family income. In both the HSE and the NHIS, family income is coded in brackets. In the 1998–2005 NHIS, the 11 brackets used are in increments of $5000 up to $25,000, and then in increments of $10,000 up to the highest category of "$75,000 and above". The HSE uses 31 brackets that range from less than £520 to more than £150,000. For the HSE and the 1998–2005 NHIS, we follow CSW and assign each child an income level at the mid-point of the bracketed value, with income top-coded at the maximum bracket value. The resulting income values were then adjusted for the changes in the cost of living over time. This was done using the monthly average earnings index for the HSE, and the quarterly consumer price index for the 1998–2005 NHIS. CLP used a slightly different procedure for handling bracketed values for the 1986–1995 NHIS. They used income data from the Current Population Survey (which is not bracketed) to compute average income within brackets, assigned those averages to children in the NHIS, and then deflated using the consumer price index. However, the results are not sensitive to the procedure used.

3. Income gradients in children's health

Table 2 presents results on the income gradients in children's health in the HSE and the NHIS, for the full samples and for children of different age groups. We show coefficients from ordered probit regressions, in which the five-point scale of health status is regressed on the logarithm of family income and a set of additional controls. Note that the ordered probit regressions should produce results that are comparable across data sets despite the differences in the response categories for health status. The ordered probits estimate a function that relates an unobserved, continuous health measure to the logarithm of income and the other controls. If this underlying function is correctly specified and identical in the two countries, then the same point estimates should be obtained even if the "cut points" that define the ordered categories differ.

Table 2
Health status and income (ordered probit models)

Ages	All	0–3	4–8	9–12	13–15
Panel A: HSE					
Currie et al. published results (1997–2002)					
ln (family income)	−0.187 (0.018)	−0.146 (0.040)	−0.212 (0.028)	−0.196 (0.031)	−0.174 (0.034)
Observations	13,745	2505	4936	3734	2570
Replicated results (1997–2002)					
ln (family income)	−0.193 (0.015)	−0.143 (0.036)	−0.212 (0.026)	−0.203 (0.030)	−0.194 (0.034)
Observations	13,781	2519	4949	3738	2575
HSE (1997–2005)					
ln (family income)	−0.194 (0.013)	−0.141 (0.029)	−0.207 (0.022)	−0.229 (0.025)	−0.180 (0.029)
Observations	19,567	3881	6766	5252	3668
Panel B: NHIS					
NHIS (1986–1995)					
ln (family income)	−0.283 (0.004)	−0.189 (0.008)	−0.251 (0.009)	−0.293 (0.008)	−0.334 (0.010)
Observations	206,640	51,448	54,067	64,746	36,379
NHIS (1998–2005)					
ln (family income)	−0.262 (0.005)	−0.224 (0.009)	−0.250 (0.009)	−0.289 (0.010)	−0.305 (0.012)
Observations	142,326	34,358	45,236	36,644	26,088

Notes: the numbers in parentheses are robust standard errors; all regressions are weighted using sampling weights. *HSE results*: controls include complete sets of age and year dummies; an indicator for whether the child is male; ethnicity; the logarithm of family size; age of mother; age of father; an indicator for the absence of a mother from the household; an indicator for the absence of a father from the household. *NHIS results*: controls include complete sets of age and year dummies; an indicators for whether the child is male, is black, is white; the logarithm of family size; age of mother; age of father; an indicator for whether a mother is present in the household; an indicator for whether a father is present in the household.

The controls included in the ordered probits are chosen to match those used by CSW, and include age and year dummies, indicators for the child's sex and ethnicity, the logarithm of family size, the age of each of the parents and indicators for whether the mother and father were absent from the household.[1] We do not know if CSW weighted their regressions using the sampling weights provided in the survey. All the results we show use weights, although their use makes very little difference to any of the estimates.

Panel A contains results from the HSE. We first show estimates from the first panel of Table 1 from CSW, for the 1997–2002 HSE, followed by our replication of these results using data from the same time period. The third set of estimates in Panel A is based on the larger 1997–2005 sample. Panel B shows results from the NHIS. The first set of estimates in this panel, for 1986–1995, are similar to those published in CLP. They differ only in that 16- and 17-year-olds are excluded, the regressions are weighted, and the same controls as in CSW are included in the models. This permits direct comparisons across the samples, with the caveat that 13–15-year-olds report for themselves in the HSE and are reported on by their parents in the NHIS. The second set of results in Panel B is for the 1998–2005 NHIS. The most directly comparable sets of numbers across the two countries are for children ages 0–12 in the 1998–2005 NHIS and the 1997–2005 HSE.

The results in Panel A indicate that we are able to nearly replicate CSW's published results for the 1997–2002 HSE, despite small differences in our samples. Higher incomes are associated with better health status (note that higher values of health status correspond to worse health). The coefficient on the logarithm of income over all children is approximately −0.19. The gradient is smallest—a value of about −0.14—for children ages 0–3. It increases to −0.212 for children ages 4–8, and then stabilizes. However, the conclusion that the gradient does not increase with age after age 4 is sensitive to the years of the HSE that are used in the analyses. When the 2003–2005 survey years are added, the income gradient in health increases through age 12. The gradient continues to be smaller for children ages 13–15 years old than for those ages 9–12. This may be a genuine decline or an artifact of the switch from parent reporting to child reporting.

[1] The parents' ages were interacted with an indicator equal to 1 if the parent is present, and 0 otherwise.

Table 3
Prevalence rates of chronic conditions

Chronic condition	Currie et al. published results	Replicated results (1997–2002)	HSE (1997–2005)
Arthritis (%)	5.4	0.1	0.1
Back (%)	6.6	1.3	1.2
Asthma (%)	7.5	10.5	9.5
Bronchitis (%)	3.1	2.7	2.5
Blind (%)	3.6	2.5	2.3
Mental illness (%)	5.3	2.8	2.8
Diabetes (%)	3.3	0.6	0.6
Hypertension (%)	2.9	0.1	0.1
Cerebral hamorrhage (%)	3.6	0.6	0.6
Digestive complaints (%)	3.3	1.1	1.2
Skin complaints (%)	2.7	3.8	3.6
Other conditions (%)	4.3	1.6	1.7
Observations	13,745	13,781	19,567

Notes: prevalence rates in the last two columns are calculated using weights.

Like CSW, we find that income gradients in children's health increase with age more for the 1986–1995 NHIS (first set in Panel B) than for the 1997–2002 HSE. Between ages 0–3 and 9–12, the income gradient increases (in absolute value) by 0.104 using the 1986–1995 NHIS, and by 0.060 using the 1997–2002 HSE. However, this difference in the increase in the gradient with age vanishes when results for the 1997–2005 HSE are compared with those from the 1998 to 2005 NHIS. Using these samples, the increase in the gradient from ages 0–3 to 9–12 is 0.088 for the HSE and 0.065 for the NHIS. This convergence is driven by two factors. The first is that the increase in the English income gradient becomes larger when 3 years of data are added to the HSE. The second is that the increase in the American income gradient becomes smaller when the more recent NHIS sample is used.

Although the income gradient in health status increases by the same amount across the two countries when similar years of data and larger sample sizes are used, there is nonetheless a substantial difference in the size of the income gradient across the two countries. The coefficient on the logarithm of income for all children combined is −0.194 using the 1997–2005 English data, relative to −0.262 using the more recent American data. One possible reason for this difference is that, in England, there may be smaller disparities in health status across wealthier and poorer children with the same chronic conditions. CSW addressed this possibility in their paper; we re-examine this in the next section.

4. Health conditions and health status

Like CLP, CSW present estimates of regressions of a measure of health status on whether the child has a chronic condition, the child's family income, and the interaction between the two. These estimates provide evidence on whether chronic conditions result in worse health status, and whether higher incomes buffer children from the adverse effects of chronic conditions on health status.

We were unable to replicate any of CSW's estimates that used measures of chronic conditions. In addition, our estimates of the prevalence of chronic conditions among children in the HSE are substantially different from those reported in CSW. Table 3 shows CSW's published prevalence rates, and our estimates of rates using the 1997–2002 and the 1997–2005 HSE. The rates published by CSW are much too high for some conditions: they show 5.4% of children having arthritis, 3.6% as having experienced a cerebral hemorrhage, 3.3% having diabetes and 2.9% having hypertension. Our estimates show markedly lower rates for these conditions, and somewhat higher rates for some more common childhood conditions such as asthma (10.5% in our replication versus 7.5% in CSW) and skin complaints (3.8% versus 2.7%.) Personal correspondence with one of the authors of CSW confirmed that an error had occurred when the measures of chronic conditions were coded.

Even with correctly coded measures, there are several reasons why comparisons between results based on the HSE and the results in CLP are difficult. The first is that the questions that elicit information about chronic conditions differ across the surveys. The conditions shown in Table 3 are drawn from the HSEs questions about "long-standing illnesses". Parents (or, for children ages 13–15, children) were asked whether the child has a long-standing illness. If

Table 4
Health status and chronic conditions, children ages 0–15; dependent variables for 1997–2005 HSE: indicator of fair/bad/very bad health; dependent variable for 1986–1995 NHIS: indicator of fair or poor health

	NHIS 1986–1995			1997–2005 HSE; one regression per condition		1997–2005 HSE; all conditions and interactions in one regression	
	β_2	β_3	Observations	β_2	β_3	β_2	β_3
Asthma	0.095 (0.008)	−0.057 (0.009)	33,520	0.200 (0.010)	−0.061 (0.013)	0.177 (0.010)	−0.051 (0.013)
Bronchitis	0.046 (0.006)	−0.026 (0.009)	33,520	0.200 (0.020)	−0.059 (0.025)	0.134 (0.019)	−0.038 (0.023)
Blind/vision problems	0.057 (0.015)	−0.051 (0.018)	34,608	0.177 (0.021)	−0.056 (0.027)	0.137 (0.020)	−0.037 (0.025)
Digestive problems	0.070 (0.011)	−0.034 (0.011)	34,550	0.301 (0.032)	−0.087 (0.041)	0.239 (0.030)	−0.090 (0.035)
Back						0.080 (0.026)	−0.007 (0.037)
Mental illness						0.191 (0.021)	0.006 (0.026)
Skin complaints						0.065 (0.014)	−0.035 (0.016)
All other conditions						0.233 (0.020)	−0.067 (0.023)

Notes: all results shown for the HSE are based on a sample of 19,567 children. The NHIS sample sizes differ because different families were randomly assigned to different sets of health questions. The regressions are estimated using ordinary least squares, and are weighted using sampling weights. The numbers in parentheses are robust standard errors. The regressions are of the form: $h = \beta_0 + \beta_1(\ln\ y - \overline{\ln\ y}) + \beta_2 C + \beta_3[C(\ln\ y - \overline{\ln\ y})] + X\delta + \varepsilon$, where h is an indicator of poor health, as noted above; $(\ln\ y - \overline{\ln\ y})$ is the deviation of the logarithm of income from its sample mean, C is an indicator that a child has a health condition and X is the controls listed in the note to Table 2. The first five columns show results of regressions that includes one condition and one interaction between the condition and income. The last two columns show results in which all conditions and their interactions with income are included in a single regression.

so, the respondent was asked to list up to six illnesses. These reports can be used to construct measures of chronic conditions, such asthma, bronchitis, mental illness and digestive problems. The 1986–1995 NHIS followed different procedures for measuring chronic conditions. Before the redesign, the NHIS randomly allocated families to "condition lists" that focused on subgroups of illnesses, and information was collected on all illness on the list for each family member. The NHIS questions on conditions were typically of the form "Has a doctor ever told you that [child] has [condition]?" Although some of the chronic conditions, such as asthma, are narrowly enough defined that they are plausibly comparable across the data sets, others—such as mental illness in the HSE—have no analog in the NHIS. A second issue is that precise estimates of the effects of rare chronic conditions on health status require large sample sizes. The HSE sample is too small to examine how conditions such as hypertension or diabetes, which are quite rare in children, are related to health status.

Table 4 presents results from the 1986 to 1995 NHIS and the 1997 to 2005 HSE. We first show results for a subset of four chronic conditions—asthma, bronchitis, blindness or vision problems and digestive problems—that are roughly comparable across the surveys and have a prevalence in excess of 1% in the HSE. Following CLP, we estimate equations of the form:

$$h = \beta_0 + \beta_1(\ln\ y - \overline{\ln\ y}) + \beta_2 C + \beta_3[C(\ln\ y - \overline{\ln\ y})] + X\delta + \varepsilon \quad (1)$$

where h is an indicator of poor health (fair or poor in the NHIS; fair, bad or very bad in the HSE); $(\ln\ y - \overline{\ln\ y})$ is the deviation of the logarithm of income from its sample mean, C is an indicator that a child has a chronic condition and X denotes the controls listed in the note to Table 2. Because income is centered around its mean, β_2 measures the effect of the condition on health status at mean income. The coefficient β_3 shows how the effects of the chronic condition on health status differ across higher and lower income children. CLP estimated (1) separately for each condition because the 1986–1995 NHIS surveys did not collect information on all conditions for any single child. However, for data sets such as the HSE where complete information is collected for each child, it is possible to estimate regressions that include indicators for all conditions and their interactions with income. Including all conditions at once mitigates biases that result from co-morbidity.

Table 4 first shows results from the 1986 to 1995 NHIS. The estimation technique is identical to that in CLP, except that we have restricted the sample to children ages 0–15 and have weighted the regressions, and the estimation results are very similar to those in CLP. Each of the conditions listed is associated with worse health status. For example, the estimates of β_2 indicate that, at mean log income, a child with asthma is 9.5 percentage points more likely to be in fair or poor health, and a child with digestive problems is 7.0 percentage points more likely to be in fair or poor health. The estimates of β_3 indicate that the effect of each condition on health status declines as income rises. For example,

asthma is associated with an increase in the probability of being in fair or poor health of 12.3 percentage points when family income is at the 25th percentile and by 6.3 percentage points when family income is at the 75th percentile.

The second and third sets of results in Table 4 indicate that, in the HSE, chronic conditions have larger effects on health status than in the NHIS, and income plays a larger role in buffering health from the adverse effects of chronic conditions. The estimates in the middle panel are based on regressions that include one condition at a time, and so are comparable to the NHIS results. The estimates of both β_2 and β_3 for the HSE are larger (in absolute value) than those for the NHIS. The English estimates of β_2 are more than double those for the US. The last two columns of Table 4 show results of a regression that includes all of the conditions listed in Table 3 and their interactions with income. (The very low prevalence conditions are grouped together under "all other conditions"). When all conditions are included, the effects of each of the original four conditions on health status are somewhat attenuated, as are the coefficients on the interaction terms, but both sets are still large and highly significant. These results indicate large differences in the health status of poorer and wealthier English children with the same chronic conditions.

5. Conclusion

Measured using the association between the log of family income and children's reported health status, income gradients in children's health status are larger in the US than in England. One possible explanation for this finding, and one offered by CSW, is that English children have equal access to high quality health care, whereas poor American children receive less and/or lower quality health care. However, two of our results are not consistent with this explanation. First, the increase in the gradient with age is the same in England and the United States, at least up through age 12 (which is the oldest age for which the measures of health status are comparable). If health care is responsible for the smaller income gradient in health status in England, these positive effects do not appear to accumulate as children grow older. Second, chronic health conditions have larger adverse effects on English children's health status, and income plays a larger role in buffering their health status from the effects of chronic conditions. One would expect that accessible and high quality health care would dampen the effects of chronic conditions on health status, and make the effects of conditions on health status less dependent on income.

It is possible that the differences in the results across the two countries do not reflect anything about the environments of or systems of health care in the two countries. Instead, it may be that comparisons based on different surveys—with different wording of questions, data collection protocols and sample sizes—make precise comparisons impossible.

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