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Parental Education Matters for Adolescent Health: The Importance of Parental Education in the US

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Abstract: Parents, not doctors, are the primary gatekeepers of their children's health. Parental behavior plays an important role in child health during the prenatal and childhood (post-natal) periods. This paper investigates the association between parental schooling on the one hand, and adolescent health outcomes (height and weight) and general health status (missing school days due to illness/injuries and number of times in ER/ED) on the other. Using recent data from National Health Interview Studies (NHIS) from 2010 to 2011, I aim to understand the mechanisms through which parental schooling affects adolescent health. The results show that parental education has a significant effect on children health status as expected. Notable findings of this paper include the followings: the effects of the paternal education level on adolescent health are much more significant than the effects of mother's; and parental educational partly affects adolescent health indirectly through the influence on income, employment, family structure, and insurance enrollment.

JEL: I15, C13, C26

Key words: Parental Education; Child Health; NHIS

1. Introduction

The significance of establishing good health during childhood and adolescence is evident from the documented link between childhood/adolescent health and later economic and life outcomes such as education, health and earnings (Alderman, Behrman, Lavy, & Menon, 2001; Crossman, 2006; Oreopoulos, Stabile, Walld, & Leslie, 2006). Generally, children in the US have good health status, but US children still experience several severe health problems, for example, a high prevalence of chronic diseases (both congenital and acquired), including asthma and diabetes. Even though the government provides several insurance and welfare programs (such as Medicaid, and CHIP/SCHIP) to improve the quality of child care, these are still not enough to ensure that almost all children are healthy. Thus, parental behavior and resources continue to play important and supplemental roles in improving adolescent health.

Parents, not physicians, are the gate keepers for their children's health. Parents are the ones who make decisions about the quantity and quality of health care their children may be able to receive. For example, parents largely choose the type of food their children eat, select the physical activity their children should engage in, recognize their kids' physical and mental health situations, and provide appropriate living environments. These choices are influenced by parents' material resources, their knowledge of health practices and programs, and their own health and health behavior.

My paper mainly focuses on two questions: 1) Is parental education significantly associated with child health? In other word, does parental education really matter? 2) How does parental education impact child health? Most existing studies have focused their research on developing countries. Tulasidhar (1993) finds that the direct effect of mother's education on reducing excess female child mortality is stronger than the effect via labor force participation, according to his study in India. A study by Thomas, Strauss and Henriques (1990) in Brazil figures that almost all the impact of maternal schooling on child height can be explained through the mother's access to information. Alderman and Christiansen (2004) in Ethiopia also find that maternal knowledge of nutrition is an important determinant of child height. Another recent study by Block (2007) uses data from Indonesia to investigate the impact of maternal nutrition knowledge and schooling on child micronutrient intake, and finds that the effects of maternal education are partially mediated through knowledge of nutrition, and household expenditure. For a developing country, improving maternal education has extremely significant and positive effects on improving child health, since maternal education level is typically lower than paternal education level. However, in developed countries, recently, the percentage of women receiving higher education is greater than the percentage of men. Under this circumstance, the effects from parents might show a different story from developing countries.

This paper investigates, whether maternal education has significant effects in developed country, similar to those in developing countries, and if the paternal education level also matters. I select children's height and weight, school days missed due to illness/injuries, and number of visits to the emergency department (or room), as the indicators of child health, using two years of cross section data for the United States from 2010 to 2011. The reason I choose heights and weights, instead of the Body Mass Index (BMI), is the different measurement of BMI between children and adults. For adults, BMI has certain standards to indicate the body status (normal, overweight, and obese). For children, the BMI numbers are plotted on the CDC BMI-for-age growth charts (for either boys or girls) to obtain a percentile ranking. BMI percentiles, received from national census, are the most commonly used indicator to assess the size and growth patterns of individual children in the United States. It is very difficult to combine national census and NHIS. Instead of Child BMI I choose heights and weights and convert them to the absolute value of z-score to measure the physical health status. The results using cross section regression are similar to those of previous studies regarding the impact of parental education: we find that both maternal and paternal education have significant, if different, impacts on children health.

2. Literature Review

The importance of parental resources and behavior on children's health is evident in the large socioeconomic differences that exist in children's health outcomes. Children in the United States have a higher risk of experiencing negative health outcomes if their parents are poor, less well educated, unemployed for a long period, or in poor health (Case & Paxson, 2002).

The importance of parental education in the improvement of child health (including both physical and mental) is well-established (Behrman & Deolalikar, 1988; Strauss & Thomas, 1995). Indeed, it has been argued that education has contributed more to mortality decline than has the provision of health services (Aslam & Kingdon, 2010). It has been generally maintained that the mother's education is the significant determinant of child health (Caldwell, 1979). Grossman (2006) supports the assertion by pointing to the larger responsibility of the mother in child-care in a household. According to Aslam and Kingdon (2010), the relationship between parental education and child health may arise because better-educated parents are more efficient "producers" of child health ("productivity efficiency") through adopting better child-care practices or superior hygiene standards. Alternatively, it may be because they choose health input mixes that generate more health output ("allocative efficiency") than those selected by less-educated parents. This may be because education instills greater knowledge of the health production function, or the ability to respond to new knowledge rapidly (Grossman, 2007).

There are two channels through which parental education can affect their children's health. Education might have a direct impact on children's health, since it increases parents' ability to collect and process relevant information. This helps parents to make appropriate health investments and develop a healthier life style for themselves and their children, and may result in better parenting in general (Lindeboom, Llena-Nozal, & van der Klaauw, 2009). In other words, children raised by parents with more educational experience usually develop healthier habits and receive better care from professional services.

Alternatively, parents' education levels are able to affect child health through indirect pathways. Parental education influences family income significantly (O'Neill, 1995; Harmon & Walker, 1995; Pischke & von Wachter, 2008). Family income can aid or hinder children's health outcomes. Ross and Roberts (1999) found that children's health outcomes and the formative living conditions are clearly linked to family income. The difference in health status between children from rich families and children from poor families increases through childhood, so that it is possible that poor children grow up with worse health situations (Currie, Shields, & Wheatley-Price, 2007). Besides, in the presence of assortative mating, individuals with a higher education level prefer to marry partners with higher levels of education, which positively affects family income.

In addition to parental education and family income (related to parents' employment), several variables are also tested. For example, family structure, as a key element of parental behavior, also has an important role in determining children's well-being. Children from divorced or single-parent families experience a higher risk of facing emotional, behavioral, physical and academic problems than children living in a coupled father-mother family (Kovar, 1991). Recent research on the relationship between family structure and children's health outcomes indicates that differences across nontraditional (separated parents) family structures are particularly prominent for child health outcomes, and children in single-father families have less access to health care than those in other families, controlling for economic resources (Conway & Li, 2012). Meanwhile, a strong positive correlation between parental heights and child health (often child height) has been empirically proven (Tanner, Goldstein, & Whitehouse, 1970). Children's height and weight have a genetic correlation with parents' height and weight, and are also correlated with acquired nutrition. Finally, health insurance reimbursement status influences the amount of emergency care received by children (Stoddard, St.Peter, & Newacheck, 1994). And having health insurance is also strongly associated with access to primary care (Newacheck, Stoddard, Hughes, & Pearl, 1998). Therefore, family structure, parents' heights and weights, and insurance reimbursement information will be involved as explanatory variables.

This study investigates the relationship between parental education and adolescent health outcomes and general health status by analyzing recent data from the NHIS. Involving with the effects from family structure, parents' health, parents' employment and insurance information, this paper aim to understand the mechanisms through which parental education promotes better/worse adolescent health outcomes.

The remainder of this paper is organized as follows. I introduce the National Health Interview Survey (NHIS) dataset, and explain how I modify it in Section 2. In Section 3, I describe the estimation methodology. In Section 4, I present the main empirical results, and I close with a conclusion and discussion in Section 5.

3. Estimation Methodology

The underlying model of child health is derived from the standard paradigm of parental utility maximization. This yields reduced form health functions of the following form:

$$H_i = f(x_{ij}, x_{ih}, x_{if}, CONTROL_i, \varepsilon_i) \quad (1)$$

where H_i is the health status of child i, x_{ij} is a vector of parents' characteristics such as mother's education, father's education, parents' income for child i. The variable x_{ih} represents parents' health status, including parents' heights and weights; x_{if} is a vector of family characteristics such as family insurance reimbursement information, family employment status and family structure. $CONTROL_i$ is a vector of control variables for variables correlated with children health outcomes, and ε_i is the error term.[1]

Several issues arise in the estimation of equation (1). Numerous studies note the importance of the health environment, and ethnicity, on child anthropometry (Barrera, 1990; Flores, Bauchner, Feinstein, & D.T.Nguyen, 1999). The consensus from Barrera's study is that the provision of a healthier environment to children yields substantial benefits through improved child health. In addition, major ethnic groups and subgroups of children differ strikingly in demographics, health, and the use of services, after adjustment for family income and parental education. The health environment and ethnicity constitute the demographic characteristics by which parental behavior may influence child health. Therefore, I use region and ethnicity as control variables in the regressions.

Correlation among the explanatory variables makes identifying which factors truly affect adolescent health difficult. For example, in the presence of assortative mating, individuals with a higher level of education also marry partners with higher levels of education (Lindeboom, Llena-Nozal, & van der Klaauw, 2009) and a highly-educated female, particularly, tends to choose a husband with a higher educational level. There is clear evidence of this in Table 1, which shows the association between the education of fathers and mothers based on NHIS data for 2010 – 2011; the largest numbers are on or

[1] Basic estimation methodology is modified from model in Aslam and Kingdon (2010)

near the diagonal, indicating that couples tend to heave similar levels of education (although, there are still some exceptions, such as in the last three columns). Besides, parents with a higher education level usually have greater chances to be hired with high wages, which in turn positively affects family income.

To indicate the relationship between paternal and maternal educations, I establish a combined explanatory variable, the ratio between father's and mother's years of schooling, called "CORRPARED". If CORRPARED is greater than 1, the father's education level is higher than the mother's; if CORRPARED is less than 1, the paternal education level is lower than the maternal; and if CORRPARED is equal to 1, father and mother have same education levels. Figure 1 is the adaptive kernel density estimation for CORRPARED; parents with similar education levels (in years) have the highest density, which is what we expects from Table 1. The left tail is shorter than the right tail, which means the percentage of the combination of low paternal education and high maternal education is lower than the percentage of the combination of high father's education and low mother's education.

One of the problems in estimating equation (1) is that is assumed that parental education is endogeneity, which is a strong assumption if there are parental or household characteristics that are correlated with parental education and also influence adolescent health outputs. In the other word, a positive effect from maternal education in equation (1) may reflect the cross-section correlation between unobserved maternal traits on the one hand and both maternal education and adolescent health on the other hand, rather than representing a direct effect of maternal education on the health outcomes being measured.

One approach to dealing with the endogeneity is using Instrumental Variables. Glewwe (1999) recognizes the potential endogeneity of maternal education and uses IV techniques to identify the causal impact of maternal education on child health outcomes. This is also the approach I adopt in this study. I hope to obtain better understanding of the impact of parental education by including all other variables deemed relevant and available in the dataset that can help reduce omitted variable bias, and endogeneity. The vector of these variables include (and is not restricted to) variables that were thought to represent the "pathways" through which parental education impacts adolescent health. Since the use of IV not only addresses the endogeneity of the relevant channels, but also allows me to deal with the concerns that many of the variables used are subject to measurement error, IV methods are likely to be especially appropriate approach.

The possible existence of heteroscedasticity is also a concern in the regression models, since the presence of heteroscedasticity can invalidate statistical tests of significance that assume that the modeling errors are uncorrelated and normally distributed and whose variances do not vary with the effects being modeled. The Breusch-Pagan test shows the presence of heteroscedasticity in my regression model. To correct for this, I implement heteroscedasticity-robust standard errors, which while still biased, improve on the OLS model by modifying the error term into $\frac{\mu_j^2}{(1-h_{jj})^2}$ (where h_{jj} is the diagonal element of the hat matrix) to produce better results when the model really is heteroscedastic, with more conservative confidence intervals[2].

4. Data and Descriptive Statistics

The data for this study come from the National Health Interview Survey (NHIS), a multi-purpose health survey conducted by the National Center for Health Statistics (NCHS) and Centers for Disease Control and Prevention (CDC), administered to a total

[2] Davidson and MacKinnon (1993) suggested this heteroscedasticity-robust standard error and report that this method tends to produce better results when the model really is heteroskedastic, since this error produces confidence intervals that tend to be even more conservative.

of 73,838 households, including 32 states and the District of Columbia, from 2010 to 2011.

This survey gathered detailed information on several family, household, and individual level variables for adults and children. I pool the data from 2010 and 2011. The interviewed sample totals 73,838 households, with 191,851 persons in 75,673 families. The research sample in this paper shrinks to 24,127 children under 18 years of age, and 60,171 adults over 18 years old by ruling out the observations with missing variables. The average response rate over these two years is 80.75%.

To measure the dependent variable, child health, anthropometric status is often used to determine the extent of malnourishment among children. The following measures are frequently used: insufficient height-for-age, insufficient weight-for-age, and having insufficient weight-for-height, indicating acute malnutrition (Aslam & Kingdon, 2010). Since child growth and their anthropometric measures, depend on age and gender, it is usual practice to standardize children's heights and weights. The z-score of any health measure is defined as:

$$\mathrm{z-score} = \frac{\text{the measures of the index child health} - \text{the sample median}}{\text{standard deviation of the health outcomes}}.$$

Given this equation, we can say that a child with a z-score of zero is exactly at the median in terms of the measure being used (such as weight-for-age), while one with a negative z-score is below the median (for example lighter than the middle point), and one with a positive z-score is above the median (for example heavier than the middle point) of the distribution.

Figures 2 and 3 show adaptive kernel density estimates of z-scores of height for age and weight for age for adolescents aged 12 – 17 years when compared to the reference population (adolescents' median level in the whole country[3]). By definition, children in the US have good health status since they also serve as the reference population. The long-tail in Figure 3, though, demonstrates the significant existence of obesity of my sample compared with the reference population. The average z-score of height of age is 0.095, with a low standard deviation (Table 2(1)), suggesting the adolescents in my sample are close to the healthy children in the whole country. The average weight-for-age z-score is 1.914 (Table 2(1)), suggesting the adolescence in my sample weigh on average almost two standard deviations more than healthy children from the reference population.

General health outcomes also could be measured indirectly by looking at factors other than height and weight. I introduce two indirect indicators, missing school days due to illness/injuries (MSCH), and number of visits to an ER/ED (#ER). As a general health indicator, MSCH reports the situation that children experience illness, injuries or medical treatments. Table 2(1) shows that the average for MSCH is 3.5 per year, with a relatively reasonable standard deviation (if one rules out the extremely outliers beyond 100 days[4]. #ER indicates the situation of children experiencing emergency sickness and/or accidents. Also, #ER may reflect parental ability to deal with emergency cases. Both the MSCH and #ER variables could supplement the z-scores by reflecting the effects of chronic disease, or long-term health issues.

Table 2(2) reports some descriptive statistics for these independent variables, including means and standard deviations. I converted maternal and paternal education from different education levels into specific years. There are five categories of education

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[3] Adolescents' average levels are from survey dataset of Center of Disease Control and Prevention (CDC), including height and weight for given age and gender, which is a different survey from the NHIS. Since the median of adolescents' heights or weights from NHIS cannot be used to represent the healthy level for the whole country, if I were to use NHIS median the z-score would not reliably represent the healthy level for adolescents.

[4] Usually in heavy-tailed distributions, outliers may occur by chance. I delete the observations that are numerically distance from the rest of the data, i.e. those greater than and equal to 100 days per years, whose frequency is less than 1% in the whole dataset.

level, including mother/father has lower than high school education level (average 10.5 years), mother/father has high school diploma (average 12 years), mother/father complete associate/certification or vocational training after receiving high school diploma (average 14 years), mother/father hold bachelors' degree (average 16 years), and mother/father pursue post-bachelor degree or graduate study (average 20 years). Parental heights, weights and employment status reflect the relevant respondents' heights, weights, and employment status. Insurance information, family structure and income represent the situations of entire households. Insurance, family structure, employment and income are all dummy variables (Table 2(2)).

5. Empirical Findings

I start by estimating child health outcomes and parental behavior functions. The equations are estimated using Ordinary Least Squares (OLS) and Instrumental Variables (IV). Estimates are corrected for heteroscedasticity and clustering of the robust error terms is allowed at the regional level. I introduce the variables that may be correlated with parental education, and may be causing omitted variable bias, one by one, to determine which variables to include. If the introduction of a particular variable causes either the coefficient on "dad ED" or "mom ED" to vary significantly (compared to the base outcome without any proxy controls), this variable (rather than parental education) may be thought of a pathway through which parental education affects adolescent health. The health functions are estimated controlling for the potential endogeneity of the channels to determine the causal impact of the channels through which parental education impacts adolescent health, which is indicated by using IV estimation.

5.1 The significant effects of parental education

This subsection addresses the first question in my study: is parental education associated with adolescent health outcomes, and their general health level? Adolescent health outcomes (zheight and zweight) and general health level (MSCH and #ER) equations are estimated for the sample of children aged 12-17. The cross section grouped OLS estimates for equation (1) are presented in Table 3.

The regression results from Table 3 indicate the importance of parents' education, compared with the genetic effects. We expect that children's height and weight are directly affected by their parents genetically, which shows in the results in Table 3. From Table 3, controlling for region and ethnicity, the effects of parents' heights on children's heights are significantly positive; however, the effects of parents' weights on the heights of their children are approximately zero. On the other hand, both parents' height and weight have significant effects on children's weight. For a given age and gender, under similar BMI, taller children are heavier than shorter children, relatively. Moreover, parents' heights and weights both have positive and significant influences on children's heights and weights. Genetically speaking, the effects of parental physical health outcomes and nutrition structure on their children's health (aged 12 – 17) are positive and significant.

Table 3 shows that the variables of most interest are not only parental heights and weights, but also parental education, as measured by "mom ED" and "dad ED". Clearly, parental education (either paternal or maternal) is not significantly important to adolescent heights, but paternal and maternal education both impact #ER negatively and significantly. It is also clear that paternal education (but not maternal) has a significant negative impact on adolescent zweight and MSCH. This is also the headline story emerging from Table 3: While maternal education seems to influence the emergency health care decisions that are reflected in the number of visits to ER/ED, paternal education influences the day-to-day decisions that are demonstrated in the weight outcomes and the missing school days due to illness/injuries. While negative, the overall effects of father's education on weight, MSCH and #ER are relatively small, increasing paternal education by 1 year will decrease weight by only 0.05%, MSCH by 0.12%, and #ER by 0.014%. Mother's education has a negative association with the number of visits to ER/ED in Table 3. In my study, an additional year of schooling of the mother is associated with a reduction in emergency room visits by 0.008 per year.

The negative association between parental education and health outcomes cannot be explained as causal because of the existence of the potential endogeneity of parent's education level. One approach to overcome this bias is to introduce variables that proxy for the unobserved variables generating endogeneity in the variable of interest (Aslam & Kingdon, 2010). These variables are the hypothesized channels through which both paternal and maternal education are expected to impact adolescent health.

Tables 4 – 6 present the estimates for the zweight, MSCH and #ER equations under a variety of different specifications. In each of these tables, the control variables are introduced one by one. Since parental education levels both have an impact on #ER, and only paternal education appears important for zweight and MSCH, "pathways" through which parental education could impact zweight, MSCH and #ER are introduced in all these three tables.

First, focusing on Table 4, I introduce channels through which paternal education potentially impacts adolescent physical health. The estimate in column one reports the same regression as Table 3 for the z-weight regression, with the coefficient of -0.05 on father's education. The introduction of insurance enrollment information reduces the size of the effect of father's education, but does not cause it to be insignificant, just changing the effects of father's education to 0.057 while reacting with one-year change of father's education. Intuitively, higher father's education could improve their children's physical health outcomes (demonstrated by weight) by enrolling in appropriate health insurance (including private insurance, Medicaid, CHIP/SCHIP, etc.), since a better-educated father usually is able to process more information about health insurance, or receive insurance from his employer. The introduction of family structure does not cause a large difference in the sample size and also has no effect on the coefficient of father's education (0.049, almost same as 0.05). Indeed, there is not much direct effect from family structure (whether children grow up in a traditional family or not) on weight-for-age. Notably, the introduction of employment causes a small reduction (from -0.05 to -0.054) in the size of the father's education coefficient and the effect of employment is also significant (the correlation between father's education and employment is 0.43). The father's employment appears to have a relatively large, direct, significant and negative effect on weight-for-age; since being employed is associated with a 0.103 unit decrease of the z-score, which drags the z-score even closer to the health level of zero. This suggests that both father's education and father's employment are positively associated with better adolescent physical health outcomes, as reflected in weight-for-age z-scores. Usually more education raises the probability of being hired in the job market. While the introduction of an income variable decreases the absolute value of the coefficient of father's education, this is largely due to the high correlation between education and income, which prevents inference of any effect of the two independent variables: the correlation is 0.81, apparently larger than the correlation between education and employment.

Table 5 explores how father's education influences the number of school days missed due to illness/injuries. The introduction of insurance, employment, family structure, and income all reduce the size of the coefficients on father's education, but the coefficients remain statistically significant. The only new significant variable in this exercise is the family structure, which measures, whether the children grow up in a traditional family (biological father, and mother) has direct effects on their school attention. However we do not know about the exact relationship between father's education and family structure.

Table 6 estimates the determinants of the number of visits to ER/ED, again adding the “pathways” one-by-one. We saw that both father’s and mother’s education influence the #ER significantly. The introduction of insurance decreases the absolute value of the coefficients of both parent’s education, and even causes maternal education to become insignificant; this is largely due to the high correlation between education and insurance coverage of emergency treatment which prevents inference of any effect of the two independently (the correlation between this two is 0.61). Besides, the introduction of the family income variable also causes a reduction in the size of the mother’s education coefficient and it is no longer significant, while mother’s education is highly correlated with the family income. Mother’s education decreases the #ER by improving the quality of insurance reimbursement and increasing the family income. Although the coefficients of father’s education are significant even after adding all these variables we concerned, each of these characteristics reduces the size of the coefficients.

The introduction of each of the channels independently is premised on there being no inter-relationships between themselves. However, those “pathways” themselves may be interlinked – for instance, employment status is likely to play an important role in determining family income. Table 7 reports the OLS estimates with all pathways added simultaneously for weight-for-age, MSCH, and #ER. In column (1), the introduction of all pathways causes the coefficient on paternal education to decrease, but it remains statistically significant, and the stronger effects are now captured in father’s employment status. Similarly, in column (2), the influence of father’s education become less significant (from 1% to 10%), and only family structure and high-level income remain significant. In column (3), mother’s education become insignificant and father’s education become less significant (from 1% to 5%), and only insurance and low-level income remain significant. These results suggest that maternal education seems to translate into fewer visits to ER/ED solely through affecting insurance enrollment and family income, while paternal education operates through father's employment status and also family income, and whether the parents are able to keep their children in a traditional-structured family.

5.2 How does parental education impact adolescent health?

This sub-section seeks to identify the causal impact of the variables identified as possible channels, including insurance reimbursement, employment status, family structure, and household income. One approach to dealing with the potential endogeneity of these variables is to use instrumental variables (IVs). Glewwe (1999) instruments maternal health knowledge through three different variables: existence of close relatives who could act as sources of health knowledge, exposure to mass media, and mother's education (with the view that if mother's education can be credibly excluded from child health equations, it will be a plausible instrument). Strauss (1990) and Handa (1999) use measures of "female empowerment" in child health functions and the endogeneity of their variables is treated by using household fixed effects estimators. However, this is based on the notion that the sources of heterogeneity are at the level of the household which may not be entirely convincing for female empowerment variables where the source of heterogeneity is most likely to be at the level of the individual rather than at the household.

However, it is very difficult to find suitable instruments, or to use other convincing methodologies to control for unobserved heterogeneity. Given this constraint, I also use variables available in the dataset that I consider to be plausible instruments. Mother's and father's education are both included as instruments in final regressions, since mother's and father's own education level are not full-directly determining children's weights or general health outcomes (MSCH/#ER). Theoretically, this is plausible because I argue that parental education translates into better child health through the channels of impact. Household's income, family structure, insurance enrollment and employment status in equation (1) are instrumented using father's education and mother's education levels.

Table 8 – 10 report IV estimates (controlling for region and ethnicity) on the following dependent variables: z-score of weight-for-age, MSCH and #ER respectively. As before, all estimates are robust and control for clustering at region and ethnicity level. Let's focus first on the findings in Table 8. The first stage regression for employment shows that one of two instruments has the predicted sign and is significant and very precisely determined. Father's education has positive and significant effects on being employed. However, the F-statistics of the excluded instruments is only 2.61. If one used more than one excluded instrumental variables to instrument for a single endogenous variable, and one wanted to restrict the bias of the IV estimator to five percent of the OLS bias, the critical value of first stage F-statistics would need to be greater than 13.91 (Stock & Yogo, 2005).

For employment, mother's and father's education may be weak instruments. For household insurance, family structure, and gross income, neither mother's nor father's education levels are weak instruments, since the F-statistics are all greater than 13.91. Both mother's and father's education are positively related to household insurance enrollment, traditional family structure, and a high gross income level; in other words, parents with higher education tend to stay as couples, enroll in insurance, and earn higher income, relative to parents with lower educational levels. In the second stage, it is clear that when a family is enrolled in a good health insurance plan, and children grow up in a traditional-structured and high-income family, there are positive effects on decreasing the z-score of weight-for-age close to zero[5], where the children's weights are

[5] In Table 8, the coefficients of second stage regression of IV on insurance, family structure and high-income all significantly relate with z-score of weight-for-age. Insured family may move children weight closer to the country health level by 2.22%; grew-up in a traditional family could improve children weight closer to the country level by 1.64%; Lived in a high-income family can make children weight closer to the country level by 0.67%.

closer to the country healthy level.

We now turn to the findings in Tables 9 and Table 10. Here too, insurance, family structure, employment, and income are treated as endogenous, and instrumented one by one using mother's education and father's education. In the first stage regression, the F-statistics for employment regression are 2.84 (MSCH) and 2.96 (#ER), which implies that mom ED and dad ED are both weak instruments for employment. Also, only father's education has a significant effect on employment status. As for the effects on weight-for-age, parental education has positive effects on decreasing MSCH and #ER, through the similar pathways of weight-for-wage.

6. Conclusion and Discussion

This study investigates the relationship between parental education levels on the one hand, and adolescent health outcomes (measured as child height and weight) and physical activities related to health status (measured as missing school days due to illness/injuries and number of times in ER/ED) on the other. This study strengthens the understanding of the mechanisms through which parents' schooling translates into better child health outcomes and parental health-seeking behavior.

Using the latest pool of data from the NHIS (2010 and 2011), a child health function (1) is estimated using grouped OLS estimation and Instrumental Variables (IV). The estimations are based on a sample of children aged 12 – 17 years. The analysis demonstrates the importance and significant effects of parental, and especially for father's education. The father's education level is more important than the mother's on three indicators I look at in this study. Since a better-educated father tends to provide a good and healthy family structure; and better and stable employment for their family, father's education significantly keeps his child in a healthy physical status, and decreases the days of missing school and visits to ER/ED. Meanwhile, mother's education has significant positive effects on decreasing the visits to ER/ED for her child. Both effects from mother and father work through the influence on enrollment in health insurance, family structure, and employment status.

Most studies have restricted their analysis of child health outcomes to children aged 5 or less by using height-for-age and weight-for-age z-score. This is often guided by the availability of data – most household datasets provide anthropometric measures only for children in this age range – or by the fact that WHO growth standards are often available only for children in this age group. Moreover, the height and weight of children in the 0-5 age groups are affected less by the outside environment than the height and weight of adolescents in the 12-17 age groups. In the NHIS database, the survey questions about children's height, weight and BMI are limited to the 12-17 age group.

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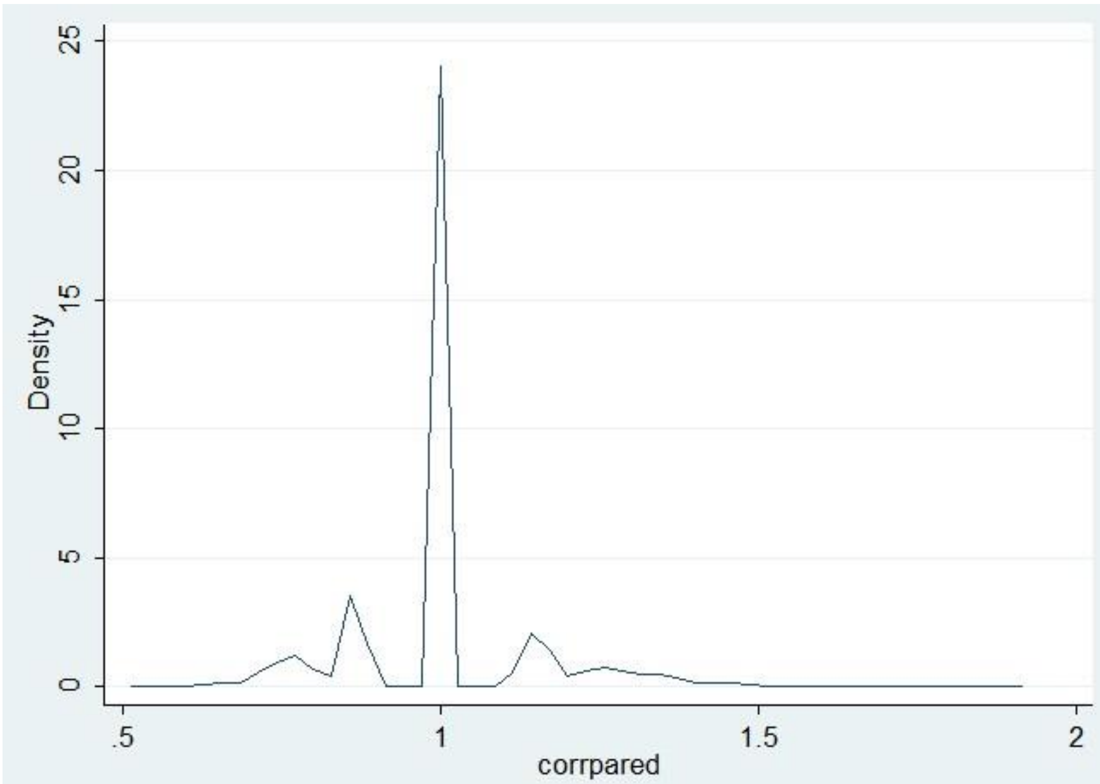
Figure 1 Kernel density of CORRPARED (ratios of father's & mother's education)



Source: NHIS (2010-2011)

Table 1 Correlation between mothers' education level and fathers' education level

Correlation between mothers' education level and fathers' education level for 2010-2011								
	Father Education							
Mother Education	1	2	3	4	5	6	7	8
1	**2,304**	380	253	48	17	2	29	4
2	498	**1,041**	533	163	47	20	41	17
3	390	627	**3,757**	**1,678**	290	112	378	96
4	110	343	**1,116**	**1,489**	336	132	570	214
5	32	119	477	363	406	70	**3,187**	99
6	13	38	258	163	**1,050**	180	279	**2,022**
7	40	60	593	569	324	212	**2,187**	**1,061**
8	5	19	156	198	83	**1,027**	830	**1,228**

Correlation (by years): 0.5862

Source: NHIS (2010-2011)

Note: 1. Less than 8th grade,

2. 9 – 12th grade, no degree

3. High school

4. College, no degree

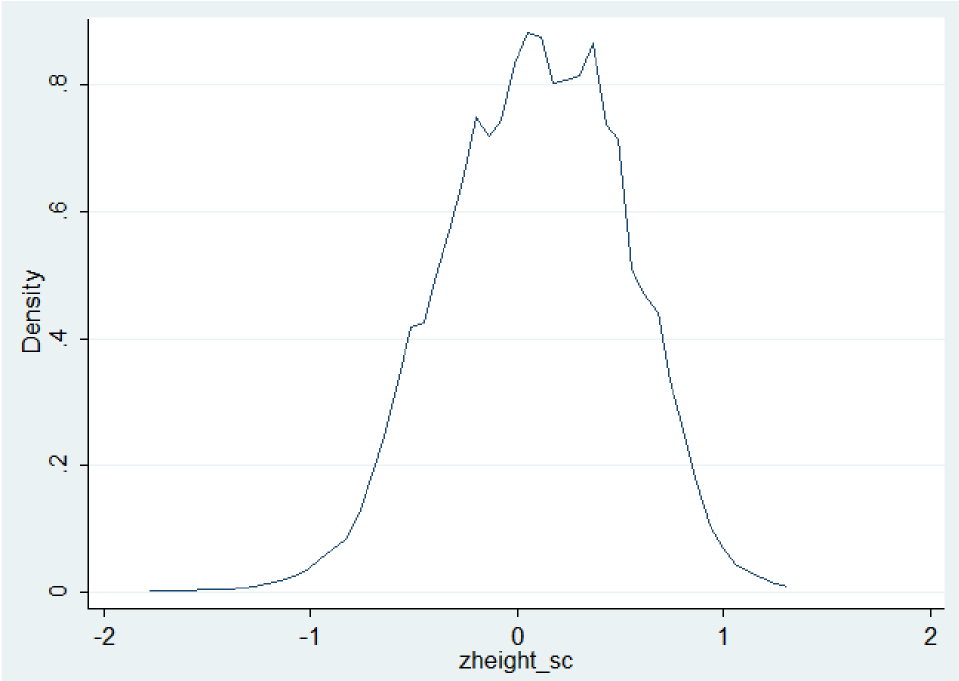
5. AA certification, on vocational/technology school

6. AA certification, on academic

7. Bachelor Degree

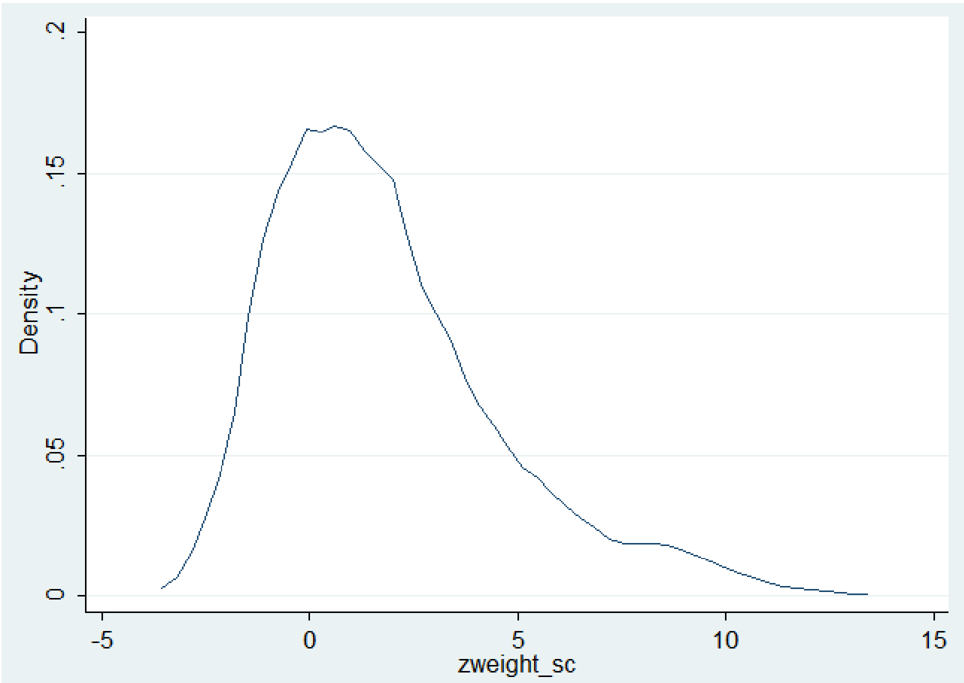
8. Master's, Professional, or Doctor Degree

Figure 2 Adaptive Kernel Density Estimation of height for age z-score (age 12-17 years)



Source: NHIS (2010-2011)

Figure 3 Adaptive Kernel Density Estimation of weight for age z-score (age 12-17 years)



Source: NHIS (2010-2011)

Table 2 (1) Descript Statistics of Dependent Variables (2010-2011)

Dependent Variables	Explanation	Mean	Standard Deviation	Min	Max
zheight	z-score of height for age	0.095	0.436	-1.715	1.252
zweight	a-score of weight for age	1.914	2.833	-3.206	13.101
azheight	absolute value of zheight	0.362	0.261	0.001	1.715
azweight	absolute value of zweight	2.473	2.361	0.002	13.101
MSCH	Missing school days due to injuries/illness	3.538	6.440	0	90
#ER	# of times visiting ER/ED	0.253	0.654	0	8

Table 2(2) Descript Statistics of Independent Variables (2010-2011)

Independet Variables	Explanation				
mom ED	maternal education level (estimated year)	Mean: 13.949	SD: 2.489	Min: 10.5	Max: 20
dad ED	paternal education level (estimated year)	Mean: 14.133	SD: 2.648	Min: 10.5	Max: 20
pheight	average parents' heights	Mean: 66.457	SD: 3.882	Min: 59	Max: 76
pweight	average parents' weights	Mean: 137.232	SD: 38.617	Min: 100	Max: 299
insurance	family insurance reimbursement	Enrolled any insurance form (includes Medicaid, CHIP, etc.): 1		No Insurance covered: 0	
Family structure		Adolescents grow in a traditional family: 1		Non-traditional family (includes single-parent family, raised by relatives, etc.): 0	
Employment		Employed in last 12 months: 1		Unemployed in last 12 months: 0	
Income	family gross income	Low income (0-$34,999): 1	Mid-level Income ($35,000-$74,999): 2	High Income ($75,000+): 3	

Source: NHIS (2010-2011)

Table 3 grouped OLS estimates of determinants of zheight, zweight, MSCH, #ER

	zheight	zweight	MSCH	#ER
mom ED	-0.001	-0.015	-0.053	-0.008***
dad ED	0.000	-0.050***	-0.117***	-0.014***
Parents' Height	0.005***	0.043***	-0.044*	-0.001
Parents' Weight	0.000	0.012***	0.013***	0.000*
Northeast	0.024**	-0.156*	0.505**	0.058**
Midwest	0.000	-0.067	-0.058	0.004
West				
South	0.011	-0.181**	0.780***	-0.066***
Hispanic	-0.004	0.316***	-1.655***	-0.012
NH-White				
NH-Black	-0.033***	0.118	-1.731***	0.028
NH-Asian	0.033**	0.108	-2.143***	-0.063***
NH-others	0.023	0.342	-1.780***	0.012
CONSTANT	0.003	4.006***	6.991***	0.589***
# of obs.	6,266	6,223	6,921	6,958
R-squared	0.0102	0.0494	0.0279	0.0146
Root MSE	0.2581	2.1835	5.8608	0.5785

Table 4 Grouped estimates of determinants of weight-for-age z-score, variables added one-by-one

zweight	(1)	(2)	(3)	(4)	(5)
mom ED	-0.015	-0.018	-0.014	-0.016	-0.007
dad ED	-0.050***	-0.057***	-0.049***	-0.054***	-0.041***
Parents' Height	0.043***	-0.029***	-0.044***	-0.047***	-0.042***
Parents' Weight	0.012***	0.011***	0.012***	0.013***	0.012***
Northeast	-0.156*	-0.212**	-0.161*	-0.128	-0.131
Midwest	-0.067	-0.027	-0.074	-0.060	-0.050
West					
South	-0.181**	-0.186**	-0.179**	-0.191**	-0.186**
Hispanic	0.316***	0.237***	0.307***	0.288***	0.267***
NH-White					
NH-Black	0.118	0.128	0.105	0.063	0.079
NH-Asian	0.108	0.129	0.118	0.141	0.096
NH-others	0.342	0.456	0.354	0.467	0.315
Insure		-0.010			
Trad Fami			-0.041		
Employment				-0.103*	
Income (0-$34,999)					0.105
Income ($35,000-$74,999)					
Income ($75,000 +)					-0.097
CONSTANT	4.006***	3.522***	4.022***	4.357***	3.733***
# of obs.	6,223	5,300	6,194	5,703	5,986
R-squared	0.0494	0.0436	0.0498	0.0532	0.0484
Root MSE	2.1835	2.1644	2.1862	2.1768	2.1969

Table 5 Grouped estimates of determinants of MSCH, variables added one-by-one

MSCH	(1)	(2)	(3)	(4)	(5)
mom ED	-0.053	-0.063*	-0.035	-0.059*	-0.003
dad ED	-0.117***	-0.091***	-0.106***	-0.111***	-0.094***
Parents' Height	-0.044**	-0.033	-0.051**	-0.055**	-0.034
Parents' Weight	0.013***	0.008***	0.013***	0.013***	0.012***
Northeast	0.505**	0.504*	0.495**	0.458*	0.663**
Midwest	-0.058	-0.031	-0.066	-0.017	-0.043
West					
South	0.780***	0.297*	0.705***	0.831***	0.829***
Hispanic	-1.655***	-1.407***	-1.718***	-1.645***	-1.873***
NH-White					
NH-Black	-1.731***	-1.419***	-1.824***	-1.688***	-1.900***
NH-Asian	-2.143***	-1.833***	-2.167***	-2.149***	-2.346***
NH-others	-1.780***	-1.439**	-1.801***	-2.274***	-1.970***
Insure		-0.045			
Trad Fami			-0.457***		
Employment				-0.088	
Income (0-$34,999)					0.368
Income ($35,000-$74,999)					
Income ($75,000 +)					-0.522***
CONSTANT	6.991***	6.896***	7.296***	7.732***	5.722***
# of obs.	6,921	5,902	6,888	6,349	6,629
R-squared	0.0279	0.0200	0.0293	0.0277	0.0304
Root MSE	5.8608	5.5714	5.8228	5.8987	5.9497

Table 6 Grouped estimates of determinants of #ER, variables added one-by-one

#ER	(1)	(2)	(3)	(4)	(5)
mom ED	-0.008***	-0.004	-0.008***	-0.006*	-0.005
dad ED	-0.014***	-0.009***	-0.014***	-0.013***	-0.011***
Parents' Height	-0.001	-0.001	-0.002	-0.001	-0.000
Parents' Weight	0.000*	0.000*	0.000*	0.000	0.000
Northeast	0.058**	0.108***	0.059**	0.046*	0.064**
Midwest	0.004	0.046**	0.006	0.002	0.011
West					
South	-0.066***	-0.035**	-0.068***	-0.066***	-0.068***
Hispanic	-0.012	0.016	-0.016	-0.011	-0.032
NH-White					
NH-Black	0.028	0.056*	0.027	0.031	0.022
NH-Asian	-0.063***	-0.036	-0.062***	-0.079***	-0.084***
NH-others	0.012	0.018	0.016	-0.032	-0.006
Insure		-0.144***			
Trad Fami			-0.010		
Employment				0.011	
Income (0-$34,999)					0.093***
Income ($35,000-$74,999)					
Income ($75,000 +)					-0.023
CONSTANT	0.589***	0.529***	0.622***	0.517***	0.449***
# of obs.	6,958	5,921	6,925	6,381	6,663
R-squared	0.0146	0.0232	0.0153	0.0130	0.0194
Root MSE	0.5785	0.5545	0.5776	0.5756	0.5843

Table 7 Reduced form estimates of determinants of zweight, MSCH and #ER, variables added simultaneously

	zweight	MSCH	#ER
mom ED	-0.022	-0.022	-0.002
dad ED	-0.055***	-0.061*	-0.008**
Parents' Height	-0.034***	-0.037	0.001
Parents' Weight	0.011***	0.007***	0.000
Northeast	-0.149	0.615**	0.096***
Midwest	-0.002	-0.045	0.041*
West			
South	-0.155*	0.189	-0.049***
Hispanic	0.190**	-1.515***	0.016
NH-White			
NH-Black	0.069	-1.540***	0.068**
NH-Asian	0.156	-1.956***	-0.065***
NH-others	0.409	-1.596***	0.024
Insure	0.058	0.249	-0.106***
Trad Fami	-0.002	-0.326**	0.002
Employment	-0.124*	0.095	0.018
Income (0-$34,999)	-0.003	-0.008	0.062**
Income ($35,000-$74,999)			
Income ($75,000 +)	-0.077	-0.597***	-0.002
CONSTANT	3.798***	6.555***	0.337**
# of obs.	4,712	5,219	5,233
R-squared	0.0455	0.0216	0.0224
Root MSE	2.1773	5.6930	0.5538

Table 8 Instrumental Variables of z-score of Weight-for-Age

zweight	Employment		Insurance		Family Structure		Low-income		Hight-income	
	First Stage	Second Stage	First Stage	Second Stage	First Stage	Second Stage	First Stage	Second Stage	First Stage	Second Stage
Employment		-7.943**								
Insurance				-2.227***						
Family Structure						-1.635***				
Low-income								1.359***		
High-income										-0.669***
mom ED	-0.004		0.022***		0.025***		-0.027***		0.048***	
dad ED	0.007**		0.007***		0.011***		-0.016***		0.044***	
Parents' Height	0.006***	0.000	0.000	-0.031***	-0.001	-0.047***	-0.006***	-0.034***	0.003**	-0.040***
Parents' Weight	-0.001**	0.009***	0.000	0.011***	0.000	0.012***	0.001***	0.011***	-0.000	0.012***
Northeast	0.053**	0.266	0.059***	-0.073	-0.014	-0.178*	-0.031*	-0.097	0.094***	-0.076
Midwest	-0.025	-0.257	0.039***	0.069	-0.024	-0.106	-0.037***	-0.000	0.016	-0.041
West										
South	-0.008	-0.258*	0.034***	-0.114	-0.017	-0.208***	-0.009	-0.178**	0.029**	-0.171**
NH_White										
NH_Black	0.129***	1.369***	-0.154***	-0.084	-0.047***	0.239***	0.170***	0.079	-0.231***	0.152*
NH_Asian	0.042*	0.417*	-0.099***	-0.069	-0.198***	-0.194	0.057***	0.035	-0.163***	-0.001
NH_others	0.105***	0.954*	-0.055***	-0..020	0.001	0.104	0.160***	-0.100	-0.154***	0.019
# of obs	5703	5703	5300	5300	6194	6194	5986	5986	5986	5986
Root MSE	0.4778	4.33	0.3474	2.297	0.4868	2.319	0.3798	2.243	0.4227	2.207
F-statistics	2.61		91.31		76.25		172.16		633.77	
DWH chi-square	15.399***		22.274***		18.74***		14.372***		11.197***	

Table 9 Instrumental Variables of MSCH

MSCH	Employment First Stage	Employment Second Stage	Insurance First Stage	Insurance Second Stage	Family Structure First Stage	Family Structure Second Stage	Low-income First Stage	Low-income Second Stage	Hight-income First Stage	Hight-income Second Stage
Employment		-18.663**								
Insurance				-5.069***						
Family Structure						-4.057***				
Low-income								3.535***		
High-income										-1.774***
mom ED	-0.003		0.021***		0.026***		-0.028***		0.049***	
dad ED	0.006**		0.007***		0.008***		-0.015***		0.043***	
Parents' Height	-0.001***	0.052	-0.000	-0.365	-0.001	-0.056**	-0.005***	-0.019	0.003**	-0.033
Parents' Weight	-0.003	0.003	0.000	0.008***	0.000	0.014***	0.001***	0.010***	-0.000*	0.011***
Northeast	0.046**	1.278**	0.054***	0.787***	-0.003	0.492**	-0.033**	0.723***	0.102***	0.786***
Midwest	-0.022	-0.439	0.045***	0.208	-0.012	-0.097	-0.043***	0.097	0.012	-0.034
West										
South	-0.013	0.589	0.035***	0.469**	-0.014	0.650***	-0.007	0.830***	0.032**	0.864***
NH_White										
NH_Black	0.138***	1.072	-0.166***	-2.217***	-0.046***	-1.863***	0.174***	-2.292***	-0.234***	-2.105***
NH_Asian	0.027	-1.140**	-0.106***	-1.923***	-0.211***	-2.548***	0.064***	-1.984***	-0.173***	-2.076***
NH_others	0.114***	-0.049	-0.060***	-2.171***	-0.014	-2.254***	0.149***	-2.762***	-0.162***	-2.515***
# of obs	6349	6349	5902	5902	6888	6888	6629	6629	6629	6629
Root MSE	0.4768	10.63	0.3481	5.834	0.4866	6.077	0.3816	6.055	0.4231	5.965
F-statistics	2.84		90.71		80.24		192.78		693.30	
DWH chi-square	12.783***		17.320***		14.178***		13.062***		7.414***	

Table 10 Instrumental Variables of #ER

#ER	Employment First Stage	Employment Second Stage	Insurance First Stage	Insurance Second Stage	Family Structure First Stage	Family Structure Second Stage	Low-income First Stage	Low-income Second Stage	Hight-income First Stage	Hight-income Second Stage
Employment		-2.157**								
Insurance				-0.545***						
Family Structure						-0.595***				
Low-income								0.484***		
High-income										-0.241***
mom ED	-0.003		0.021***		0.026***		-0.028***		0.049***	
dad ED	0.007**		0.006***		0.009***		-0.016***		0.043***	
Parents' Height	0.006***	0.012	-0.000	-0.001	-0.001	-0.002	-0.006***	0.002	0.003**	-0.000
Parents' Weight	-0.001***	-0.001	0.000	0.000**	0.000	0.001**	0.001***	0.000	-0.000*	0.000
Northeast	0.046**	0.143**	0.053***	0.131***	-0.005	0.057**	-0.035**	0.075***	0.101***	0.083***
Midwest	-0.025	-0.054	0.047***	0.065***	-0.012	-0.001	-0.044***	0.028	0.012	0.009
West										
South	-0.012	-0.091**	0.035***	-0.022	-0.018	-0.079***	-0.007	-0.066***	0.033**	-0.062***
NH_White										
NH_Black	0.141***	0.311**	-0.164***	-0.047	-0..044***	-0.039*	0.172***	-0.092***	-0.234***	-0.067***
NH_Asian	0.030	0.101*	-0.106***	0.018	-0.211***	-0.093**	0.061***	0.005	-0.171***	-0.008
NH_others	0.116***	0.168	-0.058***	-0.063*	-0.011	-0.072**	0.147***	-0.139***	-0.164***	-0.106***
# of obs	6381	6381	5921	5921	6925	6925	6663	6663	6663	6663
Root MSE	0.4766	1.182	0.3488	0.5714	0.4867	0.6438	0.3831	0.602	0.4231	0.5901
F-statistics	2.96		91.02		81.26		197.53		693.18	
DWH chi-square	18.975***		11.222***		38.442***		23.295***		20.901***	

Note: Table 3 – Table 10:

*Significant at 10%

**Significant at 5%

***Significant at 1%