The Spillover of Sibling Education On Own Education and Health in China

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Abstract

We study the spillover effect of sibling's education on own education, health and health behavior. We use the introduction of compulsory schooling law around 1986 in China as an exogenous variation in sibling's years of schooling, of which the policy effect varies across children born in separate calendar years. We find positive sibling spillover in education, while the effect is larger from older to younger sibling than vice versa. We also find positive spillovers in health and health behavior. Our heterogeneity analysis provides suggestive evidence to support the mechanisms through sibling interaction and health information transmission, other than only through the positive spillover in own education. This non-negligible externality of education policy suggests using education policy as an instrument to improve population health is more effective than we used to think.

1 Introduction

The positive relationship between education and own health has been widely demonstrated in social science literature, and several research manage to identify the causal effect of education on

health [1]. The current findings suggest that using education as a policy instrument to enhance national health is a feasible option.

Although the education health gradient attracts enormous attentions from health researchers, it is less known about the spillover effect of education on the health of other family members, which is important to understand well how the education policy could leads to better health. In current literature, some extend the scope to the spillovers on their off springs, parents and spouses (see the review in De Neve and Kawachi (2017)).

The mechanisms that sibling's education can causally have an impact on own health can be attributed to three factors: 1.) the spillover effect on education leads an increase in own education, thus a better health by being more productive in health, more and better knowledge in nutrition and health behavior, and better accessibility to health care utilization. 2.) With a higher educated sibling, individuals may benefit from interacting with the sibling by sharing preventive health information. for example being aware of the harm of smoking or the importance of physical exercise and balanced daily diet. 3.) The change in sibling's education attainment in early teenage years by an exogenous compulsory education law may leads parents alter their investment in all the children, by either reinforcing or equalizing the human capital of each child depending on the endowment level of children and preference of parents if the household resource budget is left unchanged by the compulsory law.

In this paper, we first investigate the education spillover among siblings, and then turn to a series of health measurements to investigate the health spillovers of sibling's education. We use self-reported health, body mass index (BMI), depression measured by a simplified version of ces-

[1]Most literature exploits the compulsory reforms in developed countries and examine the impact on mortality, self-reported health among other health measures: Van Kippersluis, ODonnell, and Van Doorslaer (2011) find the compulsory education has negative impact on mortality in the Netherlands, the health effect of education is also found inKemptner, Jürges, and Reinhold (2011) and Jürges, Reinhold, and Salm (2011) in Germany and Gathmann, Jürges, and Reinhold (2015) in European countires, Clark and Royer (2013) find no health effect in Britain, Lleras-Muney (2005) and J. M. Fletcher (2015) confirm the effect in the U.S.. Galama, Lleras-Muney, and van Kippersluis (2018) provides a literature review of the causal findings in the effect of education on health and mortality.

d10, and cognitive ability measured by math and words test scores. We also have health behavior information including smoking, drinking, frequency of physical exercises, healthy and unhealthy diets and whether visiting a doctor with a common minor illness (such as a fever or diarrhea). We explore the potential heterogeneity cross child gender and sibling proximity to test mechanisms mentioned above.

We exploit the introduction of compulsory education law (CEL) that rolled out across provinces in China during the period between 1986 and 1994 as an exogenous shock on sibling's education level. The fact that siblings with different ages are exposed to this policy with differential levels helps us to identify the potential spillover effects among siblings. Unlike most compulsory education policy changes happened in recent 40 years in developed countries, which usually aimed at extending the already existing compulsory years to 2 or 3 years more, the 1986 compulsory education law is the first time that Chinese government implemented spreading across the whole nation. It requires all the children between age 6 to 15 received primary and junior secondary school. This policy setting suggests that for a household with 3 children, the child with age 6 in the policy implementation year would be exposed to the policy with 9 years, the child with age 10 would have 5 years' exposure, and the child with age 16 is not affected by the policy at all. This variation of the treatment within a family allow us to separate the direct effect of the CEL on individuals and the spillovers from their siblings (Angelucci and Di Maro (2016)). To be specific, we estimate the indirect effect of CEL policy spillover from siblings on individuals conditional on their own exposure to the CEL. In this paper we focus on the spillovers from older siblings to the young and vice versa, and we mainly choose the peer siblings that have the closest age to the respondents in our data.[2]

Our first main finding is that there exists asymmetric spillover siblings effect between the effect from older sibling to young and from younger to old. For the education, we find that the spillover from younger to old sibling is 0.57 year, meaning that 1 year increase in the younger sibling's education would lead to 0.57 years increase in the older sibling. The spillover from older to young sibling is around 1 year, which is almost twice as large than the education spillover from younger sibling to old. This finding is partially consistent with the literature: for example

[2]We also experiment with siblings of furthest age distance and get similar results.

Oettinger (2000) finds that there is only spillover effect from older to young siblings on high school graduation outcomes in the United States, and find no evidence of spillover from younger to old siblings. Biavaschi, Giulietti, and Zimmermann (2015) find that the sibling spillover effect on school performance among the left-behind children in rural China. Another finding worth noting is the effect of sibling gender composition. We find that the having a male sibling would lead to a decrease in own years of schooling, and this effect is again larger if the the older sibling is male. This finding is consistent with Lei, Shen, Smith, and Zhou (2017) on sibling composition on education in China.

We also find that positive spillover of sibling's education on own health. For the younger siblings on older ones, it leads to a better self-reported health status, higher BMI mainly by reducing the chance of being underweight, less depressive symptom, and better cognition. For the health behavior, it decreases the chance of visitor a doctor when having minor illness (probably by being more likely to buy medicine themselves due to increased cognition), more time spent in physical exercise, less likely to smoke recently. For the older sibling's education on the young, we find that it only has significant effect on BMI (and chance of being underweight) and cognitive ability. It also reduces the frequency of eating unhealthy diet and the chance of smoking recently. The magnitude of spillover on health and health behavior is larger among the older siblings on younger ones, consistent with the asymmetry of sibling spillovers on education, as we introduced in the previous paragraph.

In addition, we find that there is heterogeneity across siblings' gender, own gender, whether is the same gender as own, and siblings' current proximity. We find some suggestive evidence that the spillovers in education and cognition from an older brother is more beneficial than from an older sister, which is different from findings in previous literature: Biavaschi et al. (2015), and Qureshi (2018a) find that in developing countries a female older sibling is usually assigned significant childcare responsibilities and supervisory roles thus have a positive influence on their younger siblings. The fact that boys are in general have a less positive spillover in education and health, which can be explained by the already sufficient education investment in boys due to hte prevailing son preference in China. We find some health effect, but not education effect, heterogeneity in whether the sibling pair is in the same gender or not. This finding suggest that

sibling interaction patterns do play an important role in the potential mechanisms. In the end we find that the closer a peer sibling lives to the individual, the better in general in the positive sibling education spillovers on health and health behavior. This heterogeneity provides suggestive evidence of the knowledge transmission mechanism.

In the remaining part of this paper, we first review the existing literature and highlight the contribution of this paper in section 2. Then we describe the compulsory school law reform and related institutional background in China in section 3. Then we introduce the data and variables we use in our main analysis in section 4. Section 5 shows our identification strategy and section 6 explains our main findings. Section 7 sheds light on potential mechanisms by heterogeneity analysis. We conclude the paper in section 8.

2 Literature Review

Out paper extends the research on inter-generational transmission of human capital accumulation. Existing literature has focus on the education effect on health from parents to children (the downward spillover), from children to parents (the upward spillover), and several papers to their spouses (horizontal spillover). We focus on the another aspect of horizontal spillover effect: among the siblings. Although sibship is almost the most important intimate relationship in terms of the time children spend together and the similar resources they share in the childhood and teenage years, the research on the human capital spillovers among siblings is understudied (De Neve and Kawachi (2017)).

Our research contributes to a small but expanding literature on sibling spillovers of education achievement. Early studies (Hanushek (1992) for example) noticed the association of sibling education achievement but the fact that siblings share both similar genetics, resource and parenting style in a household, it is relatively notorious to estimate the causal sibling spillover effect. Oettinger (2000) use sibling specific characteristics (gender, family intactness in each sibling's childhood, and local unemployment rate at age 18) to instrument sibling achievement and find the is a positive education spillover from older sibling to younger ones, while do not find spillover

in the reverse direction. Recent literature (Nicoletti and Rabe (2018), Qureshi (2018b)) exploit better instruments based on the intransitivity of the peer networks, as suggested in De Giorgi, Pellizzari, and Redaelli (2010). Joensen and Nielsen (2018) exploits a exogenous change in course choice set stemming from a pilot program that only influences the older siblings cohort and finds a positive spillover from older to younger siblings in education choice. Our research overcome the identification in a similar fashion as in Joensen and Nielsen (2018), by utilizing the settings of compulsory education law around 1986 in China: it generates different level of exposure on siblings born in different years. It allows us to identify the sibling spillovers in both direction: from younger to older siblings and vice versa.

Our research also relates to the literature of sibling spillovers of health shock in childhood:J. Fletcher, Hair, and Wolfe (2012) on developmental disabilities and externalizing behavior in the United States, Breining, Daysal, Simonsen, and Trandafir (2015) on medical intervention to low birth weight in Denmark, Black et al. (2017) on the child disability in Florida and Denmark, and Altonji, Cattan, and Ware (2017) on substance usage. Our paper diverts from this part of literature, as we focus on the effect of education during childhood on later health status and health behavior in adulthood.

In addition, we go one step further by investigating the spillover effect of sibling's education on own health and health behaviors. Literature on the the effect of own education on health, usually identified by exploiting exogenous education policy especially the policy of compulsory schooling, shows evidence that in most cases, increased education leads to better health (Kemptner et al. (2011), Clark and Royer (2013), Gathmann et al. (2015), J. M. Fletcher (2015) among others), and also better health behaviors (Jürges et al. (2011), Brunello, Fort, Schneeweis, and Winter-Ebmer (2016) among others). There are some research that extends the scope to see whether the accumulated health effect of education could transmit to their offspring (Lindeboom, Llena-Nozal, and van Der Klaauw (2009), Chou, Liu, Grossman, and Joyce (2010), Güneş (2015), Cui, Liu, and Zhao (2019)) or to their own parents or not (Torssander (2013), Yahirun, Sheehan, and Hayward (2017), De Neve and Fink (2018), Potente, Präg, and Monden (2018), Ma (2019)). We fill the gap in the literature by focusing on the horizontal spillovers of education on health among family members.

Understanding the sibling spillovers of education policy is important, paying no attention to the interaction between siblings when evaluating public policy like the compulsory education law in our paper may underestimate the effectiveness of the policy. Our findings suggest a strong positive spillovers from one sibling who benefits from the compulsory education to another on both education and health, and using education policy as an instrument to improve population health could be more effective than we used to believe based on the evidence focusing on independent individuals and ignoring the potential peer spillovers. Our heterogeneity analysis suggests that the mechanism includes differential sibling interaction patterns and information transmission among siblings, besides the mechanism in an positive spillover on own education.

3 Compulsory Schooling Law

China witnessed several education expansion and destruction over time since the founding of People's Republic of China in 1949. Between 1950 and 1958 the government made an great effort to reduce the illiterate rate across country. The cultural revolution in the following years cause a raise of senior secondary school closure and the cancellation of national college entrance exam. Since 1978, with the end of cultural revolution and the starting of reform and opening, providing basic education to all the citizen was back to one of the main targets of the central government. In April 1986, Chinese central government announced the Compulsory Schooling Law (CEL), which took effect on July 1 of 1986. This reform aims at decentralizing of free basic education and implementing nine-year compulsory education. The nine-year education contains six-year primary education and three-year junior secondary education. It in principle forces all the children with age of 6 attending the primary school until they are above 16. At the same time, local government in each province can decide the starting year of CEL. Table 1 lists the CEL implementation year in each province.

The setting of Compulsory education law provides us a good instrument for education attainment. The years of exposure to the Law should be positively correlated with the individual education achievement, measured by years of schooling in our case. In previous literature that us-

ing CEL as instrument of education (Huang (2015); Ma (2019)). We also exploit the heterogeneous policy effect driven by the average education before the CEL policy. As similar in Duflo (2001), a province with better pre-policy education level can be expected to have a smaller intensity, in the sense that there is more likely to have enough supply of primary and junior secondary school education. In other words, we expect that the coefficient of the interaction between exposure to the CEL and pre-policy average education is negative. In this way our first stage can be regarded as an difference-in-difference estimation. We control the pre-law education level in all of our specifications. Table 2 shows the distribution of years of exposure to CEL policy using the sample individual's young sibling with lowest education level. The group with 0 years of exposure is our control group. We define the exposure to the CEL in the following way: it equals 0 if a person is older than 15 in the implementation year meaning this person is ave effected by he CEL policy at all, it equals 1 if a person is younger than 7 in the implementation year meaning this person is fully subject to the CEL policy. If a person is in between age 7 and 15, his/her exposure is defined as $(16 - Age_{implementation\_year})/9$, to make sure that exposure is always lying in between 0 and 1.

4 Data and Variables

4.1 Data and Sample

In this paper, we use data from China Family Panel Studies (CFPS). CFPS[3] is a almost nationally representative, biennial survey that launched the first wave in 2010 by the Institute of Social Science Survey (ISSS) of Peking University, China. The 25 provinces (excluding Inner Mongolia, Xinjiang, Tibet, Hainan, Ningxia and Qinghai) covered in the 2010 baseline survey represent 95% of the population in mainland China. The survey is designed based on the Panel Study of Income Dynamics (PSID) in the United States. It is the latest household survey that contains information of demographics, economics, education and health for each individual and his/her children, i.e. the core members of the survey, in the household, as well as data at community and household level.

[3]The data introduction on CFPS official website is available via: CFPS introduction website in English.

The 2010 round collects the sample with a implicit stratification through a multi-stage probability. In the first stage, 112 counties are randomly selected from 24 provinces with probability proportional to population (pps), except Shanghai where 32 neighborhoods or towns were sampled using pps. In the second stage, 2 or village-level units are selected with pps in each county, ending up with 640 unites in total. In the last stage, 28 to 42 households were sampled from each village-level unit and we have 14,000 household in total. The national representative sample contains 9500 households and 21760 adults. In CFPS 2010, it also collect the sibling (no matter whether living together in the same household or not) information of each adult respondent including birth time, gender, education, work and other demographic details, which makes it a suitable data to analyze the sibling spillovers of education and health with the CEL introduced around 1986 as an exogenous shock.

It is worth noting that for the information of individual health and health behaviors, as well as other economic and demographic information in the questionnaire, it is only collected for the survey respondents in CFPS. This data structure has two consequences in our empirical approach: Firstly, we only use the CFPS when investigating the health spillovers effect of education; secondly, we have more than one siblings as peers in a family with more than two children. To simply our analysis, we only consider one pair sibling in one household. We estimate both the spillovers from older sibling to younger one and vice versa. We select the sibling pairs that born next to each other. That is to say, we choose respondent's youngest older sibling as peer sibling when estimating the spillovers from older to younger sibling, and oldest younger sibling as peer sibling when estimating the spillovers from younger to older sibling. To distinguish the spillover effect from the birth order effect, we control the birth order of both siblings in the model specification. We introduce below how the main variables: the years of schooling, birth information, and an array of health and health behavior measures. We present the summary statistics of variables used in our analysis in table 3.

4.2 Siblings Education and Birth Information

In CFPS 2010, the respondents' birth year and place were recorded in Part A of Adult Questionnaire. The highest education level is asked in Part C of Adult Questionnaire. We transform the highest education level in to years of schooling using the formal years required to complete the highest education level. We code one with no formal education as 0 year of schooling, elementary school degree as 6 years, junior secondary school degree as 9 years, senior secondary school degree as 12 years, 3-year college as 15 years, Bachelor's degree as 16 years, master's degree as 18 years, and Doctoral degree as 21 years. For the siblings that currently live in the same household as the respondent, their information exists in the part of household member section. For the siblings that do not live together with the respondent, their information is collected in Part B of Adult Questionnaire. We have, for each sibling, his/her gender, birth year and month, born with same parents or not, surviving status, marital status, highest education level, occupation, administrative position and current residence. We use the same method as describe above to impute the years of schooling from the highest education level. We don't know which province the sibling was born or lived in when they attended primary and junior secondary school. At current stage we assume that they all lived in the same province as the respondent's birth place.

4.3 Measures of Health

We use both subjective and objective measures on physical and mental health conditions as introduced below.

Self-reported Health. The respondents rate their own health status from 5 levels: 1, healthy; 2, fair; 3, relatively unhealthy; 4, unhealthy; and 5 very unhealthy. We also generate an indicator of bad health when the self-reported health equals 4 or 5.

Chronic Disease. This variable is defined from the question "During the past six months, have you had any doctor-diagnosed chronic disease". It equals 1 if the answer is yes and 0 if otherwise.

Body Mass Index. Body Mass Index (BMI) is considered to be highly related to nutrition

status and risk-factors for future health problems like diabetes or cardiovascular disease (Kemptner et al. (2011)). We use the self-reported height and weight to calculate BMI. We also generate two indicators for underweight if BMI is less than 18.5 and being obesity if BMI is larger than 30.

Depression and Life Satisfiction. Depressive symptoms are measured by a simplified version of the Center for Epidemiological Studies-Depression (CES-D) 10 questions in the CFPS 2010. The simplified CES-D questions contains 6 parts: 1, feel depressed and cannot cheer up; 2, feel nervous; 3, feel agitated or upset and cannot remain calm; 4, feel hopeless about the future; 5, feel that everything is difficult; 6, think life is meaningless. For each question respondents are asked to rate from 1 to 5 according to their situation in the past month, ranging from almost every day to never. We recode each answer by 5 minus the original rating and sum the six answers together and divided by 24, implying that the variable *depression* lies in between 0 and 1. CFPS 2010 also asks an array of questions about subjective attitudes. Here we use the life satisfaction as a measure of subjective well-being. It ranges from 1 (very low) to 5 (very high). The binary measure of life satisfaction equals 1 if the rating is greater than 3.

Cognitive Ability. We use two measures of cognitive functioning from the words recalling test and mathematical calculation test. In the first test, respondents needs to recall as many nouns as they remember immediately after interviewers read a list of 34 nouns. The test would stop if respondents consecutively give three nouns that did not exist on the list. In the math test, 24 questions are asked about arithmetic. The test would stop if respondents give wrong answers to three questions continuously. Questions in both words and math lists are ordered from simple to difficult. Respondents with higher education level would start with the question with a higher order number. Variable *wordtest* and *mathtest* are defined as the question number of the most difficult question the respondent answer correctly in the word test and math test respectively. If the respondent does not give any correct answer at all, then the score is assigned as the question number before his/her starting question.

4.4 Measures of Health Behavior

Seeing Doctor with Minor Illness. The respondent is asked "what would you do in general with a common minor illness (such as a fever or diarrhea)" with six options: see a doctor right away; find-/buy medicine myself; folk medical treatment; ask for religious/Buddha's help or hold a religious ritual; take no actions and wait for natural recovery; and others. In current stage we define this variable as 1 if the respondent chooses "see a doctor right away", and 0 if otherwise. In the CFPS 2010, 32% of respondents choose seeing the doctor immediately, 61% choose find/buy medicine themselves, and 7% choose remaining options.

Diet Behavior. We use two variables to measure the daily diet behavior. The healthy diet is defined as the total times per week in the past month of having meat, fish or other aquatic products, fresh fruits and vegetables, dairy products, bean products and eggs. The unhealthy diet is defined as the total times of having preserved foods and fried foods.

Physical Exercise. We use the total length (in minutes) of exercise last week (times of exercise $\times$ duration of each time) to measure the intensity of physical exercise. It equals 0 if the respondent reports no exercise last week.

Smoking and Drinking Behavior. Smoking and drinking are both addictive behaviors that could reduce mortality. We measure the smoking and drink behaviors in two dimensions: whether smoked/drunk recently (in the past month), and have you ever smoked/drunk (there are also questions about the frequency of smoking and drinking and we do not use them).

5 Research Design

5.1 Identifying Spillover Effect

Since we focus on the spillover effect in siblings, one concern is the estimation problems in peer effect: (i) endogenous group membership, (ii) simultaneity (the reflection problem) and (iii) cor-

related unobservables in the peer group. We illustrate these identification issues in the following four equations where equation 2 and 4 represent older sibling and the equation 1 and 3 represent the younger sibling:

$$eduL_{young} = \pi_0 + eduL_{old} \cdot \pi_1 + X_{young} \cdot \pi_2 + X_{old} \cdot \pi_3 + F \cdot \pi_4 + \epsilon_{young} \tag{1}$$

$$eduL_{old} = \gamma_0 + eduL_{young} \cdot \gamma_1 + X_{old} \cdot \gamma_2 + X_{young} \cdot \gamma_3 + F \cdot \gamma_4 + \epsilon_{old} \tag{2}$$

$$health_{young} = \alpha_0 + eduL_{old} \cdot \alpha_1 + X_{young} \cdot \alpha_2 + X_{old} \cdot \alpha_3 + \upsilon_{young} \tag{3}$$

$$health_{old} = \beta_0 + eduL_{young} \cdot \beta_1 + X_{old} \cdot \beta_2 + X_{young} \cdot \beta_3 + \upsilon_{old} \tag{4}$$

Equation 1 and 2 demonstrates how the siblings influence each other's education attainment. Equation 4 is our main concern in our research. In our siblings settings, problem (i) is solved as siblings are born in a family and this decision if out of their control. For problem (ii) and (iii), although it is possible that older sibling can positively influence the younger sibling's education achievement, and there are unobserved common family factors that can simultaneously determine siblings education, the instrument strategy allows us to identify coefficient β_1 in equation 4. As we can see, the channel of young sibling's education on individual's health can either be peer effect, i.e. the coefficient β_1 in equation 4, meanwhile it can also have an impact on individual's health by peer effect on education, as described in equation 2.

In all of our specifications, we use available characteristics of individuals, siblings, and parents. For respondents, we control the age squared, gender, birth order, whether obtain an urban registration status now, marital status (currently married v.s. all other status). In addition, we also control the respondents' own length of exposure to CEL in the equations described above to partial out the direct effect of CEL on respondents' education and health outcomes. For siblings, we control the siblings' exposure to CEL, gender, birth order, the sibling pair's age gap, birth year fixed effect, and province specific linear birth year trend. For parents, we use total number of children, whether currently living or not, and a full set of combinations of parents' education level. As the current health is a stock of the previous health human capital accumulation, it is

important to control for the health condition in the early childhood which could have a persistent health effect into the adulthood. CFPS 2010 collected the self-reported weight at birth, we have not added this control due to the severe missing value problem: only 28% of adult respondents report their birth weight.

6 Main Results

6.1 First Stage

The first stage is estimated based on the following specification:

$$EduL_{ilk} = \theta_0 + Exposure_i \cdot \theta_1 + Exp\_PreLawEdu_{ik} \cdot \theta_2 + X_i \cdot \theta_3 + X_j \cdot \theta_4 + F_{ij} \cdot \theta_5 + ChildYear_{l(province)} + \pi_k + \tau_l + \epsilon_{ilk} \tag{5}$$

$EduL_{ilk}$ is the years of schooling for peer sibling i (and the corresponding respondent is j in the equation) born in year l and province k. $Exposure_i$ is the length of the policy exposure for child i, as we defined in the previous section. $Exp\_PreLawEdu_{ik}$ is the interaction between policy exposure and the average education level in province k before the CEL implementation, with a window of 10 years. We put the average pre-law education level in the control variables. π is the province fixed effect and τ is the birth year fixed effect, while $ChildYear_{l(province)}$ measures the province-specific linear trend as an attempt to control the time-varying unobservables at the province level. All the control variables shown up in the first stage are also included in our second stage equation.

Table 4 shows the first stage results using the baseline estimation sample for own years of schooling. With a sample mean of average province level years of schooling before CEL reform equal to 8.6, with a change from no exposure (0) to full reform exposure (1) leads to 0.91 (4.87 - 0.46·8.6) years increase in education for the younger peer siblings. The magnitude (0.86) is slightly smaller for the older peer siblings. In addition, as expected, individuals in a province with higher average population education level receive a smaller increase in their years of schooling from the CEL reform. Because we cluster the standard errors at the community level for all the

specifications in our analysis, we use the Kleibergen-Paap rk Wald F statistic and compare it with 10, the rule-of-thumb threshold suggested in Baum, Schaffer, and Stillman (2007). The F statistics for the younger to older spillover equation (shown in column (1) in table 6) is 24.9, and for the older to younger spillover equation (shown in column (1) in table 8) is 5.7. The first stage of the older to younger spillover equation suffers the weak instrument problem partly because we have 2000 less observations as in the younger to older spillover equation. In this case we rely on the Anderson-Rubin F test that tests the joint significance of endogenous variables. If the null hypotheses of Anderson-Rubin F test is rejected, there is more confidence in drawing a statistical inference from the IV estimates. We report the weak instrument F statistics and the p value of Anderson-Rubin F test in the main results tables for the corresponding health and health behavior outcomes in the next section.

6.2 Education Spillover Effect Among Siblings

The education spillover effect among siblings are shown in the column (1) in table 5 and table 7 using the sibling pairs with nearest distance in age. The coefficient of education spillover from younger on older sibling is 0.57, meaning that one year more education for the younger sibling would lead the older sibling having 0.57 more year in education. On the other side, the coefficient of education spillover from older sibling on young is 1.12, meaning that one year more education for the older siblings would almost lead the same amount of increase in years of schooling for their younger siblings. The previous literature noticed this asymmetry of sibling spillovers as in Oettinger (2000), but they find that there is no spillover from younger siblings to older ones. In contract, we find there is a spillover from younger sibling to older ones, although its magnitude is half the size of that from older sibling to younger ones. The mechanism underlying the asymmetry may comes from the reduced burden of taking care of young siblings if young siblings were not forced to attending school with the absence of compulsory schooling law. It is worth noting that for the 1986 CEL policy the compulsory education was not free yet, and local government usually required a fraction of tuition fee. There is almost no chance of a expansion in parents' budget constrain due to the 1986 CEL reform. So we think that it is not that possible for parents to

invest more in older sibling's education due to the younger sibling's exposure to the CEL.

Another interesting finding is the coefficient of own gender and peer sibling's gender. We notice that being a boy itself would lead to a higher education level in general, and this effect would be even larger is the peer sibling is a girl. In addition, if the older peer sibling is a girl, there would be a larger increase in the young sibling's education level. This finding can be explained by the post-natal boy preference in China, where parents tend to invest more on boys and assign more childcare responsibilities on older girls. This finding is consistent with Lei et al. (2017), where they find that in terms of sibling sex composition, a boy benefits from being the oldest child and having more female siblings.

We also report the estimates using siblings with largest age difference in table 9 and 10 for the spillovers from younger to older siblings, and table 11 and 12 for the effect from older to younger siblings. A similar pattern in health and health behavior shows up as we use the siblings with closest age.

6.3 Effect of Sibling Education On Health & Health Behavior

We first explain the effect from younger siblings to older ones. The results of health outcomes using the closest in age sibling pairs are listed in table 5. We find that 1 year increase in younger sibling's education leads to better reported health, and reduces the chance of reporting in bad health by 1.6 percentage points. In addition, it also increase the BMI by 0.44. By further analysis, we find that the increase in BMI mainly comes from reducing the chance of underweight, rather than being more likely to obesity. It suggests that the increased education in siblings mainly leads individuals to obtain better nutrition. The older siblings' depressive symptom is also decrease by a factor of 0.01. The last two columns in table 5 shows the results on two cognitive abilities: the words test and math test scores in the survey. It suggests that there is an increase in older siblings' cognition.

Then we turn to the effect from older siblings' education on younger siblings' health in table 7 using the closest in age sibling pairs. We only find significant effect on BMI (and chance of being underweight) and cognitive ability, although the effect size is larger than that from younger

siblings to older ones, possibly due the larger spillover effect in education we find from older sibling to younger ones.

For the health behaviors shown in table 6, the increased younger siblings' education can reduce older siblings' chance of visiting a doctor when having a minor illness (may due to be more likely to find the medicine by themselves because the have better cognition now), lead older siblings to exercise 30 minutes more on average in past week, and also to be 2.1% less likely to smoke recently.

The sibling effect of education on health behaviors seems work in different ways from older siblings on younger ones. From table 8 we can see it reduces the frequency of unhealthy diet (eating preserved/pickled food and fried food) and the chance of smoking ever[4]. But for the chance of visiting doctors and physical exercises, which are significant from the younger sibling on older ones, we do not observe such an effect from the older siblings on younger ones, although the education spillover is larger from the older siblings to younger ones.

7 Heterogeneous Effect by Child Gender and Sibling Proximity

The relationship between sibling gender composition and children education achievement has drawn researchers' attention in recent years (Butcher and Case (1994), citeAhauser1998does). This association could differ from the findings using data in developed countries (the United States for example) mainly due toe two reasons: firstly, the oldest child in developing countries are usually assigned with a large share of household responsibility, especially taking care of their younger siblings; secondly, the prevailing son preference in Asian societies indicates that parents may have more incentive to invest in their sons than daughters, besides that they might alter the fertility behavior in order to have at least one son or more sons. Lei et al. (2017) uses the same

[4]The weak instrument problem here makes the 2SLS estimates bias and we rely on the p value of Anderson-Rubin F test, which is robust to the weak instrument problem.

data CFPS and finds that in China, being the oldest child benefit most from parents in terms of educational investment, and having more sisters leads to a larger educational benefit in boys than in girls. In our paper, we use the sibling gender composition as an proxy of parental investment by assuming that boys can get more investment from parents than girls. In our paper we investigate the heterogeneous effect by sibling's gender and own gender as an attempt to verify the potential changes in parental resource allocation across children.

In addition, literature (Nicoletti and Rabe (2018)) in sibiling spillovers has argued that siblings with same gender tend to interact more with each other and thus the peer effect on education achievement among the same-gender sibling pairs is larger. We use the same gender indicator as a proxy of the interaction intensity during the childhood and adolescence and test whether there exist any heterogeneous effect or not. We also use the sibling's current residence proximity as a proxy for the frequency of contact and championship in the adulthood[5].

Table 13 and 14 show the heterogeneity in education and health effect of younger sibling's education by sibling's gender. In general we do not find evidence that there is a difference in the impact from a younger sister ($sibgender = 0$) and a younger brother ($sibgender = 1$), except for the probability of underweight and the score of word test. 1 year more education in a younger brother leads to 2 percentage points less of being underweight, and 0.5 point more in word test score, than the effect from a younger sister. As there is no heterogeneity of spillover in own education, the more benefit from a younger brother may result from the differential sibling interaction patterns with a younger brother and sister. Table 15 and 16 show the heterogeneity for the older sibling's education. Although suffering the weak instrument problem, the results suggest that the spillover from an older brother than from an older sister in terms of own education and cognitive abilities (measured by word and math test)[6]. This result suggest sibling benefit more from a more educated

[5]Although it is possible, as pointed in Lei, Strauss, Tian, and Zhao (2015), that children with higher education are more likely to live in another place with better labor market opportunity and further to their parents than their less educated siblings, we assume that the proximity between siblings is exogenously determined and is not effected by their own education level.

[6]The coefficient of the interaction between sibling gender and sibling education is significant at 10% for self-reported health status and obesity, the Anderson-Rubin F test cannot reject the hypothesis that the endogenous variables are jointly insignificant. With the presence of weak instrument problem, it suggests that there is neither

older brother than from an older sister in own education and cognition, indicating that a older brothers may play an more important role in supervising study of their younger siblings in a family. Our finding is a bit different from previous literature focusing developing countries: Qureshi (2018a) find positive causal spillovers from oldest girls on younger siblings in Pakistan, Biavaschi et al. (2015) find that the sibling spillover among the left-behind children in rural China is mainly from the older girls to younger siblings. In our case, we find that the spillovers from older brother is larger.

Then we examine the heterogeneity by own gender. Table 17 and 18 show the results of the spillovers from younger siblings to older ones, and table 19 and 20 from older siblings to younger ones. We find the a boy benefit less positive spillovers from either older or younger siblings in education and health indicators, except for BMI and underweight. For health behavior, we find that the sibling education spillover on reducing smoking and drinking is mainly driven by the male individuals in our sample, although they are less influenced by a better educated sibling in education compared to female individuals. This may due to the relative high smoking rate in male sample and is consistent with previous research Jürges et al. (2011) using German data and focusing on education on own health behavior, where they find more education reduce the smoking behavior. The lesser benefit of sibling spillover on boys may reflect the fact that in China, especially the areas with severe son preference, parents already shift much resource to boys than girls, thus the marginal effect of sibling spillover is smaller as we observe here.

It is believed that siblings with the same gender interact more and influence more in each other than opposite siblings. From table 22 we find that having a more educated same-gender younger sibling indeed reduce the chance of smoking and drinking more than opposite-gender younger sibling. But it also leads to slightly less decrease in word test score (see table 21) but the magnitude is relatively small (the coefficient on sibling education for opposite-gender sibling is 1.76 while for same-gender sibling is 1.42). These heterogeneity does not work through spillover in eduacation because column (1) in table 21 and 23 suggests no heterogeneity is found in own education. We do not find strong evidence of heterogeneity in same gender or not for the spillover from older siblings to younger ones (as we can see from table 23 and 24). It suggests that the

effect nor heterogeneity for these two outcomes.

sibling education spillovers on health and health behaviors works beyond the mechanism of own education, and it depends on the interaction patterns in siblings, for example whether the peer sibling is in the same gender or not.

In the end we explore the heterogeneity in sibling's current proximity. The variable proximity is an ordered from close to far in distance and ranges from 0 to 7, where 0 means living in the same household, 1 same neighborhood/next door, 2 same village/street, 3 different village/street in the same county/district, 4 different district in the same city, 5 different county in the same province, 6 different province and 7 outside of Mainland China. We treat it as an continuous variable. At first we find no heterogeneous effect in own education, providing us some confidence to assume that there is no selection bias from education level in the proximity between siblings. Having a more educated younger sibling living closer leads to slightly higher BMI, less depressive symptoms, and better cognition measured by math test score. For health behavior, we also find that a closer more educated younger sibling increases the chance of visiting a doctor when having minor illness, consume more healthy and also unhealthy diet, has 5 minutes longer exercise per week, and slightly less chance of smoking. For the spillovers from older siblings to younger ones, we do not find very solid evidence of heterogeneity in sibling proximity, expect for the subjective welling of which a closer more educated older sibling leads to higher chance of feeling satisfied with life. All the findings here indicates that the sibling spillover of education on health may work through the mechanism of information transmission in health knowledge, as one can expect siblings living closer to each other might have more chance to contact in person, and have small talks in which the health knowledge can be shared.

8 Conclusion

We study the spillover effect of sibling's education on own education attainment and health in adulthood. We exploit the introduction of compulsory education law (CEL) around 1986 in China as an exogenous shock on sibling's years of schooling. The fact that it gradually rolled out across provinces and required all the students aged between 6 and 15 staying in school generated a vari-

ation in the length of exposure to the CEL for siblings born in different years. We find that conditional on own exposure to CEL and sibling age gap, one year's increase in older sibling's education leads to 1 year increase in own education, while the reverse spillover from younger sibling to older ones only is smaller (0.57). We further investigate how the sibling's education could have an impact on later health and health behavior in adulthood and find a positive spillovers in health and health behavior. Heterogeneity analysis suggests that the sibling interaction pattern and information transmission both play important roles in underlying mechanisms, besides the mechanism of positive spillover in own education. Our findings suggest there would be an underestimate of the education policy effectiveness on health if we ignore any potential peer spillovers.

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Table 1: CEL Implementation Year

Province	CEL Implementation Year	First Eligible Cohort
Beijing	1986	1971
tianjin	1987	1972
Hebei	1986	1971
Shanxi	1986	1971
Inner Mongolia	1989	1974
Liaoning	1986	1971
Jilin	1987	1972
Heilongjiang	1986	1971
Shanghai	1985	1970
Jiangsu	1987	1972
Zhejiang	1985	1970
Anhui	1987	1972
Fujian	1988	1973
Jiangxi	1986	1971
Shandong	1987	1972
Henan	1987	1972
Hubei	1987	1972
Hunan	1991	1976
Guangdong	1987	1972
Guangxi	1991	1976
Chongqing	1986	1971
Sichuan	1986	1971
Guizhou	1988	1973
Yunnan	1987	1972
Tibet	1994	1979
Shaanxi	1988	1972
Gansu	1991	1976
Qinghai	1989	1974
Ningxia	1993	1978
Xinjiang	1988	1973

9 Tables

Table 2: Years of Expusure to CEL: Youngest Siblings

	freq	pct	cumpct
0	4970	46.7	46.7
1	322	3.03	49.7
2	352	3.31	53.0
3	300	2.82	55.9
4	312	2.93	58.8
5	324	3.04	61.8
6	277	2.60	64.4
7	217	2.04	66.5
8	257	2.42	68.9
9	3310	31.1	100
Total	10641	100	
N	10641		

Table 3: Descriptive statistics of variables

	individuals with older siblings	individuals with younger siblings
Instrumental Variables		
sibExpoLength	0.358	0.207
	(0.45)	(0.37)
EduPre2	8.867	8.897
	(1.58)	(1.60)
sibEduL	7.596	7.622
	(4.40)	(4.47)
Dependent Variables		
eduL	7.399	7.527
	(4.61)	(4.58)
health_sr	1.762	1.744
	(0.95)	(0.93)
health_bad	0.084	0.082
	(0.28)	(0.27)
chronic	0.141	0.130
	(0.35)	(0.34)
BMI	22.348	22.361
	(3.31)	(3.19)
underweight	0.096	0.086
	(0.29)	(0.28)
obese	0.018	0.015
	(0.13)	(0.12)
depression	0.122	0.120
	(0.15)	(0.15)
satisfylife2	0.475	0.466
	(0.50)	(0.50)
wordtest	18.855	18.989
	(10.18)	(9.87)
mathtest	11.133	11.207
	(6.37)	(6.16)
sickDoctor	0.310	0.309
	(0.46)	(0.46)
healthydiet	23.350	23.894
	(12.70)	(12.83)
unhydiet	15.241	15.470
	(17.71)	(18.01)
exerciseLength	59.253	55.484
	(167.71)	(159.81)
smokeRecent	0.294	0.312
	(0.46)	(0.46)
smokeEver	0.090	0.084

	(0.29)	(0.28)
drinkRecent	0.168	0.181
	(0.37)	(0.39)
drinkEver	0.056	0.053
	(0.23)	(0.22)
Control Variables: Sibling Char.		
sibgender	0.535	0.481
	(0.50)	(0.50)
sibBOrder	2.756	1.766
	(1.12)	(1.14)
sibHukou0	0.228	0.240
	(0.42)	(0.43)
sibAgeGap	4.196	3.791
	(3.52)	(3.00)
sibSameGender	0.497	0.488
	(0.50)	(0.50)
sibProximity	2.996	3.342
	(1.72)	(1.44)
Individual Char.		
gender	0.474	0.493
	(0.50)	(0.50)
bOrder	1.725	2.751
	(1.09)	(1.16)
hukou03	0.158	0.173
	(0.36)	(0.38)
marry	0.833	0.857
	(0.37)	(0.35)
age2	21.497	20.192
	(13.74)	(12.17)
Parents Char.		
sibNr	2.660	2.732
	(1.77)	(1.71)
alive_parents	2.897	2.783
	(1.26)	(1.28)
meduL	2.009	1.782
	(3.58)	(3.43)
feduL	2.880	2.621
	(4.27)	(4.18)
Observations	10558	8450

Table 4: First Stage Estimates: Using the Closest In Age Sibling Pairs

	(1) Younger on Old	(2) Older on Young
sibExpoLength	4.874***	3.783***
	(0.794)	(1.254)
sibExpoLength×EduPre2	-0.466***	-0.343***
	(0.069)	(0.104)
controls	Yes	Yes
Obs	9575	7623

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

9.1 IV Estimation Younger Siblings on Older Individuals: Province Fixed Effect

Table 5: Spillover Effect of Yonger Sibling Education on Health

	(1) eduL	(2) health_sr	(3) health_bad	(4) chronic	(5) BMI	(6) underweight	(7) obese	(8) depression	(9) satisfylife2	(10) wordtest	(11) mathtest
sibEduL	0.572***	-0.070**	-0.016*	0.018	0.445***	-0.031**	0.004	-0.011*	-0.029	1.651***	0.858***
	(0.137)	(0.033)	(0.009)	(0.013)	(0.142)	(0.014)	(0.005)	(0.006)	(0.020)	(0.309)	(0.195)
ExpoLength	1.760***	-0.106	-0.042*	-0.029	0.630*	-0.051	0.022	-0.023	0.059	0.700	0.723
	(0.370)	(0.089)	(0.023)	(0.031)	(0.376)	(0.034)	(0.013)	(0.016)	(0.055)	(0.869)	(0.508)
EduPre2	-0.259	0.058	-0.002	-0.012	-0.242	0.027	-0.002	-0.002	0.041	-0.500	-0.302
	(0.197)	(0.053)	(0.014)	(0.020)	(0.236)	(0.023)	(0.007)	(0.009)	(0.028)	(0.488)	(0.300)
gender	1.349***	-0.181***	-0.030***	-0.035***	0.660***	-0.043***	0.008***	-0.022***	-0.012	3.246***	2.021***
	(0.087)	(0.020)	(0.006)	(0.007)	(0.077)	(0.007)	(0.003)	(0.003)	(0.010)	(0.214)	(0.128)
sibgender	-0.490***	0.023	0.015**	-0.015	-0.226**	0.009	-0.003	0.014***	-0.024	-1.364***	-0.720***
	(0.103)	(0.025)	(0.007)	(0.009)	(0.100)	(0.008)	(0.004)	(0.005)	(0.015)	(0.233)	(0.144)
sibNr	-0.006	-0.014	-0.004	0.008**	0.105***	-0.007**	0.000	-0.001	0.001	0.187**	0.082*
	(0.032)	(0.009)	(0.003)	(0.003)	(0.037)	(0.003)	(0.001)	(0.002)	(0.005)	(0.085)	(0.045)
Individual char.	x	x	x	x	x	x	x	x	x	x	x
Parents char.	x	x	x	x	x	x	x	x	x	x	x
Cohort Province FE	x	x	x	x	x	x	x	x	x	x	x
WeakIV F stat	24.92	24.91	24.91	24.93	24.37	24.92	24.92	24.92	24.92	24.83	24.83
p_val A-R test	0.00	0.02	0.03	0.11	0.00	0.07	0.61	0.16	0.14	0.00	0.00
p_val HansenJ test	0.71	0.07	0.06	0.12	0.03	0.73	0.56	0.48	0.23	0.51	0.62
Obs	9575	9574	9574	9571	9439	9575	9575	9575	9575	9571	9571

Table 6: Spillover Effect of Yonger Sibling Education on Health Behavior

	(1) sickDoctor	(2) healthydiet	(3) unhydiet	(4) exerciseLength	(5) smokeRecent	(6) smokeEver	(7) drinkRecent	(8) drinkEver
sibEduL	-0.042**	-0.338	-1.096	31.839***	-0.021	0.008	-0.013	-0.002
	(0.019)	(0.602)	(0.788)	(7.225)	(0.014)	(0.012)	(0.013)	(0.008)
ExpoLength	0.010	3.245**	1.479	-19.848	0.038	-0.001	0.015	0.041*
	(0.051)	(1.570)	(2.117)	(18.711)	(0.041)	(0.035)	(0.037)	(0.023)
EduPre2	0.052*	2.319*	2.770*	-37.500***	0.014	0.017	0.026	0.007
	(0.029)	(1.184)	(1.466)	(11.735)	(0.021)	(0.018)	(0.023)	(0.015)
gender	-0.039***	0.756***	1.428***	5.708	0.560***	0.292***	0.289***	0.107***
	(0.010)	(0.242)	(0.356)	(3.987)	(0.009)	(0.013)	(0.009)	(0.007)
sibgender	0.002	-1.191***	-0.428	-5.599	0.001	-0.015*	0.001	-0.003
	(0.012)	(0.399)	(0.554)	(6.031)	(0.010)	(0.009)	(0.011)	(0.007)
sibNr	-0.006	-0.303**	-0.436**	3.881**	-0.004	0.000	0.004	0.001
	(0.004)	(0.123)	(0.171)	(1.902)	(0.004)	(0.003)	(0.003)	(0.002)
Individual char.	x	x	x	x	x	x	x	x
Parents char.	x	x	x	x	x	x	x	x
Cohort Province FE	x	x	x	x	x	x	x	x
WeakIV F stat	24.87	24.92	24.92	24.73	24.75	17.02	24.75	26.95
p_val A-R test	0.08	0.75	0.25	0.00	0.02	0.41	0.35	0.06
p_val HansenJ test	0.96	0.51	0.66	0.75	0.02	0.24	0.31	0.02
Obs	9573	9575	9575	9565	9516	6657	9516	7877

9.2 IV Estimation Older Siblings on younger Individuals: Province Fixed Effect

Table 7: Spillover Effect of Older Sibling Education on Health

	(1) eduL	(2) health_sr	(3) health_bad	(4) chronic	(5) BMI	(6) underweight	(7) obese	(8) depression	(9) satisfylife2	(10) wordtest	(11) mathtest
sibEduL	1.123***	-0.016	-0.008	0.025	0.578**	-0.075**	0.006	-0.004	-0.056	2.715***	1.432***
	(0.307)	(0.050)	(0.013)	(0.018)	(0.290)	(0.038)	(0.006)	(0.009)	(0.043)	(0.735)	(0.440)
ExpoLength	1.232**	-0.105	-0.041*	-0.068**	0.405	0.010	0.013	-0.009	-0.046	0.865	0.189
	(0.501)	(0.091)	(0.022)	(0.032)	(0.440)	(0.050)	(0.014)	(0.017)	(0.064)	(1.230)	(0.663)
EduPre2	-0.954**	0.072	0.020	-0.035	-0.618*	0.094*	-0.003	0.001	0.069	-2.318**	-1.130*
	(0.408)	(0.068)	(0.018)	(0.024)	(0.368)	(0.050)	(0.008)	(0.012)	(0.057)	(0.974)	(0.578)
gender	1.240***	-0.183***	-0.022***	-0.036***	0.592***	-0.049***	0.005*	-0.025***	-0.018	2.822***	1.949***
	(0.114)	(0.020)	(0.006)	(0.008)	(0.088)	(0.009)	(0.003)	(0.003)	(0.012)	(0.273)	(0.153)
sibgender	-1.228***	-0.015	0.004	-0.023	-0.546**	0.053*	-0.012**	0.002	0.023	-2.881***	-1.665***
	(0.255)	(0.044)	(0.012)	(0.016)	(0.227)	(0.029)	(0.005)	(0.008)	(0.033)	(0.598)	(0.354)
sibNr	0.009	-0.010	-0.000	0.008**	0.108*	-0.013*	-0.001	0.002	-0.006	0.189	0.064
	(0.063)	(0.012)	(0.004)	(0.004)	(0.056)	(0.007)	(0.001)	(0.002)	(0.008)	(0.153)	(0.087)
Individual char.	x	x	x	x	x	x	x	x	x	x	x
Parents char.	x	x	x	x	x	x	x	x	x	x	x
Cohort Province FE	x	x	x	x	x	x	x	x	x	x	x
WeakIV F stat	5.72	5.72	5.72	5.73	5.46	5.72	5.72	5.72	5.72	5.73	5.73
p_val A-R test	0.00	0.55	0.80	0.34	0.03	0.03	0.42	0.83	0.05	0.00	0.00
p_val HansenJ test	0.18	0.28	0.73	0.68	0.87	0.86	0.51	0.62	0.07	0.28	0.60
Obs	7623	7623	7623	7620	7535	7623	7623	7623	7623	7620	7620

Table 8: Spillover Effect of Older Sibling Education on Health Behavior

	(1) sickDoctor	(2) healthydiet	(3) unhydiet	(4) exerciseLength	(5) smokeRecent	(6) smokeEver	(7) drinkRecent	(8) drinkEver
sibEduL	-0.018	-1.649	-2.856*	16.378	-0.004	-0.047	0.007	0.002
	(0.030)	(1.575)	(1.736)	(11.824)	(0.024)	(0.029)	(0.024)	(0.016)
ExpoLength	-0.048	2.048	-0.816	-4.444	-0.001	0.037	-0.038	0.005
	(0.054)	(1.736)	(2.627)	(15.794)	(0.042)	(0.045)	(0.035)	(0.027)
EduPre2	-0.007	4.798**	5.925**	-12.271	-0.007	0.081*	-0.005	0.009
	(0.041)	(2.399)	(2.444)	(14.659)	(0.032)	(0.042)	(0.032)	(0.022)
gender	-0.039***	1.085***	1.583***	2.320	0.584***	0.281***	0.302***	0.100***
	(0.010)	(0.303)	(0.467)	(3.751)	(0.009)	(0.016)	(0.011)	(0.007)
sibgender	0.055**	-0.622	0.421	-10.372	0.006	0.027	-0.013	-0.017
	(0.025)	(1.045)	(1.293)	(9.976)	(0.020)	(0.023)	(0.021)	(0.012)
sibNr	-0.006	-0.464*	-0.680**	2.491	-0.001	-0.006	0.003	0.001
	(0.007)	(0.273)	(0.338)	(2.165)	(0.005)	(0.007)	(0.005)	(0.003)
Individual char.	x	x	x	x	x	x	x	x
Parents char.	x	x	x	x	x	x	x	x
Cohort Province FE	x	x	x	x	x	x	x	x
WeakIV F stat	5.72	5.72	5.72	5.52	5.53	2.95	5.53	4.11
p_val A-R test	0.17	0.35	0.03	0.27	0.41	0.07	0.95	0.90
p_val HansenJ test	0.08	0.26	0.10	0.42	0.18	0.57	0.91	0.66
Obs	7623	7623	7623	7618	7587	5167	7587	6181

9.3 Iv Estimation of Sibling Spillovers Using Sibling Furthest in Age

Table 9: Spillover Effect of Yonger Sibling Education on Health: Using Sibling Furthest in Age

	(1) eduL	(2) health_sr	(3) health_bad	(4) chronic	(5) BMI	(6) underweight	(7) obese	(8) depression	(9) satisfylife2	(10) wordtest	(11) mathtest
sibEduL	0.615***	-0.095**	-0.028**	0.015	0.815***	-0.046***	0.006	-0.017**	-0.024	1.750***	0.880***
	(0.143)	(0.040)	(0.011)	(0.014)	(0.176)	(0.015)	(0.005)	(0.007)	(0.021)	(0.347)	(0.205)
ExpoLength	1.359***	-0.093	-0.050**	-0.044	0.427	-0.028	0.007	-0.005	0.033	-0.958	0.241
	(0.323)	(0.071)	(0.021)	(0.027)	(0.378)	(0.030)	(0.012)	(0.013)	(0.046)	(0.755)	(0.459)
EduPre2	0.040	0.073	0.008	-0.002	-0.641**	0.045**	-0.004	-0.006	0.034	-0.121	0.080
	(0.208)	(0.054)	(0.015)	(0.019)	(0.251)	(0.022)	(0.007)	(0.009)	(0.028)	(0.538)	(0.307)
gender	1.314***	-0.179***	-0.027***	-0.037***	0.635***	-0.043***	0.007**	-0.021***	-0.008	3.201***	1.978***
	(0.083)	(0.020)	(0.006)	(0.007)	(0.091)	(0.007)	(0.003)	(0.003)	(0.010)	(0.212)	(0.125)
sibgender	-0.469***	0.025	0.017**	-0.005	-0.185	0.001	-0.003	0.017***	-0.007	-1.074***	-0.685***
	(0.104)	(0.028)	(0.008)	(0.010)	(0.119)	(0.009)	(0.005)	(0.005)	(0.016)	(0.252)	(0.146)
sibNr	-0.049	-0.033	-0.012	0.003	0.148	-0.035**	0.016*	0.002	-0.020	-0.038	-0.024
	(0.227)	(0.042)	(0.009)	(0.013)	(0.204)	(0.018)	(0.009)	(0.011)	(0.028)	(0.457)	(0.292)
Individual char.	x	x	x	x	x	x	x	x	x	x	x
Parents char.	x	x	x	x	x	x	x	x	x	x	x
Cohort Province FE	x	x	x	x	x	x	x	x	x	x	x
WeakIV F stat	22.50	22.42	22.42	22.46	22.59	22.50	22.50	22.50	22.50	22.32	22.32
p_val A-R test	0.00	0.01	0.00	0.38	0.00	0.00	0.53	0.01	0.53	0.00	0.00
p_val HansenJ test	0.70	0.05	0.04	0.34	0.12	0.71	0.93	0.19	0.96	0.03	0.31
Obs	9641	9639	9639	9636	9499	9641	9641	9641	9640	9636	9636

Table 10: Spillover Effect of Yonger Sibling Education on Health Behavior: Using Sibling Furthest in Age

	(1) sickDoctor	(2) healthydiet	(3) unhydiet	(4) exerciseLength	(5) smokeRecent	(6) smokeEver	(7) drinkRecent	(8) drinkEver
sibEduL	-0.031*	-0.327	-0.899	47.703***	-0.007	0.010	-0.014	-0.003
	(0.019)	(0.635)	(0.794)	(9.319)	(0.016)	(0.013)	(0.016)	(0.009)
ExpoLength	0.013	2.415**	1.658	-26.610	0.029	-0.005	0.020	0.006
	(0.041)	(1.224)	(1.762)	(20.494)	(0.032)	(0.026)	(0.029)	(0.019)
EduPre2	0.033	2.452**	2.441**	-48.716***	-0.000	0.026	0.030	0.032**
	(0.025)	(1.034)	(1.210)	(13.051)	(0.022)	(0.017)	(0.023)	(0.014)
gender	-0.031***	0.791***	1.515***	3.219	0.558***	0.296***	0.289***	0.109***
	(0.009)	(0.229)	(0.346)	(4.734)	(0.009)	(0.013)	(0.009)	(0.007)
sibgender	-0.004	-1.169***	0.039	-11.897*	0.008	-0.012	-0.008	-0.014**
	(0.012)	(0.393)	(0.541)	(7.153)	(0.011)	(0.008)	(0.011)	(0.007)
sibNr	-0.026	-1.063	0.615	16.835	0.029	0.018	-0.013	-0.022***
	(0.024)	(0.707)	(0.941)	(10.682)	(0.020)	(0.016)	(0.021)	(0.008)
Individual char.	x	x	x	x	x	x	x	x
Parents char.	x	x	x	x	x	x	x	x
Cohort Province FE	x	x	x	x	x	x	x	x
WeakIV F stat	22.29	22.50	22.50	22.24	22.00	13.33	22.00	22.30
p_val A-R test	0.10	0.45	0.50	0.00	0.13	0.57	0.28	0.01
p_val HansenJ test	0.21	0.22	0.95	0.94	0.05	0.41	0.18	0.00
Obs	9638	9641	9641	9629	9580	6700	9580	7919

Table 11: Spillover Effect of Older Sibling Education on Health: Using Sibling Furthest in Age

	(1) eduL	(2) health_sr	(3) health_bad	(4) chronic	(5) BMI	(6) underweight	(7) obese	(8) depression	(9) satisfylife2	(10) wordtest	(11) mathtest
sibEduL	1.034***	-0.057	-0.017	0.015	0.416*	-0.060**	0.003	-0.006	-0.050	2.279***	1.181***
	(0.254)	(0.043)	(0.011)	(0.015)	(0.221)	(0.028)	(0.004)	(0.007)	(0.032)	(0.559)	(0.343)
ExpoLength	1.169***	-0.087	-0.034	-0.060**	0.331	-0.021	0.011	-0.013	-0.050	0.605	0.332
	(0.416)	(0.086)	(0.022)	(0.027)	(0.311)	(0.037)	(0.011)	(0.016)	(0.049)	(0.893)	(0.516)
EduPre2	-0.962**	0.118*	0.028	-0.020	-0.538*	0.100**	-0.002	0.004	0.052	-2.006**	-0.963*
	(0.401)	(0.067)	(0.017)	(0.023)	(0.327)	(0.044)	(0.007)	(0.012)	(0.052)	(0.906)	(0.542)
gender	1.214***	-0.179***	-0.021***	-0.036***	0.602***	-0.051***	0.005*	-0.025***	-0.012	2.684***	1.897***
	(0.113)	(0.021)	(0.006)	(0.008)	(0.082)	(0.008)	(0.003)	(0.003)	(0.012)	(0.262)	(0.147)
sibgender	-1.328***	0.035	0.015	-0.021	-0.393*	0.038	-0.007	0.003	0.044	-2.918***	-1.593***
	(0.246)	(0.046)	(0.012)	(0.015)	(0.208)	(0.025)	(0.005)	(0.008)	(0.029)	(0.512)	(0.319)
sibNr	0.010	-0.017	-0.003	0.009**	0.091*	-0.011*	-0.001	-0.000	-0.005	0.156	0.034
	(0.061)	(0.012)	(0.004)	(0.004)	(0.047)	(0.006)	(0.001)	(0.002)	(0.007)	(0.147)	(0.075)
Individual char.	x	x	x	x	x	x	x	x	x	x	x
Parents char.	x	x	x	x	x	x	x	x	x	x	x
Cohort Province FE	x	x	x	x	x	x	x	x	x	x	x
WeakIV F stat	10.04	10.04	10.04	10.03	9.29	10.04	10.04	10.04	10.04	10.07	10.07
p_val A-R test	0.00	0.12	0.23	0.37	0.09	0.02	0.76	0.63	0.00	0.00	0.00
p_val HansenJ test	0.57	0.13	0.64	0.32	0.74	0.88	0.65	0.67	0.00	0.20	0.63
Obs	7478	7478	7478	7475	7393	7478	7478	7478	7478	7475	7475

Table 12: Spillover Effect of Older Sibling Education on Health Behavior: Using Sibling Furthest in Age

	(1) sickDoctor	(2) healthydiet	(3) unhydiet	(4) exerciseLength	(5) smokeRecent	(6) smokeEver	(7) drinkRecent	(8) drinkEver
sibEduL	-0.031	-0.985	-2.106	14.297	-0.013	-0.026	0.010	0.009
	(0.024)	(1.182)	(1.303)	(9.969)	(0.021)	(0.020)	(0.019)	(0.013)
ExpoLength	-0.034	1.289	-0.217	-11.168	0.023	0.027	-0.003	0.003
	(0.046)	(1.335)	(2.045)	(12.755)	(0.036)	(0.029)	(0.032)	(0.022)
EduPre2	0.035	4.168*	5.822**	-9.736	0.026	0.063**	-0.015	-0.004
	(0.038)	(2.254)	(2.273)	(15.809)	(0.032)	(0.031)	(0.029)	(0.020)
gender	-0.039***	0.919***	1.580***	2.446	0.585***	0.274***	0.301***	0.098***
	(0.011)	(0.268)	(0.438)	(3.749)	(0.009)	(0.015)	(0.010)	(0.007)
sibgender	0.059**	-0.681	0.388	-14.503	0.000	0.008	-0.003	-0.013
	(0.024)	(0.870)	(1.134)	(8.955)	(0.020)	(0.019)	(0.020)	(0.012)
sibNr	-0.005	-0.411**	-0.596**	2.802	-0.003	-0.001	0.005	0.002
	(0.006)	(0.208)	(0.277)	(2.005)	(0.005)	(0.005)	(0.005)	(0.003)
Individual char.	x	x	x	x	x	x	x	x
Parents char.	x	x	x	x	x	x	x	x
Cohort Province FE	x	x	x	x	x	x	x	x
WeakIV F stat	10.04	10.04	10.04	9.82	9.95	4.26	9.95	6.91
p_val A-R test	0.13	0.55	0.08	0.24	0.43	0.06	0.78	0.72
p_val HansenJ test	0.14	0.36	0.17	0.39	0.25	0.07	0.63	0.67
Obs	7478	7478	7478	7473	7442	5088	7442	6075

9.4 Tables of Heterogeneous Effect by Sibling Gender

Table 13: Spillover Effect of Yonger Sibling Education on Health: by Sibling's Gender

	(1) eduL	(2) health_sr	(3) health_bad	(4) chronic	(5) BMI	(6) underweight	(7) obese	(8) depression	(9) satisfylife2	(10) wordtest	(11) mathtest
sibEduL	0.218**	-0.012	0.002	0.008	0.121	-0.010	0.004	-0.001	-0.016	0.608**	0.485***
	(0.102)	(0.024)	(0.007)	(0.009)	(0.092)	(0.010)	(0.003)	(0.004)	(0.013)	(0.236)	(0.148)
sibEduL×sibgender	0.155	-0.004	-0.008	-0.011	0.152	-0.020*	-0.001	0.001	-0.014	0.584***	0.202
	(0.100)	(0.022)	(0.006)	(0.009)	(0.103)	(0.011)	(0.004)	(0.004)	(0.015)	(0.203)	(0.148)
WeakIV F stat	25.60	25.60	25.60	25.60	25.67	25.60	25.60	25.60	25.60	25.55	25.55
p_val A-R test	0.00	0.05	0.01	0.15	0.00	0.05	0.82	0.18	0.30	0.00	0.00
p_val HansenJ test	0.00	0.01	0.00	0.11	0.00	0.20	0.83	0.04	0.34	0.00	0.05
Obs	9575	9574	9574	9571	9439	9575	9575	9575	9575	9571	9571

Table 14: Spillover Effect of Yonger Sibling Education on Health Behavior: Sibling's Gender

	(1) sickDoctor	(2) healthydiet	(3) unhydiet	(4) exerciseLength	(5) smokeRecent	(6) smokeEver	(7) drinkRecent	(8) drinkEver
sibEduL	-0.030**	-0.028	-0.186	15.579***	-0.021**	-0.001	-0.007	-0.004
	(0.014)	(0.379)	(0.530)	(4.640)	(0.011)	(0.009)	(0.009)	(0.007)
sibEduL×sibgender	-0.017	0.693	0.624	-7.740	0.014	-0.004	0.007	-0.003
	(0.013)	(0.604)	(0.712)	(5.223)	(0.011)	(0.008)	(0.010)	(0.007)
WeakIV F stat	25.58	25.60	25.60	25.58	25.44	20.55	25.44	24.11
p_val A-R test	0.13	0.63	0.23	0.00	0.03	0.45	0.64	0.21
p_val HansenJ test	0.81	0.49	0.10	0.00	0.08	0.21	0.45	0.07
Obs	9573	9575	9575	9565	9516	6657	9516	7877

Table 15: Spillover Effect of Older Sibling Education on Health: by Sibling's Gender

	(1) eduL	(2) health_sr	(3) health_bad	(4) chronic	(5) BMI	(6) underweight	(7) obese	(8) depression	(9) satisfylife2	(10) wordtest	(11) mathtest
sibEduL	0.699***	-0.017	-0.010	0.016	0.390*	-0.071**	0.001	0.000	-0.044	2.011***	1.132***
	(0.257)	(0.045)	(0.012)	(0.015)	(0.220)	(0.033)	(0.005)	(0.008)	(0.036)	(0.642)	(0.396)
sibEduL×sibgender	0.439***	0.038*	0.000	0.010	0.158	-0.018	0.006**	-0.001	-0.024	0.928***	0.598***
	(0.131)	(0.023)	(0.005)	(0.009)	(0.126)	(0.018)	(0.003)	(0.004)	(0.022)	(0.334)	(0.198)
WeakIV F stat	3.27	3.27	3.27	3.28	3.10	3.27	3.27	3.27	3.27	3.28	3.28
p_val A-R test	0.00	0.15	0.85	0.66	0.11	0.06	0.17	0.90	0.17	0.00	0.02
p_val HansenJ test	0.01	0.52	0.86	0.57	0.29	0.96	0.23	0.61	0.17	0.06	0.37
Obs	7623	7623	7623	7620	7535	7623	7623	7623	7623	7620	7620

Table 16: Spillover Effect of Older Sibling Education on Health Behavior: Sibling's Gender

	(1) sickDoctor	(2) healthydiet	(3) unhydiet	(4) exerciseLength	(5) smokeRecent	(6) smokeEver	(7) drinkRecent	(8) drinkEver
sibEduL	-0.021	-0.970	-1.575	15.798	-0.008	-0.037*	-0.002	-0.005
	(0.028)	(1.197)	(1.284)	(9.841)	(0.022)	(0.019)	(0.020)	(0.014)
sibEduL×sibgender	-0.010	-0.312	-1.023	2.270	-0.000	-0.004	0.006	0.005
	(0.015)	(0.613)	(0.717)	(5.829)	(0.013)	(0.010)	(0.013)	(0.007)
WeakIV F stat	3.27	3.27	3.27	3.17	3.25	2.31	3.25	2.33
p_val A-R test	0.39	0.61	0.08	0.36	0.73	0.07	0.91	0.60
p_val HansenJ test	0.19	0.40	0.11	0.71	0.39	0.72	0.78	0.57
Obs	7623	7623	7623	7618	7587	5167	7587	6181

9.5 Tables of Heterogeneous Effect by Own Gender

Table 17: Spillover Effect of Yonger Sibling Education on Health: by Own Gender

	(1) eduL	(2) health_sr	(3) health_bad	(4) chronic	(5) BMI	(6) underweight	(7) obese	(8) depression	(9) satisfylife2	(10) wordtest	(11) mathtest
sibEduL	1.144***	-0.134***	-0.026**	0.013	0.030	-0.009	0.001	-0.016***	-0.001	3.435***	1.606***
	(0.155)	(0.035)	(0.010)	(0.012)	(0.146)	(0.013)	(0.005)	(0.006)	(0.020)	(0.392)	(0.213)
sibEduL×gender	-0.350***	0.037*	0.002	-0.005	0.336***	-0.015*	0.002	0.004	-0.029**	-1.214***	-0.604***
	(0.086)	(0.019)	(0.004)	(0.006)	(0.083)	(0.008)	(0.003)	(0.003)	(0.012)	(0.235)	(0.129)
WeakIV F stat	13.73	13.73	13.73	13.73	13.39	13.73	13.73	13.73	13.73	13.69	13.69
p_val A-R test	0.00	0.00	0.00	0.05	0.00	0.01	0.65	0.03	0.04	0.00	0.00
p_val HansenJ test	0.00	0.00	0.01	0.03	0.00	0.03	0.36	0.28	0.19	0.00	0.00
Obs	9575	9574	9574	9571	9439	9575	9575	9575	9575	9571	9571

Table 18: Spillover Effect of Yonger Sibling Education on Health Behavior: Own Gender

	(1) sickDoctor	(2) healthydiet	(3) unhydiet	(4) exerciseLength	(5) smokeRecent	(6) smokeEver	(7) drinkRecent	(8) drinkEver
sibEduL	-0.037**	-0.286	-1.318*	23.129***	0.016	0.076***	0.022	0.016*
	(0.018)	(0.541)	(0.768)	(6.984)	(0.016)	(0.018)	(0.015)	(0.010)
sibEduL×gender	0.001	-0.072	0.482	6.031	-0.024***	0.004	-0.021**	-0.006
	(0.010)	(0.247)	(0.388)	(3.788)	(0.009)	(0.014)	(0.009)	(0.006)
WeakIV F stat	13.71	13.73	13.73	13.65	13.62	11.07	13.62	14.28
p_val A-R test	0.26	0.95	0.35	0.00	0.00	0.00	0.00	0.00
p_val HansenJ test	0.63	0.80	0.75	0.10	0.00	0.00	0.00	0.00
Obs	9573	9575	9575	9565	9516	6657	9516	7877

Table 19: Spillover Effect of Older Sibling Education on Health: by Own Gender

	(1) eduL	(2) health_sr	(3) health_bad	(4) chronic	(5) BMI	(6) underweight	(7) obese	(8) depression	(9) satisfylife2	(10) wordtest	(11) mathtest
sibEduL	1.490***	-0.046	-0.014	0.015	0.351	-0.045	0.006	-0.009	-0.035	3.706***	1.818***
	(0.326)	(0.051)	(0.013)	(0.019)	(0.273)	(0.036)	(0.006)	(0.009)	(0.041)	(0.804)	(0.452)
sibEduL×gender	-0.477***	0.034***	0.007**	0.013***	0.297***	-0.037***	0.001	0.007***	-0.030***	-1.196***	-0.559***
	(0.085)	(0.013)	(0.003)	(0.005)	(0.076)	(0.009)	(0.002)	(0.003)	(0.011)	(0.212)	(0.113)
WeakIV F stat	2.97	2.97	2.97	2.97	2.82	2.97	2.97	2.97	2.97	2.97	2.97
p_val A-R test	0.00	0.06	0.20	0.03	0.00	0.00	0.08	0.07	0.01	0.00	0.00
p_val HansenJ test	0.32	0.21	0.59	0.90	0.90	0.51	0.27	0.87	0.18	0.10	0.90
Obs	7623	7623	7623	7620	7535	7623	7623	7623	7623	7620	7620

Table 20: Spillover Effect of Older Sibling Education on Health Behavior: Own Gender

	(1) sickDoctor	(2) healthydiet	(3) unhydiet	(4) exerciseLength	(5) smokeRecent	(6) smokeEver	(7) drinkRecent	(8) drinkEver
sibEduL	-0.016	-1.570	-3.067*	11.486	0.029	0.034*	0.041*	0.021
	(0.031)	(1.504)	(1.715)	(11.183)	(0.026)	(0.020)	(0.025)	(0.016)
sibEduL×gender	-0.003	-0.300	0.086	3.461	-0.027***	-0.046***	-0.035***	-0.026***
	(0.009)	(0.301)	(0.464)	(3.039)	(0.008)	(0.009)	(0.007)	(0.004)
WeakIV F stat	2.97	2.97	2.97	2.87	2.87	1.80	2.87	2.15
p_val A-R test	0.43	0.32	0.05	0.02	0.00	0.00	0.00	0.00
p_val HansenJ test	0.20	0.30	0.18	0.02	0.00	0.00	0.01	0.01
Obs	7623	7623	7623	7618	7587	5167	7587	6181

9.6 Tables of Heterogeneous Effect by Same Gender of the Sibling Pair or Not

Table 21: Spillover Effect of Yonger Sibling Education on Health: by Same Gender or Not

	(1) eduL	(2) health_sr	(3) health_bad	(4) chronic	(5) BMI	(6) underweight	(7) obese	(8) depression	(9) satisfylife2	(10) wordtest	(11) mathtest
sibEduL	0.586***	-0.071**	-0.016	0.019	0.428***	-0.031**	0.005	-0.010	-0.026	1.763***	0.835***
	(0.142)	(0.034)	(0.010)	(0.013)	(0.148)	(0.014)	(0.005)	(0.007)	(0.020)	(0.314)	(0.205)
sibEduL×sibSameGender	-0.045	0.003	-0.001	-0.004	0.045	-0.001	-0.001	-0.002	-0.010	-0.343**	0.070
	(0.075)	(0.017)	(0.004)	(0.007)	(0.082)	(0.008)	(0.003)	(0.003)	(0.012)	(0.173)	(0.121)
WeakIV F stat	12.65	12.65	12.65	12.66	12.35	12.65	12.65	12.65	12.65	12.61	12.61
p_val A-R test	0.01	0.10	0.08	0.08	0.00	0.18	0.78	0.16	0.30	0.00	0.00
p_val HansenJ test	0.84	0.17	0.09	0.05	0.07	0.63	0.54	0.23	0.51	0.84	0.61
Obs	9575	9574	9574	9571	9439	9575	9575	9575	9575	9571	9571

Table 22: Spillover Effect of Yonger Sibling Education on Health Behavior: by Same Gender or Not

	(1) sickDoctor	(2) healthydiet	(3) unhydiet	(4) exerciseLength	(5) smokeRecent	(6) smokeEver	(7) drinkRecent	(8) drinkEver
sibEduL	-0.037*	-0.272	-1.012	31.259***	-0.021	0.027**	-0.014	0.003
	(0.020)	(0.591)	(0.805)	(7.621)	(0.015)	(0.011)	(0.014)	(0.009)
sibEduL×sibSameGender	-0.014	-0.213	-0.274	1.611	0.000	-0.028***	0.002	-0.012**
	(0.010)	(0.323)	(0.426)	(4.249)	(0.008)	(0.008)	(0.008)	(0.005)
WeakIV F stat	12.63	12.65	12.65	12.55	12.57	10.93	12.57	14.17
p_val A-R test	0.09	0.74	0.46	0.00	0.11	0.00	0.52	0.03
p_val HansenJ test	0.84	0.46	0.87	0.37	0.06	0.35	0.29	0.10
Obs	9573	9575	9575	9565	9516	6657	9516	7877

Table 23: Spillover Effect of Older Sibling Education on Health: by Same Gender or Not

	(1) eduL	(2) health_sr	(3) health_bad	(4) chronic	(5) BMI	(6) underweight	(7) obese	(8) depression	(9) satisfylife2	(10) wordtest	(11) mathtest
sibEduL	1.014***	-0.017	-0.010	0.027	0.606*	-0.078**	0.007	-0.004	-0.065	2.729***	1.264***
	(0.289)	(0.053)	(0.013)	(0.019)	(0.310)	(0.038)	(0.006)	(0.009)	(0.045)	(0.734)	(0.404)
sibEduL×sibSameGender	0.035	-0.005	-0.000	-0.006	-0.086	0.018*	-0.001	-0.002	0.005	0.078	0.060
	(0.085)	(0.014)	(0.003)	(0.005)	(0.082)	(0.009)	(0.002)	(0.003)	(0.013)	(0.198)	(0.105)
WeakIV F stat	3.55	3.55	3.55	3.56	3.24	3.55	3.55	3.55	3.55	3.54	3.54
p_val A-R test	0.00	0.81	0.78	0.63	0.14	0.03	0.67	0.87	0.08	0.00	0.01
p_val HansenJ test	0.18	0.49	0.59	0.89	0.84	0.55	0.75	0.76	0.15	0.55	0.32
Obs	7623	7623	7623	7620	7535	7623	7623	7623	7623	7620	7620

Table 24: Spillover Effect of Older Sibling Education on Health Behavior: by Same Gender or Not

	(1) sickDoctor	(2) healthydiet	(3) unhydiet	(4) exerciseLength	(5) smokeRecent	(6) smokeEver	(7) drinkRecent	(8) drinkEver
sibEduL	-0.018	-1.760	-3.091*	18.040	0.012	0.013	0.018	0.022
	(0.032)	(1.679)	(1.849)	(11.352)	(0.024)	(0.019)	(0.025)	(0.015)
sibEduL×sibSameGender	-0.006	0.452	0.460	-5.404*	0.000	0.007	0.003	-0.002
	(0.009)	(0.489)	(0.564)	(3.261)	(0.008)	(0.007)	(0.007)	(0.004)
WeakIV F stat	3.55	3.55	3.55	3.43	3.50	2.54	3.50	3.23
p_val A-R test	0.24	0.65	0.11	0.29	0.10	0.00	0.17	0.01
p_val HansenJ test	0.16	0.42	0.24	0.52	0.04	0.00	0.10	0.04
Obs	7623	7623	7623	7618	7587	5167	7587	6181

9.7 Tables of Heterogeneous Effect by Sibling Current Residence Proximity

Table 25: Spillover Effect of Yonger Sibling Education on Health: by Residence Proximity

	(1) eduL	(2) health_sr	(3) health_bad	(4) chronic	(5) BMI	(6) underweight	(7) obese	(8) depression	(9) satisfylife2	(10) wordtest	(11) mathtest
sibEduL	0.771***	-0.053	-0.014	0.011	0.521***	-0.037***	0.007	-0.017***	-0.023	1.621***	1.277***
	(0.153)	(0.037)	(0.010)	(0.014)	(0.136)	(0.013)	(0.005)	(0.006)	(0.021)	(0.343)	(0.215)
sibEduL×sibProximity	-0.036	0.001	0.002	-0.000	-0.058***	0.003	-0.001	0.002**	0.001	-0.067	-0.103***
	(0.024)	(0.006)	(0.002)	(0.002)	(0.022)	(0.002)	(0.001)	(0.001)	(0.003)	(0.051)	(0.032)
WeakIV F stat	18.52	18.52	18.52	18.51	18.30	18.52	18.52	18.52	18.52	18.48	18.48
p_val A-R test	0.00	0.05	0.12	0.29	0.00	0.07	0.63	0.09	0.38	0.00	0.00
p_val HansenJ test	0.69	0.14	0.09	0.19	0.07	0.84	0.85	0.75	0.35	0.40	0.68
Obs	9545	9544	9544	9541	9409	9545	9545	9545	9545	9541	9541

Table 26: Spillover Effect of Yonger Sibling Education on Health Behavior: by Residence Proximity

	(1) sickDoctor	(2) healthydiet	(3) unhydiet	(4) exerciseLength	(5) smokeRecent	(6) smokeEver	(7) drinkRecent	(8) drinkEver
sibEduL	-0.065***	0.990*	0.662	40.608***	-0.043***	-0.004	-0.004	-0.007
	(0.020)	(0.530)	(0.744)	(7.912)	(0.015)	(0.014)	(0.014)	(0.009)
sibEduL×sibProximity	0.005*	-0.181*	-0.294**	-4.981***	0.005**	0.000	0.000	0.001
	(0.003)	(0.093)	(0.132)	(1.322)	(0.002)	(0.002)	(0.002)	(0.002)
WeakIV F stat	18.51	18.52	18.52	18.56	18.43	15.15	18.43	20.51
p_val A-R test	0.01	0.02	0.06	0.00	0.01	0.63	0.60	0.15
p_val HansenJ test	0.86	0.08	0.22	0.24	0.07	0.28	0.27	0.06
Obs	9543	9545	9545	9535	9486	6639	9486	7855

Table 27: Spillover Effect of Older Sibling Education on Health: by Residence Proximity

	(1) eduL	(2) health_sr	(3) health_bad	(4) chronic	(5) BMI	(6) underweight	(7) obese	(8) depression	(9) satisfylife2	(10) wordtest	(11) mathtest
sibEduL	0.749***	-0.068***	-0.016**	0.004	0.335***	-0.025**	0.003	-0.010**	-0.015	1.499***	1.016***
	(0.133)	(0.026)	(0.007)	(0.009)	(0.112)	(0.011)	(0.003)	(0.005)	(0.019)	(0.282)	(0.194)
sibEduL×sibProximity	0.004	0.006	0.002	0.002	0.022	-0.001	-0.001	0.001	-0.010**	0.011	-0.003
	(0.029)	(0.005)	(0.001)	(0.002)	(0.025)	(0.003)	(0.001)	(0.001)	(0.004)	(0.058)	(0.042)
WeakIV F stat	9.01	9.01	9.01	9.00	8.91	9.01	9.01	9.01	9.01	9.08	9.08
p_val A-R test	0.00	0.02	0.06	0.64	0.01	0.06	0.29	0.23	0.03	0.00	0.00
p_val HansenJ test	0.08	0.29	0.74	0.58	0.70	0.15	0.35	0.72	0.27	0.02	0.37
Obs	7587	7587	7587	7584	7500	7587	7587	7587	7587	7584	7584

Table 28: Spillover Effect of Older Sibling Education on Health Behavior: by Residence Proximity

	(1) sickDoctor	(2) healthydiet	(3) unhydiet	(4) exerciseLength	(5) smokeRecent	(6) smokeEver	(7) drinkRecent	(8) drinkEver
sibEduL	-0.020	1.207**	0.327	11.300**	-0.031**	-0.026**	0.012	-0.006
	(0.017)	(0.580)	(0.678)	(5.300)	(0.013)	(0.012)	(0.012)	(0.007)
sibEduL×sibProximity	0.000	-0.164	-0.235	-1.386	0.002	-0.004*	0.000	0.000
	(0.003)	(0.148)	(0.177)	(1.504)	(0.003)	(0.002)	(0.002)	(0.001)
WeakIV F stat	9.01	9.01	9.01	8.88	9.02	6.51	9.02	7.60
p_val A-R test	0.32	0.00	0.03	0.06	0.04	0.06	0.86	0.87
p_val HansenJ test	0.20	0.01	0.02	0.28	0.21	0.77	0.91	0.85
Obs	7587	7587	7587	7582	7551	5138	7551	6150