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Does teenage childbearing increase smoking, drinking and body size?

Dinand Webbink [a,*], Nicholas G. Martin [b], Peter M. Visscher [b]

[a] *CPB Netherlands Bureau for Economic Policy Analysis and SCHOLAR, University of Amsterdam, P.O. Box 80510, 2508 GM, The Hague, The Netherlands*
[b] *Queensland Institute of Medical Research, Brisbane, Australia*

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Abstract

This paper analyses the causal effect of teenage childbearing on smoking, drinking and body size using a sample of Australian twins and their relatives. Fixed effects estimates on samples of siblings, all twin pairs and identical twin pairs show that teenage mothers smoke more during their lives. Teen mothers tend to have a higher probability of being overweight, especially if they are older than 40 years. Their spouses are more likely to smoke and drink more. The quality of the spouse seems to be an important mechanism through which teenage childbearing affects subsequent maternal health.

JEL classification: I18

Keywords: Teenage childbearing; Smoking; Drinking; Body size

1. Introduction

Teenage childbearing is considered a major problem in many countries because of the possible adverse outcomes for the mothers, their children and society.[1] For instance, the US and Britain included teenage pregnancy as a national public health problem requiring targeted interventions (Lawlor and Shaw, 2002). This paper analyses the longer term effects on health behavior of teen mothers. Teenage motherhood might lead to adverse health outcomes through reducing choices and opportunities (Hobcraft and Kiernan, 2001), for instance in educational attainment, the labor market and the marriage market, which may affect mental health and induce negative health behavior such as smoking and drinking. Recent studies have found a lower level of mental health for teenage mothers than for other mothers or teenage non-mothers (Liao, 2003) and higher likelihoods of being a current smoker and reporting poor physical and mental health for teenage mothers (Hobcraft and Kiernan, 2001).

The crucial question in the recent literature on teenage childbearing is whether the effects are causally related to the age of the mother, or whether there are other factors, for instance the poor socio-economic condition of many teenage

* Corresponding author. Tel.: +31 703383411.
E-mail address: webbink@cpb.nl (D. Webbink).

[1] The highest rates for the developed countries are found in the US (52 per 1000), UK (31), New Zealand (30), Canada (20) and Australia (18) (UNICEF, 2001, data for 1998).

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mothers, which lead to the adverse outcomes. To address the endogeneity of teenage childbearing several studies use within-family estimation based on samples of siblings (Geronimus and Korenman, 1992; Holmlund, 2005). In this paper we extend this approach by comparing the health behavior of teenage mothers with the behavior of their (twin) sisters who had their first child after the age of twenty. For the analysis we use a sample of Australian twins and their relatives.

Our paper makes several contributions to the literature on the effects of teenage childbearing. First, previous research mainly focused on socio-economic outcomes of teen mothers such as educational attainment, labor market and marital outcomes. The focus of our paper is on longer term adult health outcomes of teen mothers. We study the effects on the leading preventable causes of death—smoking, drinking and obesity (Mokdad et al., 2004). Second, one of the main approaches to address the endogeneity of teenage childbearing is within-family estimation using samples of siblings (Geronimus and Korenman, 1992; Holmlund, 2005). Our data enable us to compare outcomes within pairs of siblings, within pairs of twins and also within pairs of identical twins. A further contribution is that we also study three mechanisms through which teenage childbearing possibly affects health: socio-economic opportunities, the number of children or the 'quality of the spouse'.

The main finding from the within-family estimates is that teenage childbearing leads to adverse health behavior, especially with respect to smoking. We find that teenage mothers smoke 2.6–4 more years during their life and are less likely to quit smoking than their (twin) sisters. These differences are not related to a difference in the initial smoking phase. Moreover, teenage mothers have spouses who more often currently smoke and drink more. Next to the adverse effects on smoking we also find a higher probability of being overweight for teenage mothers, especially when they are 40 years or older. Moving the cutoff age for teenage mothers from 20 to 19.5, 19 or 18.5 years tends to increase the adverse outcomes. We checked the impact of measurement error by instrumenting teenage childbearing measured in the most recent survey with teenage childbearing measured in the previous survey. The IV-estimates are larger and consistent with the previous findings. The findings are robust for including birth weight and age at menarche as additional controls, the exclusion of pairs of twins with a large difference in the age at which their first children were born and a large difference in years of education and for pairs of twins who report a separation of at least 1 year. Finally, we find that the effect of teenage childbearing on smoking seems to be related with 'the lower quality of their spouses'. The lower socio-economic opportunities and the higher number of children of teenage mothers have a slight effect on body size.

The remainder of this paper is organized as follows. The next section reviews previous studies on the effects of teenage childbearing and explains the methodology used in this paper. Section three describes the data. The main estimation results are shown in Section 4. Section 5 deals with the issue of measurement error and Section 6 addresses endogeneity bias. In Section 7 we explore the mechanisms through which teenage childbearing possibly affects health and Section 8 concludes.

2. Previous studies and methodology

The traditional approach to estimate the causal effect of teenage childbearing on adult outcomes is to control for observable factors, especially measures of socio-economic status, using regression models (see for instance Card and Wise, 1978; Hofferth and Moore, 1979; Upchurch and McCarthy, 1990; McElroy, 1996). These studies typically find substantial adverse outcomes of teenage childbearing. A recent study using longitudinal data from the UK finds that teenage mothers are more than two and a half times more likely to be cigarette smokers at the age of 33 than those who delay their first birth to ages 23–32 (Hobcraft and Kiernan, 2001). This study also finds that teenage mothers are more likely to report poor physical and mental health. Liao (2003) investigates the effects on mental health using ten waves of the British Household Panel Survey. The main findings are that teenage mothers have a significant lower level of mental health than other mothers or teenage non-mothers. In addition, the development of mental health appears to be different for teenage mothers than for other women. Postnatal depression tends to be more severe for teenage mothers than for older women. This study also finds that the negative impact on a mother's mental health decreases with older age at first birth. However, the question remains whether these findings may be interpreted as causal effects. The estimates obtained with this approach will be biased if unobserved factors are correlated with teenage childbearing and adult outcomes.

Several studies have attempted to improve on these estimates by explicitly taking the endogeneity of teenage childbearing into account. For instance, bivariate probit models have been used to estimate the joint process of the

woman's decision to bear a child as a teenager as well as the maternal outcome of interest, such as, education (Ribar, 1994), labor supply, or poverty status (Lundberg and Plotnick, 1990). These studies find at most modest negative outcomes of teenage childbearing.

Several recent papers use an instrumental variable approach. Hotz et al. (2005) exploit the fact that some women who become pregnant experience a miscarriage and do not have a live birth. If miscarriages are random and all miscarriages occur before abortions have taken place this provides a consistent estimate of the effect of teenage childbearing. They find that teenage childbearing increases the probability of completing high school and also has a positive effect on later earnings. Ermisch and Pevalin (2003, 2005) employ the same technique for the UK. They do not find adverse effects of teenage childbearing on education or labor market outcomes, but do find that women who were teenage mothers are more likely to have unemployed or low-income husbands at age 30. Bradbury (2006) uses the same approach for Australian data and finds no adverse impact of early childbearing on education, employment and income, and a lower probability of having a partner. However, the findings by Hotz et al. (2005) have been criticized. In a re-analysis of the data, Hoffman (2003) found the effects to be smaller. In addition, Ashcraft and Lang (2006) show that miscarriages occur both early and late in pregnancy and some abortions prevent miscarriages, which violates the assumptions of the IV-estimator. Using a competing risk model they find modest adverse outcomes of teenage childbearing. The approach to reduce bias by unobserved effects followed in this paper is based on within-family estimation.

2.1. Methodology

The typical econometric model used for within-family estimation is:

$$y_{ij} = \alpha + \beta T_{ij} + \gamma X_{ij} + f_j + \varepsilon_{ij} \tag{1}$$

where y_{ij} is the outcome of individual i in family j, T_{ij} is a dummy variable that takes the value one if the individual is a teenage mother and zero otherwise, X_{ij} is a vector of covariates, f_j is an unobserved family effect common to all siblings within the same family, and ε_{ij} is a random error term. In this model the family fixed effect is removed by differencing (de-meaning) between siblings.

An application of this approach is found in Geronimus and Korenman (1992) (G&K) who compare the socio-economic outcomes of sisters who timed their first birth at different ages. In two of the three data sets that they examine they find that the adverse outcomes of teenage childbearing are much smaller when family fixed effects are taken into account. A recent paper on the effect of teenage childbearing on educational attainment extends the within-sibling analysis by including information on pre motherhood school performance (Holmlund, 2005). She finds a lower educational attainment for teenage mothers.

In this paper we estimate the consequences of teenage childbearing on smoking, drinking and body size using 'within-family' estimation on data of Australian twins and their relatives. The sample used in the analysis consists of women who all have at least one child and one sister in the sample who is also a mother. We follow the approach of G&K and Holmlund (2005) by comparing cross-sectional estimates with within-sibling estimates, and extend this research by investigating differences within pairs of twins and within pairs of identical twins. After the main analysis we address the two main concerns in within-family models: measurement error and endogeneity bias.

A well-known concern in within-family models is measurement error. The within-family estimator exacerbates measurement error, which is likely to bias the estimates towards zero. Several studies on the returns to schooling using samples of twins address measurement error in schooling by instrumenting with a second independent measure of schooling (Ashenfelter and Krueger, 1994; Miller et al., 1995). This approach produces consistent estimates when the measurement error is classical. However, our main explanatory variable is a binary indicator which means that the measurement error is per definition non-classical. It has been shown that the IV-estimate will then be upward biased, such that the OLS estimate provides a lower bound and the IV-estimate an upper bound of the true effect (Aigner, 1973; Kane et al., 1999). We follow this approach by instrumenting teenage childbearing measured in the most recent survey with teenage childbearing measured in the previous survey (Section 5). This gives us an upper bound of the true effect of teenage childbearing on health behavior.

The second concern in within-family models is endogeneity bias. G&K note that the comparison of sisters provides an improved way of accounting for family background characteristics but these estimates might still be biased by heterogeneity within families. There may be differences between siblings in genetic endowments or in the way parents treat them (Rosenzweig and Wolpin, 1988). In addition, the socio-economic conditions facing sisters and the parental

inputs received by sisters may differ if family circumstances change over time and with the childrearing experiences of their parents (Hotz et al., 2005). This concern has also been expressed in the context of estimating returns to schooling (Bound and Solon, 1999). The bias in the within-family estimator is not always smaller than the bias in the cross-sectional estimator. This depends on the importance of the fixed family component in the unobservables that both affect teenage fertility and the outcome variable. If endogenous variation comprises a smaller share of the between-twins variation than it does of the between-families variation then the bias of the within-estimator is smaller than the bias in the cross-sectional estimator. Our paper extends the previous literature, which used data of siblings, by addressing this possible bias in two ways.

First, we replicate the within-estimation for samples which consist of all twins and identical (monozygotic, MZ) twins only. It is likely that family circumstances for twins will be more equal than for siblings, which differ in age. For instance, the socio-economic conditions facing the sisters in the twin sample are expected to be more comparable than the conditions in the sample that also includes the relatives. In addition, the within-estimates of identical twins also control for differences in genetic endowments. Hence, we may expect that the within-twin estimates will be less biased by heterogeneity within families than the within-sibling estimates.

Second, we investigate the robustness of the estimates after including additional controls for birth weight and age at menarche and after excluding pairs of twins with large differences in the age at which their first children were born or in years of education. These large differences might indicate that these twins are different. In addition, we exclude twins who report a separation of their co-twin of at least 1 year during childhood. These reductions of the samples will probably eliminate heterogeneity which may confound the effects (Holmlund et al., 2006).

3. Data

The data of twins used in this study were gathered in two mail surveys, in 1980–1982 and 1988–1989. The sample consists of all 5967 twin pairs aged over 18 years enrolled in the Australian National Health and Medical Research Council Twin Registry at the time of the first survey. In the first survey 3810 complete pairs participated, and of these 2934 twin pairs responded in the second survey (Miller et al., 1995). In addition to these surveys, data were gathered for the relatives of these twins, including parents, siblings and children, in a survey in 1989–1991. The total number of siblings in this data set is 4832 of which 2434 are female.

The surveys gathered information on the respondent's family background (parents, siblings, marital status, and children), socio-economic status (education, employment status and income), health behavior (body size, smoking and drinking habits), personality, and feelings and attitudes. In this paper we restrict the sample to women who are mothers who have at least one (twin)sister in the sample who is also a mother. To avoid sample selection, for instance due to retirement or natural death, we exclude women above the age of 60 at the time of the second survey.

The main independent variable in the analysis is a dummy variable which has value 1 if the women had a child before the age of twenty and has value 0 if the women had her first child at the age of twenty or at a later age. For the construction of this variable we use information from both surveys. The first survey only asked the year of first birth, whereas in the second survey the exact date was asked. Therefore, we use information from the second survey. If this information is missing, we add information from the first survey (this applies to 12 twin pairs). As covariates we use mother's and father's education, age at survey, birth weight and age at menarche. Educational attainment is measured using a seven-point scale and translated into years of education (Miller et al., 1995).

We distinguish three categories of health outcomes measured in the surveys of 1988 (twins) and 1989 (relatives of twins): smoking, drinking and body size. These surveys collected information on current and previous smoking behavior and the starting age of smoking. For drinking we use the variable 'the number of drinks in a typical week' measured in 9 categories (0, 1–3, 4–6, 7–12, 13–18, 19–24, 25–42, 43–70, more than 70). We translated this variable by taking the average per category and for the maximum category 80 drinks per week. For body size we constructed the standard BMI (body-mass-index) measure. Overweight (obesity) is defined as a BMI-score of 25 (30) or more. The surveys also collected information on smoking and drinking of the spouse. These outcomes might also be relevant for the health of the teenage mothers. The questions on smoking and drinking refer to the habits of the spouse during their lifetime and include spouses that are deceased. Hence, they do not distinguish between present and absent spouses.

Table 1 shows sample means and proportions for background characteristics and outcome variables. The cross-section sample consists of mothers with at least one child and a sister in the sample who also has at least one child. The number of teenage mothers in this sample is 280 and the number of non-teen mothers is 2789. The within-family

Table 1
Sample means (standard deviations) and proportions

	Cross-section		Within-family					
			All siblings		All twins		MZ twins	
	(1) Teen	(2) Non-teen	(3) Teen	(4) Non-teen	(5) Teen	(6) Non-teen	(7) Teen	(8) Non-teen
Years of education mother	8.8	9.3	8.9	8.9	8.7	8.7	8.7	8.4
	(2.4)	(2.5)	(2.3)	(2.5)	(2.4)	(2.3)	(2.7)	(2.4)
Years of education father	8.8	9.7	9.0	9.0	8.8	8.7	9.3	8.7
	(2.8)	(3.1)	(2.7)	(2.8)	(2.7)	(2.6)	(3.0)	(2.6)
Years of education	10.0	11.3	10.1	10.9	9.9	10.3	10.0	10.3
	(1.8)	(2.3)	(1.7)	(2.3)	(1.5)	(1.9)	(1.4)	(1.7)
Age in 1988	39.6	41.0	39.1	39.0	40.4	40.4	41.1	41.1
	(8.2)	(8.7)	(8.1)	(8.2)	(8.4)	(8.4)	(9.1)	(9.1)
Age at first birth	18.5	25.6	18.5	24.5	18.5	23.9	18.4	23.7
	(1.1)	(3.6)	(1.1)	(3.4)	(1.2)	(3.3)	(1.3)	(3.1)
Birth weight	2534	2427	2494	2469	2475	2556	2376	2474
	(696)	(630)	(637)	(670)	(656)	(704)	(681)	(732)
Age at menarche	12.8	13.1	12.8	13.0	12.9	13.0	13.0	12.9
	(1.3)	(1.4)	(1.4)	(1.4)	(1.4)	(1.3)	(1.4)	(1.2)
Ever smoker	0.57	0.40	0.56	0.54	0.52	0.55	0.52	0.55
	(0.50)	(0.49)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)
Starting age smoking	16.9	17.7	16.8	16.8	17.0	16.5	16.7	16.5
	(3.7)	(3.8)	(3.9)	(3.3)	(4.4)	(3.3)	(3.7)	(2.5)
Former smoker	0.36	0.55	0.35	0.50	0.33	0.51	0.29	0.57
	(0.48)	(0.50)	(0.48)	(0.50)	(0.47)	(0.50)	(0.46)	(0.50)
Current smoker	0.37	0.18	0.37	0.27	0.35	0.27	0.37	0.24
	(0.48)	(0.39)	(0.48)	(0.44)	(0.48)	(0.45)	(0.49)	(0.43)
Smoking years	18.2	15.6	18.1	15.5	18.9	15.4	19.4	14.7
	(9.3)	(9.0)	(9.6)	(8.7)	(9.7)	(8.7)	(10.1)	(9.3)
Spouse current smoker	0.40	0.24	0.42	0.25	0.44	0.23	0.48	0.17
	(0.49)	(0.43)	(0.50)	(0.44)	(0.50)	(0.42)	(0.50)	(0.38)
Weekly drinks	3.4	3.3	3.7	2.3	3.0	2.1	2.7	2.5
	(8.3)	(6.0)	(9.1)	(3.3)	(5.3)	(3.5)	(4.1)	(3.9)
Spouse weekly drinks	10.5	7.8	11.3	7.2	11.8	7.6	13.0	8.1
	(14.9)	(10.9)	(16.1)	(9.8)	(16.4)	(11.0)	(17.6)	(10.9)
BMI	24.6	23.4	24.3	23.8	24.3	23.3	23.6	23.2
	(4.9)	(4.1)	(4.7)	(4.1)	(4.6)	(3.3)	(3.8)	(3.6)
Overweight	0.38	0.27	0.35	0.30	0.37	0.25	0.33	0.23
	(0.49)	(0.44)	(0.48)	(0.46)	(0.49)	(0.44)	(0.48)	(0.42)
Obese	0.13	0.07	0.12	0.08	0.09	0.04	0.03	0.05
	(0.34)	(0.25)	(0.32)	(0.27)	(0.29)	(0.20)	(0.18)	(0.23)
N	280	2789	215	286	127	127	71	71

samples consist of sisters of which at least one is a teen mother. With this restriction the sample size reduces to 215 teenage mothers and 286 (twin) sisters who had their first child at the age of twenty or older. The number of teen mothers is smaller than in the cross-sectional sample because of losing pairs concordant for being teen mothers. The number of non-teen mothers in the sibling sample exceeds the number of teen mothers because of sibships that include three sisters or more. Previous studies included between 50 and 125 pairs of siblings (G&K, 1992) and 322 pairs of siblings (Holmlund, 2005). Our sample of (identical) twins consists of 127 (71) teenage mothers and their twin sisters.

Table 1 shows two columns of means and proportions for each sample. The first column shows the statistics for women who have a child as a teenager. The second column shows the statistics for women who have a child when they are at least 20. The number of observations used in each row might differ because of missing values on the relevant variables. In addition, several variables refer to subsets of the samples. For instance, the variable 'starting age of smoking' refers to the subset of smokers. The means for these variables are based on the corresponding subsets of the samples.

Starting with the cross-sectional comparisons in columns (1) and (2) we observe that teen mothers have less educated parents and are less educated that non-teen mothers. The health indicators show a clear picture. Teen mothers more often smoked during their life, started smoking at an earlier age, are less likely to quit smoking, more often are currently smoking and have more years of smoking. In addition, their spouse more often currently smokes and drinks more than the spouse of non-teen mothers. Moreover, teen mothers have a higher BMI and are more likely to be overweight and obese. Columns (3)–(8) show the within-family comparison of teen mothers and their sisters. This comparison eliminates the differences in social background in the first rows of Table 1.[2] The smoking variables show that the differences in ever smoking and starting age of smoking become quite small. But there remain clear differences on the other smoking variables: teen mothers are less likely to quit smoking, more often are currently smoking and have more smoking years. In addition, spouses of teen mothers smoke more often and drink more than the spouse of their sisters. The differences in BMI seem to become smaller in the within-family samples but there remain clear differences in the probability of being overweight.

4. Main estimation results

Table 2 shows the estimated effects of teenage childbearing on smoking, drinking and BMI. Column (1) is based on a linear regression model of a dummy for teenage childbearing on adult health (standard errors are adjusted for clustering within families). Column (2) shows the results after including the education of the parents and age as covariates. Columns (3)–(5) show the within-family estimates of linear regression models for, respectively, the sample of siblings, twins and identical twins only. The sample of siblings includes siblings and all twins and the sample of all twins includes identical and fraternal twins. The model for the sample of siblings also controls for age. Each cell shows the results of a separate regression, Table A.1 in Appendix A shows the number of observations used in each regression.

The cross-sectional estimates in columns (1) and (2) show that teenage childbearing is associated with adverse outcomes on almost all measures of health. Women who bear children as teens smoked more often during their lives, started smoking at an earlier age, less often stopped smoking, more often currently smoke and smoked for more years. In addition, their spouses more often smoke and drink more. They also have a higher BMI and are more often overweight. In contrast to many studies on socio-economic outcomes of teenage childbearing, this picture of adverse outcomes changes only slightly when family fixed effects are taken into account (columns (3)–(5)). For the first two smoking variables there are clear changes. The three within-family estimates show no difference in experience with smoking or age of onset of smoking between teen mothers and their (twin)sisters. This suggest that there is no difference in the initial smoking phase. However, the next smoking variables show that teen mothers less often quit smoking and more often are currently smoking. This translates into 2.6–4 more years of smoking for teen mothers. In addition, their spouses more often smoke and have more weekly drinks than the spouses of their twin sisters. It should be noted that the size of these effects tends to increase if we move from the sibling sample (column (3)) to the sample of identical twins (column (5)). Hence, the estimated differences become more transparent when mothers become more comparable. For BMI we find a significant estimate for the first two within-family samples. We also find a higher probability of being overweight in both samples of twins. Increases in weight typically occur (and become observable) when people grow older. We therefore show at the bottom of Table 2 the within-family estimates for the sample of women older than 40 years. It should be noted that this reduces the sample sizes (see Appendix A). These estimates show a higher BMI and more overweight for teenage mothers. We do not report results on obesity because of small sample sizes (see Table 1).

Next, we analyzed whether the findings are robust for the arbitrary threshold of the age of 20 for being a teenage mother. We also investigated cutoffs at the age of, respectively, 19.5, 19 and 18.5 years which reduces the number of teenage mothers in the (identical) twin samples to 100 (59), 70 (38) and 55 (32), respectively. Table 3 shows the results for these three cutoffs for the samples of twins.

With the reductions of the sample sizes the estimates lose precision. However, the estimates are robust to the new thresholds. Several adverse outcomes become more pronounced as the threshold moves to younger groups. This especially holds for former and current smoking. For teenage mothers who had their first child before the age of 18.5 we find the largest difference with their twin sisters in current smoking.

[2] The difference in parental education in the sample of identical twins are due to missing values.

Table 2
Effect of teenage childbearing on health behavior

	Cross-section		Within-family		
	(1)	(2)	(3) Siblings	(4) All twins	(5) MZ twins
Ever smoker	0.171	0.201	0.005	−0.052	−0.045
	(0.030)***	(0.035)***	(0.039)	(0.042)	(0.045)
Starting age smoking	−0.803	−0.587	−0.076	0.163	0.704
	(0.305)***	(0.370)	(0.399)	(0.475)	(0.514)
Former smoker	−0.200	−0.164	−0.092	−0.163	−0.233
	(0.039)***	(0.046)***	(0.066)	(0.084)*	(0.114)*
Current smoker	0.191	0.190	0.075	0.060	0.106
	(0.029)***	(0.034)***	(0.037)**	(0.045)	(0.058)*
Smoking years	3.034	3.364	2.562	3.844	3.963
	(0.755)***	(0.636)***	(0.911)***	(1.440)**	(1.967)*
Spouse current smoker	0.162	0.176	0.158	0.213	0.298
	(0.029)***	(0.035)***	(0.050)***	(0.071)***	(0.083)***
Weekly drinks	0.283	0.117	1.860	0.946	0.539
	(0.481)	(0.488)	(0.658)***	(0.552)*	(0.621)
Spouse weekly drinks	2.977	3.428	4.321	4.831	5.266
	(0.960)***	(1.088)***	(1.350)***	(2.172)**	(2.724)*
BMI	1.206	1.333	0.650	1.003	0.179
	(0.307)***	(0.365)***	(0.375)*	(0.470)**	(0.381)
Overweight	0.132	0.151	0.054	0.135	0.094
	(0.031)***	(0.035)***	(0.042)	(0.053)**	(0.056)*
>40 years					
BMI	1.512	1.642	1.314	2.324	0.851
	(0.467)***	(0.564)***	(0.624)**	(0.857)**	(0.423)*
Overweight	0.201	0.216	0.188	0.297	0.227
	(0.051)***	(0.060)***	(0.067)***	(0.085)***	(0.091)**
Controls					
Education parents	No	Yes	–	–	–
Age	No	Yes	Yes	–	–

* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

In sum, we find clear adverse health outcomes for teenage mothers in comparison with their sisters, twin sisters or identical twin sisters. Teen mothers have more years of smoking and have spouses that smoke more often and drink more. In addition, teen mothers are more likely to be overweight.

The main concerns in the literature using within-family estimation are measurement error and endogeneity bias. We address these issues in the next sections.

5. Measurement error

Measurement error is an important concern in within-family models. The within-family estimator aggravates measurement error, which is likely to bias the estimates towards zero. In the literature on the returns to schooling using samples of twins several studies address the issue of measurement error in schooling by instrumenting with a second independent measure of schooling (Ashenfelter and Krueger, 1994; Miller et al., 1995). This approach produces consistent estimates when the measurement error is classical. However, since our main variable is a binary indicator the measurement error is non-classical. It has been shown that the IV-estimate will then be biased upward (Aigner, 1973; Kane et al., 1999). The within-family estimate from the previous section will then provide a lower bound and the IV-estimate an upper bound of the true effect.

Previous studies on the returns to schooling typically use measures of the schooling of a twin reported by the co-twin. Our data do not include this type of information on teenage childbearing. However, our data on twins come

Table 3
Within-twin effect of teenage childbearing on health behavior using other age cutoffs

	Teen mum< 19.5 years		Teen mum <19 years		Teen mum <18.5 years	
	(1) All twins	(2) MZ twins	(3) All twins	(4) MZ twins	(5) All twins	(6) MZ twins
Ever smoker	−0.032	−0.036	−0.013	−0.023	−0.016	0.026
	(0.048)	(0.052)	(0.058)	(0.062)	(0.059)	(0.059)
Starting age smoking	0.771	0.826	1.000	1.316	1.409	1.471
	(0.506)	(0.592)	(0.600)	(0.709)*	(0.660)**	(0.743)*
Former smoker	−0.150	−0.269	−0.188	−0.381	−0.192	−0.316
	(0.092)	(0.118)**	(0.095)*	(0.109)***	(0.096)*	(0.110)***
Current smoker	0.084	0.127	0.118	0.209	0.129	0.211
	(0.049)*	(0.064)*	(0.056)**	(0.071)***	(0.054)**	(0.067)***
Smoking years	3.270	4.417	3.103	4.632	2.957	3.882
	(1.605)**	(2.179)*	(1.825)	(2.519)*	(2.075)	(2.629)
Spouse current smoker	0.230	0.298	0.246	0.333	0.152	0.250
	(0.078)***	(0.096)***	(0.088)***	(0.105)***	(0.093)	(0.110)**
Weekly drinks	0.932	0.250	1.153	0.091	1.163	0.150
	(0.675)	(0.699)	(0.765)	(0.729)	(0.859)	(0.762)
Spouse weekly drinks	3.750	5.679	2.060	3.578	0.915	2.661
	(2.289)	(3.143)*	(2.415)	(3.105)	(2.669)	(3.386)
BMI	0.648	0.407	1.371	0.429	1.543	0.383
	(0.567)	(0.432)	(0.477)***	(0.440)	(0.564)***	(0.487)
Overweight	0.132	0.133	0.129	0.081	0.120	0.091
	(0.057)**	(0.060)**	(0.059)**	(0.060)	(0.068)*	(0.067)
>40 years						
BMI	1.813	1.112	2.440	0.861	2.942	0.596
	(0.747)**	(0.493)**	(0.921)**	(0.645)	(1.124)**	(0.735)
Overweight	0.258	0.278	0.227	0.167	0.294	0.182
	(0.103)**	(0.109)**	(0.113)*	(0.112)	(0.143)*	(0.122)

* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

from two surveys. Both surveys contain information on the date of birth of the first child. Our measure of teenage childbearing used in the previous analysis is mainly based on information from the second survey because only in this survey the exact date of birth has been asked (see Section 3). To address the issue of measurement error we instrumented the difference in teenage childbearing measured in the second survey with the difference measured in the first survey. The correlation between the two measures of teenage childbearing, which indicates the reliability ratio, is 0.7. It seems likely that this relatively low reliability ratio comes from the imprecise measure of the date of first birth in the first survey (only the year of first birth has been asked). For 28 observations we find that the two measures of teenage childbearing have different values, but only 6 individuals report in the first survey that their age at first birth is older than 21 years. Due to missing values on these two measures of teenage childbearing the sample of teenage mothers in the IV-estimates will be smaller than the sample used in Table 2. To increase comparability, when there is a missing value we imputed the values of the other measure. For the largest sample of twins we imputed values for 68 observations.[3] Table 4 shows the estimation results.

In general, the findings are consistent with those in Table 2 but the size of most estimates has increased. This especially holds for smoking years and number of weekly drinks taken by the spouse. If we consider the estimates in Table 4 as an upper bound of the true effect of teenage childbearing, then this implies that the adverse health behavior outcomes for teenage mothers might even be more severe than indicated by the findings in Table 2.

[3] The results are not affected by the imputation of the missing values. The estimates for the subset of the original sample are similar to those in Table 2 and the IV-results for the same subset are similar to those in Table 4.

Table 4
Instrumental variable estimates of teenage childbearing on health behavior

	(1) All twins	(2) MZ twins
Ever smoker	−0.048	−0.022
	(0.050)	(0.055)
Starting age smoking	0.839	1.211
	(0.573)	(0.624)*
Former smoker	−0.194	−0.364
	(0.098)**	(0.136)***
Current smoker	0.072	0.178
	(0.053)	(0.071)**
Smoking years	4.156	5.895
	(1.709)**	(2.388)**
Spouse current smoker	0.250	0.385
	(0.083)***	(0.101)***
Weekly drinks	0.877	0.147
	(0.656)	(0.764)
Spouse weekly drinks	6.366	8.409
	(2.556)**	(3.298)**
BMI	0.807	0.380
	(0.546)	(0.451)
Overweight	0.136	0.132
	(0.062)**	(0.066)**
>40 years		
BMI	1.604	1.055
	(1.074)	(0.533)**
Overweight	0.292	0.286
	(0.106)***	(0.116)**

* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

6. Endogeneity bias

The second concern in within-twin models is endogeneity bias. Twins might differ on unobserved factors and the estimated differences might not be caused by teenage childbearing but by these unobserved factors. In this section we follow three approaches. First, we introduce additional controls in the within-twin models. Second, we focus on smaller samples of twins that are arguably more alike. Third, we investigate the impact of the selection on mothers only in the control group and checked whether the results on the drinking and smoking behavior of the spouse are sensitive to the exclusion of a small group of 'single mothers'.

We start with including controls for birth weight and age at menarche in the within-twin models. A recent study by Black et al. (2007) shows that birth weight is important for future outcomes. Lower birth weight babies have worse longer run outcomes such as IQ, earnings and education. If there is also an association between birth weight and teenage childbearing the estimated health effects in the previous sections might be spurious. The sample means for (identical) twins in Table 1 indicate that teenage mothers have lower birth weight. In addition, several studies show that age at menarche is associated with teenage childbearing (Klepinger et al., 1999; Chevalier and Viitanen, 2003). Women who experience earlier menarche are more likely to have a baby before the age of twenty. Our sample means for (identical) twins do not confirm this (Table 1). To improve the comparison with our main results in Table 2 we imputed the missing values for birth weight and age at menarche. In the sample of all twins we have 23 observations with missing values for birth weight and 4 observations with missing values for age at menarche. For these cases we imputed the value of the other twin, if the value was missing for both twins we imputed the sample mean.[4] The estimation results are shown in columns (1) and (2) of Table 5. We find that the results are robust to the inclusion of these two controls.

[4] The results without these imputations are very similar.

Table 5
Within-twin effect of teenage childbearing on health behavior after including additional controls or excluding twin pairs

	Birth weight and age at menarche as controls		Without twins reporting early separation		Difference in age at first birth <10 years	
	(1) All twins	(2) MZ twins	(3) All twins	(4) MZ twins	(5) All twins	(6) MZ twins
Ever smoker	−0.043	−0.045	−0.036	−0.046	−0.078	−0.050
	(0.043)	(0.046)	(0.042)	(0.046)	(0.043)*	(0.044)
Starting age smoking	0.197	0.749	0.244	0.808	0.231	0.760
	(0.499)	(0.544)	(0.495)	(0.523)	(0.523)	(0.555)
Former smoker	−0.163	−0.225	−0.170	−0.241	−0.156	−0.214
	(0.087)*	(0.120)*	(0.088)*	(0.118)*	(0.090)*	(0.119)*
Current smoker	0.069	0.102	0.072	0.108	0.049	0.100
	(0.045)	(0.058)*	(0.046)	(0.059)*	(0.049)	(0.062)
Smoking years	3.656	4.256	3.953	4.000	4.073	4.000
	(1.466)**	(2.071)*	(1.505)**	(2.044)*	(1.574)**	(2.126)*
Spouse current smoker	0.219	0.289	0.221	0.304	0.190	0.294
	(0.073)***	(0.086)***	(0.073)***	(0.084)***	(0.077)**	(0.090)***
Weekly drinks	0.978	0.360	0.954	0.550	0.750	0.533
	(0.575)*	(0.597)	(0.583)	(0.634)	(0.487)	(0.680)
Spouse weekly drinks	5.921	6.351	5.226	5.217	4.949	5.679
	(2.240)**	(2.697)**	(2.265)**	(2.784)*	(2.418)**	(3.039)*
BMI	0.902	0.228	0.959	0.179	1.163	0.049
	(0.477)*	(0.384)	(0.488)*	(0.381)	(0.514)**	(0.354)
Overweight	0.127	0.096	0.129	0.094	0.143	0.085
	(0.055)**	(0.057)*	(0.052)**	(0.056)*	(0.058)**	(0.060)
>40 years						
BMI	2.118	0.928	2.285	0.851	2.363	0.847
	(0.955)**	(0.451)*	(0.904)**	(0.423)*	(0.880)**	(0.443)*
Overweight	0.273	0.231	0.286	0.227	0.306	0.238
	(0.095)***	(0.098)**	(0.088)***	(0.091)**	(0.087)***	(0.095)**

The regressions in columns (1) and (2) control for birth weight and age at menarche. The samples used in columns (3) and (4) do not include twin pairs reporting early separation, the samples used in columns (5) and (6) do not include twin pairs with a large difference in age at first birth.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

Next, we investigated the robustness of the estimates by focusing on smaller samples of twins that we expect to be more alike. We excluded pairs of twins who reported a separation of at least 1 year in early childhood (5 pairs) or pairs which differ at least 10 years in age at first birth (6 pairs). This separation or large differences in age at first birth might indicate that these twins are different and introduce heterogeneity, which will confound the effects we wish to estimate. The estimation results are shown in the last four columns of Table 5. We find that the results are robust for these reductions of the samples. Moreover, we investigated the effect of excluding pairs that differ more than 4 years in educational attainment (6 pairs). The findings are also robust for this reduction of the sample (not shown in Table 5).

The focus of the analysis is on the effect of the timing of birth. We, therefore, restrict the sample to teenage mothers with sisters who also have at least one child and exclude teenage mothers with childless sisters. Given the postponement of motherhood among many women, we might exclude women who will have children in the near future. We tested the effect of this restriction by including teenage mothers with childless sisters younger than 40 years. This increases the number of teenage mothers in the (identical) twin samples to 135 (76). The estimation results are not affected by this extension of the sample.[5]

Approximately 10% of the women who reported on the drinking and smoking behavior of their spouse report not living with a partner in the second survey. It is likely that these women reported on the habits of their previous spouse. We checked whether the estimation results on the spousal drinking and smoking habits in Table 2 are sensitive to these answers by excluding the group of 'single mothers'. The results are not affected by excluding this group of women.[5]

In sum, this section investigated whether unobserved differences between twin sisters might bias the findings on the effects of teenage motherhood. First, we included birth weight and age at menarche as controls. Second, we tested whether the findings were robust by focusing on smaller samples of twins which we expect to be less heterogeneous. Third, we tested the impact of the restriction on mothers only in the control group. In addition, we checked whether the estimation results on the drinking and smoking behavior of the spouse are affected by missing spouses. We find that the estimates are robust to all these changes. Hence, the analyses is this section do not suggest that unobserved effects bias our findings on teenage childbearing.

7. Mechanisms

This brings us to the question: what drives these results? Why does teenage childbearing have an effect on health outcomes? In this section we explore three possible mechanisms through which teenage childbearing could possibly affect health. The first mechanism is that teenage childbearing reduces socio-economic opportunities, such as education and income, which leads to bad health. This mechanism has been suggested in several recent studies on mental and physical health problems of teenage mothers (Hobcraft and Kiernan, 2001; Liao, 2003). These studies indicate that teenage mothers are more likely to suffer from mental health problems after having a baby, which might be linked with reducing choices and opportunities. The findings on lower educational attainment of teenage mothers (Holmlund, 2005) also fit into this pattern. Hence, the reduction of socio-economic opportunities and the stress of having a baby at an early age in a poor socio-economic position might drive teenage mothers to negative health behavior. A second mechanism is that teenage mothers might have more children which might affect health. Starting childbearing early leaves the women more time for having children. More children might lead to more stress or may have a direct impact on body size. The third mechanism is that teenage childbearing leads to 'lower quality spouses' and this might lead to bad health. Teenage mothers might more often meet 'the wrong guy'. A recent study shows that teenage mothers more often have unemployed or low-income partners (Ermisch and Pevalin, 2005). Our previous estimates show that the spouses of teenage mothers smoke and drink more than the spouses of their sisters. Teenage mothers might adopt the lifestyle of their spouses.

We tested the impact of these three mechanisms by including relevant indicators in our regressions. For testing the first mechanism we included the educational attainment and the income of the teenage mother and their sisters in our regressions. We tested the second mechanism by including the number of children (and the number of children squared) in the regression. For the third mechanism we included educational attainment and income of the spouses and the variables on the smoking and drinking behavior of the spouse in the regression. The sample means of these indicators are shown in Table B.1 in Appendix B or in Table 1. The estimation results are shown in Table 6; columns

[5] Results can be obtained from the authors on request.

Table 6
Within-twin estimates of the effect of teenage childbearing on health behavior after controlling for indicators of three mechanisms

	Socio-economic opportunities		Number of children		Quality of the current spouse	
	(1) All twins	(2) MZ twins	(3) All twins	(4) MZ twins	(5) All twins	(6) MZ twins
Ever smoker	−0.061	−0.058	−0.051	−0.036	−0.059	−0.043
	(0.043)	(0.046)	(0.045)	(0.048)	(0.045)	(0.052)
Starting age smoking	0.120	0.720	0.365	0.853	0.246	0.769
	(0.485)	(0.548)	(0.490)	(0.538)	(0.513)	(0.564)
Former smoker	−0.159	−0.235	−0.176	−0.254	−0.104	−0.142
	(0.087)*	(0.122)*	(0.091)*	(0.122)**	(0.085)	(0.112)
Current smoker	0.064	0.108	0.066	0.111	0.024	0.044
	(0.046)	(0.060)*	(0.047)	(0.062)*	(0.046)	(0.062)
Smoking years	3.738	3.849	3.747	4.809	3.002	3.002
	(1.483)**	(2.094)*	(1.559)**	(2.064)**	(1.365)**	(2.005)
Spouse current smoker	0.195	0.268	0.245	0.273		
	(0.072)***	(0.085)***	(0.078)***	(0.095)***		
Weekly drinks	0.948	0.459	0.858	0.415	1.053	0.426
	(0.560)*	(0.618)	(0.592)	(0.678)	(0.597)*	(0.704)
Spouse weekly drinks	4.772	5.257	4.793	3.977		
	(2.206)**	(2.800)*	(2.378)**	−3.038		
BMI	0.799	0.022	0.676	−0.174	0.992	−0.034
	(0.472)*	(0.369)	(0.500)	(0.424)	(0.514)*	(0.405)
Overweight	0.117	0.081	0.104	0.050	0.143	0.082
	(0.054)**	(0.055)	(0.058)*	(0.063)	(0.058)**	(0.061)
>40 years						
BMI	1.844	0.667	1.677	0.339	2.388	0.836
	(0.901)**	(0.440)	(0.904)*	(0.494)	(0.983)**	(0.481)*
Overweight	0.239	0.173	0.242	0.163	0.316	0.206
	(0.088)**	(0.090)*	(0.093)**	(0.123)	(0.097)***	(0.099)*

The regressions in columns (1) and (2) also control for education and income of the mother. Columns (3) and (4) controls for the number of children and columns (5) and (6) controls for education, income, smoking and drinking of the spouse.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

(1) and (2) show the results for the first mechanism, columns (3) and (4) for the second mechanism and columns (5) and (6) for the third mechanism.

The estimates in columns (1) and (2) show that including education and income of the teenage mother does only slightly affect the results. We find that only the estimates on BMI and overweight are slightly reduced. This suggests that the reduction of socio-economic opportunities of teen mothers is not a very important mechanism that drives the adverse health outcomes. The impact of the second mechanism is tested in columns (3) and (4). The sample means show that teen mothers on average have more children (Table B.1). Including the number of children in the regressions does slightly affect the estimates of the effects on BMI and overweight. For the sample of identical twins the estimates for those older than 40 years are no longer statistically significant. For the sample of all twins the estimates for this group also reduce but remain statistically significant. This suggests that part of the effect of teenage childbearing on body size is due to having more children. The impact of the quality of the spouse, the third mechanism, is tested in columns (5) and (6). The sample means show that teenage mother on average have spouses with less education and income (Table B.1), confirming the results by Ermisch and Pevalin (2005). We find that the estimates on smoking are much smaller after controlling for the 'quality of the spouse'. The estimates in the sample of identical twins are no longer statistically significant. In addition, separate analyses show that the reduction of the smoking estimates in Table 6 is the result of including the variables on smoking and drinking of the spouse. Including only the education and income of the spouse does not affect the smoking results. Hence, the smoking behavior of teenage mothers is associated with the quality of their spouses, in particular with the smoking and drinking behavior of their spouses.

Table 7
The effect of teenage childbearing on health behavior for single teen mothers

	(1) Siblings	(2) All twins
Ever smoker	−0.032	0.087
	(0.096)	(0.087)
Starting age smoking	−0.534	−0.300
	(0.995)	(1.257)
Former smoker	−0.222	−0.182
	(0.144)	(0.182)
Current smoker	0.142	0.130
	(0.085)*	(0.114)
Smoking years	4.185	4.500
	(1.747)**	(2.557)
Weekly	4.806	1.342
drinks	(1.787)***	(2.058)
BMI	−0.462	2.045
	(0.980)	(1.452)
Overweight	−0.011	0.333
	(0.105)	(0.114)***
>40 years		
BMI	2.242	4.119
	(1.608)	(2.541)
Overweight	0.174	0.333
	(0.146)	(0.167)*

Note: Single teen mothers are teen mothers who do not live with a partner at the time of the second survey.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

We further investigated the impact of the spouse by an analysis of single teen mothers. About one third of the sample of teen mothers does not live with a partner at the time of the second survey. An analysis of this smaller sample may indicate what happens with the adverse health behavior after the partner has left. It should be noted that this analysis is limited by sample sizes which reduces the precision of the estimates. Table 7 shows the results. We do not report results for the identical twins because we only have 12 'single mothers' in this sample.

The estimates indicate that the adverse outcomes for 'single' teen mothers are at least as severe as for the total sample. Hence, the adverse health outcomes are also found when there is currently no partner. This may indicate that the impact of the low quality partners remains after they have left. However, it is also possible that the adverse health outcomes are related to the difficulties of being a single mother.

In sum, we investigated three mechanisms through which teenage childbearing could have an effect on health outcomes. We find that the reduction of socio-economic opportunities and the increase of the number of children both have a slight effect on body size. The third mechanism seems to be the most important. The smoking behavior of teenage mothers seems to be related to the lower quality of their spouses.

8. Conclusions and discussion

The main finding from the within-family estimates is that teenage childbearing leads to negative health behavior, especially with respect to smoking. Teenage mothers smoke 2.6–4 more years than their (twin)sisters and their spouses more often currently smoke than the spouses of their (twin) sisters. We also find evidence for a higher probability of being overweight, especially in women older than 40 years of age. These findings are not sensitive for the cutoff age for teenage mothers. We checked the impact of measurement error by instrumenting teenage childbearing measured in the most recent survey with teenage childbearing measured in the previous survey. The IV-estimates are larger and consistent with the previous findings. The findings are robust for including birth weight and age at menarche as controls, the exclusion of pairs of twins with large difference in age at birth and education and pairs of twins who report

a separation of at least 1 year. We investigated three mechanisms through which teenage childbearing could have an effect on health outcomes. The reduction of socio-economic opportunities and the increase of the number of children both have a slight effect on body size. The third mechanism seems to be the most important. The smoking behavior of teenage mothers seems to be related to the lower quality of their spouses.

To get a sense of the magnitude of our estimates we tentatively calculated the effect of teenage childbearing on the relative risk of mortality. We find that teenage childbearing increases the probability of being a current smoker by approximately 15% if we consider the estimates in Table 2 as a lower bound and the estimates in Table 4 as an upper bound. A 25-year study of residents from Norway found that smoking doubled the risk of dying for women (Vollset et al., 2006). Between the ages of 40 and 70 years 9.4% of never smokers died, compared with 18.7% of continuing smokers. This twofold increase would translate to a relative risk of dying for teenage mothers of 1.12 compared to their twin sisters.[6] We also find that teenage childbearing increases the probability of being overweight by approximately 25% for those older than 40 years (Tables 2 and 4). In a study on US men and women who were 50–71 years on enrolment, the association of being overweight and the risk of death was investigated in a 10-year follow-up (Adams et al., 2006). Compared to healthy people who had never smoked the mortality risk increased by 20–40% among overweight persons. If we translate this to our estimates this could mean that the relative risk of dying for teen mothers due to being overweight would be 1.07 compared to their twin sisters. These calculations indicate that the effect of teenage childbearing on mortality can be substantial. However, we stress that these calculations are only tentative indications as they are based on extrapolations of findings from different countries, periods and samples.

The main conclusion of our paper is that teenage childbearing seems to induce negative health behavior. This implies that having a baby at an early age might not only induce costs in terms of a lower socio-economic position, but also induces costs through negative health behavior.

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Appendix A. Sample sizes

Table A.1
Number of observations (groups) used in each separate regression in Table 2

	Within-family		
	Siblings	Twins	MZ
Ever smoker	466 (183)	232 (116)	132 (66)
Starting age smoking	168 (73)	86 (43)	54 (27)
Former smoker	189 (82)	98 (49)	60 (30)
Current smoker	466 (183)	232 (116)	132 (66)
Smoking years	178 (76)	90 (45)	54 (27)
Spouse current smoker	386 (150)	178 (89)	114 (57)
Weekly drinks	421 (165)	184 (92)	102 (51)
Spouse weekly drinks	355 (140)	154 (77)	94 (47)
BMI	406 (156)	178 (89)	106 (53)
Overweight	406 (156)	178 (89)	106 (53)
>40 years			
BMI	131 (54)	74 (37)	44 (22)
Overweight	131 (54)	74 (37)	44 (22)

[6] $[2(p+0.15)+(1-(p+0.15))]/(2p+(1-p))$ with p is proportion of smokers.

Appendix B. Socio-economic characteristics of teen mothers

Table B.1
Socio-economic characteristics of teen mothers and their sisters (sample means)

	All twins		MZ twins	
	Teen	Non-teen	Teen	Non-teen
Years of education 1988	9.9	10.3	10.0	10.3
	(1.5)	(1.9)	(1.4)	(1.7)
(log) Yearly income 1988	9.29	9.29	9.26	9.18
	(0.72)	(0.74)	(0.71)	(0.75)
Number of children	3.3	2.8	3.1	2.7
	(1.5)	(1.3)	(1.1)	(0.9)
Current spouse				
Years of education 1988	10.6	10.8	10.7	11.1
	(2.1)	(2.1)	(2.3)	(2.3)
(log) Yearly income 1988	10.04	10.11	10.03	10.14
	(0.59)	(0.63)	(0.58)	(0.51)
N	127	127	71	71

The annual earnings data for the twin pairs and their spouses were collected in 8 categories: (i) None; (ii) under $5000; (iii) $5000–10,000; (iv) $10,000–15,000; (v) $15,000–25,000; (vi) $25,000–35,000; (vii) $35,000–50,000; (viii) $50,000 or more. Values of $3750 and $70,000 are used for (ii) and (viii) and mid-points for the other intervals.

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