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THE IMPORTANCE OF DURATION OF FAMILY STRUCTURE IN THE PRODUCTION OF ADOLESCENT HEALTH

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The incidence of single-parent families has been increasing since the 1960s, with the well-being of children living in those families consistently lower than those living in households with two parents. We use the National Longitudinal Study of Adolescent Health (Add Health) to examine the relationship between the length of time spent in a single-parent family and the risk of adverse health outcomes during adolescence. A recursive health production function is estimated using a multivariate probit model to clarify the relationship between health outcomes, health investment activities, and single-parent family structure. We find that children who spent varying amounts of time in a single-parent family had systematically different rates of adverse health outcomes, such as obesity and fair or poor health status, which we consider as measures of health "stocks". Time in a single-parent family also mediates investments made in adolescent health, such as check-up visits to a doctor and insurance status, which we consider as health "flows". Notably, adolescents who spent some time, but not their entire lives, in a single-parent family have a higher likelihood of reporting fair to poor health, and are less likely to have private health insurance. Our results also suggest that males are more adversely affected by living in a single-parent family than females are, which is consistent with previous literature on educational and behavioral outcomes. Additionally, our measure suggests that commonly used binary, static indicators for single-parent status might be mischaracterizing the effects of living in a single-parent family.

1. INTRODUCTION

Since 1960, the prevalence of the traditional family (i.e. two parents) has been declining in the United States. In particular, the percentage of children living in a single-parent family increased from about 8% in 1960 to over 20% in 1984 (Scott 1993). This number had jumped to 27% by 1995 (U.S. Census Bureau 1997). In 2004, about 26% of children lived in one-parent households, most of them being led by women (Kreider 2008). In fact, it was predicted that of

children born in 1986, about 60% would spend at least some time in a single-parent household before age 18 (Norton and Glick 1986). On average, single-parent households headed by women suffer from lower income and less parental time available than two-parent households. The time of the single parent, usually the mother, can be spread thin among work, child care and other household production activities.

An extensive body of literature documents the effects of single-parent family structure on the welfare and outcomes of children. A preponderance of the studies have focused on educational attainment. One of the first, Krein and Beller (1988), document negative effects of living in a single-parent family headed by a woman on the educational attainment of young adults, finding it varies by length of time lived in a single-parent family, age of the child(ren) at the occurrence, and child's gender. In terms of other outcomes, children living in single-parent families, tend to be more likely to engage in drug-related behaviors (Hoffmann and Johnson 1998) and sexual intercourse (Lammers et al. 2000).

The literature documenting the role of family structure on health outcomes has documented similarly negative effects. Evidence has pointed to younger children living in single-mother homes having worse physical, mental, and dental health outcomes than their counterparts in two-parent homes (Angel and Worobey 1988; Bramlett and Blumberg 2007). With regard to general health, evidence from the 1988 National Health Interview Survey (NHIS) suggests that children living in households with a single mother or a mother and stepfather were more likely to have elevated scores for health vulnerability and behavioral issues (Dawson 1991). Further, Dawson finds that compared with children living with their biological parents, children in other living arrangements were more likely to have an accidental injury or develop

asthma. A recent study suggests that children of single-father households have less access to health care (Leininger and Ziol-Guest 2008).

Children who experience transitions away from a two-parent family also are more likely to face a myriad of mental and physical health problems, including depression and delinquency (Brown 2006; Mauldon 1990; Spruijt and de Goede 1997). Health problems that originate in childhood can often persist and become exacerbated into adulthood (Case et al. 2005), making it even more important to understand the contexts underlying the development of poor health outcomes in adolescents.

There are several pathways for how spending time in a single-parent family can lead to adverse health consequences. As an example of an adverse health outcome, obesity is one of the largest health burdens of the 21st century. One of the explanations for the significant rise of obesity in recent years involves an increased consumption of calories over time (Cutler et al. 2003). Furthermore, technological advances have enabled calorie-dense foods to be produced in a shorter amount of time and at a lower cost. Single mothers (and fathers) may have less time to devote to household production activities like food preparation than two-parent households, along with a lower income (Monna and Gauthier 2008). Thus, the lower cost of calories in terms of monetary cost and time, may support lower-quality nutritional choices in single-parent households compared with two-parent households. This explanation can apply to additional health behaviors as well, such as routine visits to the doctor or dentist.

There is strong evidence to suggest that children faced with single- and step-parent family structures have poorer diets compared with those living in a two-parent household. From a low-income, multi-ethnic sample of children aged 9-12 years old in Montreal, Canada, children living in single-parent families were found to consume a higher percentage of their calories from

fat as compared to two-parent families (Johnson-Down et al. 1997). Furthermore, Stewart and Menning (2009) use the National Longitudinal Study of Adolescent Health (Add Health) data set and find that living in a single-mother family during Waves I and II (1995 and 1996, respectively) decreased the frequency of vegetable and variety of simple sugar consumption, and raised the likelihood of skipping breakfast. Furthermore, father involvement significantly raised the frequency of days when breakfast and lunch was consumed.

The role of family structure in predicting overweight and obesity outcomes is somewhat less clear. Using the National Longitudinal Survey of Youth (NLSY), Strauss and Knight (1999) find that normal weight children living in a single-parent family are 36% more likely to be obese six years later compared with children in two-parent families. However, after controlling for demographic and socioeconomic characteristics, living in a single-mother household did not significantly explain subsequent obesity status. Additionally, Strauss and Knight found that the incidence of obesity among children previously living in single-mother homes varied significantly according to the cognitive environment of the household (e.g. reading to the child, taking the child to the museum). Crossman, Sullivan and Benin (2006) used the Add Health data to find that family structure (e.g. living in a single-parent family) during Wave I played no significant role at predicting overweight or obesity outcomes six years later at Wave III.

Measures of investment in health, such as insurance status, physician check-ups, and dentist visits have been studied less extensively. Access to healthcare is limited in single-parent families, and uninsured status is a large barrier to health care, including mental health services (Heck and Parker 2002; Kataoka et al. 2002). Specific early health practices of the child, including routine physical and dental check-ups, can sometimes avert problems that can manifest themselves more severely in adulthood (e.g. Section on Pediatric Dentistry 2003).

This study analyzes the role of duration in a single-parent family on health outcomes and health investment behaviors in adolescents using data from the National Longitudinal Study of Adolescent Health (Add Health). This study contributes to the literature in several ways. First, and most importantly, we consider the *duration* of time that an adolescent spent in a single-parent family, rather than just a static, binary indicator. The vast majority of studies discussed above documenting the potential consequences of living in a single-parent family on child health have used a binary indicator for single-parent family status at the time of the survey interview. The limitation of such an indicator is that it does not capture variation in the length of time spent in a single-parent family. Since many household-level surveys (including Add Health and NLSY) collect information about children of varying ages, the potential exists to observe children living in a single-parent family over a wide range of ages. Duration of time in a single-parent family has been found to be important for other outcomes, including educational attainment (Krein and Beller 1988) and misbehavior (Hao and Xie 2002).

Secondly, this study distinguishes between health "stocks" and "flows" of adolescent health, and uses proxies to measure both of these constructs. Self-reported health status and obesity serve as health stocks, whereas dental visits, physicals, and insurance status measure health flows.

Third, this study uses a trivariate probit approach to estimate a recursive health stock production function, which allows us to capture the correlations between the unobserved factors that underlie the "stocks" and "flows" of adolescent health. In this way, a less biased estimate of the role of family structure on health outcomes can be obtained.

2. THEORETICAL FRAMEWORK

Grossman (1972) originally formulated a model for the production of health, whereby each individual was endowed with a "stock" of health that depreciates over their lifetime. These stocks are the result of an accumulation of various observed and unobserved "flows," combined with a baseline endowment. We measure these stocks as weight status and fair/poor health status. Individuals gain utility from good health, which enables them to increase their income through increased wages as well as more available and more productive time in both the labor market and the home. Importantly, investments in health (flows) enable a person's health stock to be maintained or increased. Similarly, negative investments have long-term ramifications for future health.

Jacobson (2000) later expanded this model to account for how spouses and families jointly consume and produce health for themselves and their families. Jacobson describes a model whereby families must choose between market goods and their investment in their child's health. Parents can divide their time between market work, time in the household, time on other commodities, and time themselves being sick. In a single-parent household, there is a smaller endowment of both money and time to devote to these tasks. Depending on their varying utility for their health, their child's health, market goods, and leisure, among other factors, their time would be allocated differently than in a two-parent household.

In a similar vein, Becker's (1965) model of time allocation stipulates that households combine money and time inputs to produce commodities that are objects of utility in the household. The health of children can be viewed as such a commodity. In general, an increase in either the time or money inputs into producing a child's health would yield beneficial effects. A parent can choose to spend time in the labor market generating income, which they can use in combination with time to produce health investments (e.g. healthy meals or doctor's visits).

Single-parent families have a much lower income than two-parent families (see for example, Tables 1 and 2 in our study), and if the parent is working, she would have less time to devote to investments in her child(ren). This gives less time and money resources for single parents to combine in order to produce commodities in the household, including the health of their children.

More recently, the theories of health production and time allocation have been unified by more modern and multi-dimensional concepts such as genetics and neurobiology, as described by Heckman (2007). Heckman stresses the notion that epigenetics (environment influences genetic expression) underlies much of capacity formation, including the ability to create and maintain one's health stock.

We apply the Grossman framework of health production of health outcomes, as well as the decisions parents make to invest in their childrens' health through insurance and physicans visits. We follow the general conceptual framework that Jones et al. (2007) uses to estimate the relationship between mortality, health status, and lifestyle behaviors. The health production theory can be operationalized by considering a recursive system of equations for health (*h)*, single-parent status (*S),* and demographic characteristics (*Z)* and health investments (*I)* by parents:

$$h = h(I, S, Z, \mu_h) \qquad (1)$$
$$I = f(S, Z, \mu_I)$$

In this model, single-parent status is viewed as an input into the production of health investments in children, as well as directly into the child's health production itself. Exogenous socio-demographic variables (*Z)* are included, the most important of which is a measure of household income. This model is derived from previous literature where the negative consequences of living in a single-parent family are found to persist even after controlling for parental income levels. Within the production functions for health outcomes and health

investments, unobserved heterogeneity (μ) is present, which is assumed to be correlated between both the investments and the outcomes. This unobserved heterogeneity may stem from health outcome or investment production, or be part of the general health utility function. It is also assumed that part of the unobserved processes driving parents to invest in their childrens' health (μ_I) is related to the unobserved processes driving the outcomes themselves (μ_h).

In addition to the role of parental characteristics and investments in explaining health outcomes of children, there is also the potential for reverse causality, whereby child health might affect parental relationships and family structure. For instance, Reichman, Corman, and Noonan (2004) report that in families with children born out of wedlock, the father and mother are less likely to stay together if the child is in poor health (as defined by developmental problems and birth weight). However, we believe that the potential for childhood weight to affect relationship status is slim in our study, since Reichman, Corman, and Noonan only investigated the first two years after the child was born, and we focus on a longer time-horizon, and control for early-life health through birthweight. Thus, we believe that reverse causality is not a major source of endogeneity in our study.

We hypothesize that increased time in a single-parent household reduces parental investment in a child's health, thereby leading to poorer health outcomes. In this paper, we focus on the outcomes of fair/poor self-reported health status and obesity, but the effect could be manifest through other health outcomes.

3. EMPIRICAL STRATEGY AND DATA

Our analyses are carried out with the National Longitudinal Study of Adolescent Health (Add Health) data, which broadly surveys health behaviors and their contexts throughout

adolescence and young adulthood. The first Wave (Wave I) data consisted of approximately 90,000 adolescents in grades 7 through 12 collected in 1994-1995 from primary sampling units of high-schools and "feeder schools," whose enrollees were expected to attend the high school. These students were ages 12-21 at the time of the survey. A subsample of 20,000 students participated in the in-home questionnaire. The adolescents were interviewed in follow-up waves in 1996, 2001-2002, and 2007-2008 (Waves II, III and IV, respectively).

We use only Wave I for our analyses because key household variables, such as family structure and income, are only collected in that Wave. In our study, we include only those adolescents whose biological or adoptive mothers completed the survey (n = 15,575) and a questionnaire about their most recent three marriage or marriage-like relationships, or reported that they were never married, reducing the eligible number of mother-child pairs to 15,012. We drop observations that are missing the income, other key demographic variables, or outcome variables, bringing the sample to 10,521. Dropping observations that were missing income was necessary because income differences are an important component of why family structure matters. We also drop 316 adolescents who are younger than 13 or older than 18, along with those missing sampling weights, leaving 9,681 adolescents ages 13-18. We chose to limit the sample to the normal ages for teens to be in high school and live at home. We use the sampling weights to correct for the complex survey design. Though other studies (e.g., Crossman et al. 2006) combine single-mother and single-father households together as "single-parent" households, we contend that there are fundamental differences between these two family types. For example, by contrast to fathers, mothers tend to make most of the investments in children's health (Case and Paxson 2001), and single-father families have higher incomes and are less likely to receive child support than single-mother families.

Variable Definitions

Our independent variable of interest, the duration of time a child spent in a single-parent family, is calculated indirectly from a series of questions in the Add Health data that ask about the past three marriage and marriage-like relationships (including the present such relationship) of the mother. The interview took place in 1995, and the adult is asked about their relationship status in each year from 1977 through 1995. The number of years *in between* the mother's marriages or marriage-like relationships after the child's year of birth is considered to be time spent in a single-parent household. Since the survey asks mothers about their relationship status by year (rather than by date), we assume that this status persisted for the entire year. We measure the duration of time in a single-parent family as two dichotomous variables to indicate if the child spent some (but not all) of their life, or their entire life in a single-parent family. While a continuous measure of family structure (e.g. number of years in a single-parent family) would be ideal, only a fraction of children in the sample have attained age 18, yielding a theoretical maximum number that differs across children. We consider the child to have spent their entire life in a single-parent family if the mother reported no marriage or marriage-like relationships. However, children who are reported to spend their entire life in a single-parent family could have faced two distinct living arrangements. In the first, the mother could have had a relationship that ended before the child was born, or a very short relationship that did not last an entire year. In the second, the mother could have had no marriage or marriage-like relationships at all. To address this distinction, we include a binary variable to denote the latter (we label this as "mother never married" for simplicity).

Thus, the baseline value of no time spent in a single-parent family represents both the original two-parent families as well as cases in which the mother initiated and ended

relationship(s) within a single year. Mothers who reported a marriage-like relationship, or co-habitation without marriage, are treated identically to married mothers. However, our measure of duration in a single-parent household may not capture "informal" co-habitation, in which a mother does not report a co-habiting partner as a marriage-like relationship. With these definitions, approximately 41% of the population, accounting for sample weights, is classified as ever having lived in a single-parent household, whereas the remaining observations are classified as never having lived in a single-parent household.

Although we can measure family structure over the course of the child's life, we can only measure income, the most important mediating factor for single-parent households, at the time of the Wave I interview in 1995. Income of the household is not reported retrospectively over the child's life when they were potentially in a single-parent family, which may misrepresent the "true" income across the evolution of the household (e.g. Jeynes 2002). This variable is valuable, nevertheless, because it is reported at the same time as the outcome. Therefore, including income as an explanatory variable can capture contemporaneous contributors to health outcomes.

Other than income, several household characteristics collected at Wave I from the child's mother, including if mother or father is obese, race, national origin, and parental educational level will be employed as covariates. These observed variables can account for heterogeneity at the household and child level. Recent research suggests that race and national origin play a significant role in determining obesity in children, and that the odds of obesity can start even before birth (Taveras et al. 2010). Since Black children are much more likely to grow up in single-parent families, it is important to separate the effects of family structure from those of race *per se*.

Measures of Health Outcomes and Health Investments

The primary dependent variables involve measures of health status, which include obesity status and fair/poor health status. We also consider measures of health investments by the parents, including insurance status and routine physician and dentist check-ups.

Body mass index (BMI)[1], which is a ratio of weight to height, is a commonly used indicator of weight status. We classify those who are obese based on the Center for Disease Control and Prevention (CDC)'s age- and gender- based percentiles for children age 2-20 (Kuczmarski et al. 2002). We define an adolescent to be obese if their BMI exceeds the 95th percentile for their age and gender, respectively. Under this classification, we find that about 10% of our sample is obese, which is consistent with other estimates of the prevalence of obesity in adolescents.

In Wave I, weights and heights of respondents were self-reported by the adolescent. Though there is the potential for measurement error with self-reported height and weight, Goodman, Hinden, and Khandelwal (2000) analyze Wave II of the Add Health Study and find an extremely high correlation (0.92) between self-reported and measured BMI, and only about a 4% misclassification of obesity status by using the self-reported height and weight.

Nevertheless, to partially correct for measurement error, we used the Add Health Wave II Public Use data to generate a linear relationship between measured and stated height and weight. This generated function from Wave II was used to adjust self-reported BMI values used in the classification of obesity status in Wave I. We use the corrected BMI to generate an indicator for

[1] BMI is calculated as $703 \times \left(\frac{\text{weight (in pounds)}}{\text{height (in inches)}^2} \right)$.

if the child is obese, and employ this corrected measure in our descriptive statistics and regression analyses.

Health investments in children made by the parents are also recorded. The Add Health study asks if the adolescents had a routine physical in the past year. In addition, health insurance status is considered. Though adolescents have multiple options to be insured (e.g. under their parents' employer-sponsored plan, Medicaid, military plan), we only consider the outcome of whether the child has a private health insurance plan. We consider a private insurance plan to be more of a direct investment in child welfare than other forms of insurance since there was little federal policy in place in 1995 that affected how children received private (usually employer-based) health insurance.

Empirical Strategy

As discussed in Section 2 above, health investments and outcomes can be expressed as functions of individual, household, and unobserved factors. Investments in childrens' health (*I*) are considered inputs to an adolescent's health production function. As previously mentioned, we segment our analyses by gender to reflect fundamental differences in their responses to social disadvantage as well as biological differences in health outcomes themselves, like obesity.

To estimate reduced form demand for parental health investment behaviors, we estimate multivariate probit models[2] which simultaneously estimate each health outcome with two parental investments of interest: private health insurance status, and whether the child saw a doctor for a routine check-up in the past year.

The reduced form estimation follows the structural nature of the model in Equation 1, and is shown below as equation (2):

[2] For examples of other studies using multivariate probit models, please see Gage (2005), Holly (1998), and Garasky et al. (2010)

$$(2) \qquad \begin{aligned} \Pr(H_i = 1 \mid Z) &= \Phi(\alpha + I_i + \beta SP_i + \gamma Inc_i + \phi Z_i + \varepsilon_i^h) \\ \Pr(I_i = 1 \mid Z) &= \Phi(\alpha + \beta SP_i + \gamma Inc_i + \phi Z_i + \varepsilon_i^I) \end{aligned}$$

In equation (2), health outcomes (*H*) and investments (*I*) are written as functions of duration in a single-parent family (*SP*) up to 1995, as discussed above. Also included is household income (*Inc*) and a vector of demographic and other socioeconomic variables (*Z).*

These equations can be viewed two separate systems of equations, where each *H* represents a health outcome variable and *I* represents two investment variables (insurance status, and physican visits) during Wave I. Further, we assume the error terms ε for the regressions within the system are dependent on one another. We therefore estimate a multivariate probit model for the health outcome variables to account for the correlations of errors within the equation health outcome and each of the investments, as well as the correlation of the errors involved in estimating the investments themselves. This method will address endogeneity to the extent that it captures the unobserved components that systematically affect the health investment and outcome variables that we consider. The error terms for each individual equation are assumed to have multivariate normal distributions, and are reported at the end of the results.

To facilitate the interpretation of results, an average partial effect (APE) is calculated based on the results of the univariate and multivariate probit models. For dummy variables, these effects are calculated by subtracting the incremental value of the coefficient of interest from the original probit model (e.g. if the child spent some of their life in a single-parent family) from the predicted value of a nonzero result, normalizing this value, and averaging it across individuals. Similarly, for continuous variables, the coefficient from the probit model is

multiplied by the normalized value of the predicted value. In tables, the average partial effect is reported with a standard deviation, which represents the variation around *individual observations* of the partial effect. In tables 3-6, we report statistical significance for a particular coefficient if the unscaled coefficient in the original probit model was significant.[3]

4. RESULTS AND DISCUSSION

[INSERT TABLES 1 and 2, and FIGURE 1]

Descriptive Statistics

Table 1 displays descriptive statistics according to whether or not boys in our sample lived in a single-parent family at the time of the Wave I interview (1995). As shown in the table, boys in single-parent families, on average, tend to live in households with lower incomes, and to have mothers who are less likely to have attained a college or post-college education. Additionally, about 29% of boys who were always in a single-parent family were African American, as compared with only 21%, who spent *some* time in a single-parent family, and 6%, who didn't spend any time in a single-parent family. Boys on average, spent 3 years in a single-parent family. Among those who spent some time in a single-parent family, the average was 6 years. Furthermore, boys spending time in single-parent families tended to have higher average rates of fair/poor health status than those who never did so. This characterization does not hold true for obesity status, however. Interestingly, boys spending some time in single-parent families are less likely to have an obese mother. This can possibly be rationalized by the observation that men and women tend to lose weight after divorce or separation (Sobal et al. 2003) .

[3] Bootstrapped standard errors will be computed.

Girls show similar characteristics to boys, as shown in Table 2. The main exception is that for girls, obesity status seems to be more tied to single-parent family status than it is for boys, with girls who spent their entire lives in a single-parent family having higher rates of obesity than those who spent only some time in this family structure. Girls (as well as boys) who spent their entire life in a single-parent family also had, on average, a lower birth weight, which might be due to a lack of parental investments during pregnancy (Reichman et al. 2009). Given that they begin life with lower birth weight, and there is evidence that obesity begins pre-natally (Taveras, et al.), it is somewhat surprising that girls in single-parent families are more likely to become obese.

Given the negative consequences that have been documented for spending time in a single-parent family, it is relatively surprising that both the rate of fair/poor health and obesity is lower for adolescents who spent *some* time versus all of the time in a single-parent family. However, this can be partially rationalized by the lower maternal and paternal obesity rate among the group of children spending *some* time in a single-parent family. Since genetic factors play large roles in explaining adolescent and adult obesity (Crossman et al. 2006; Stewart and Menning 2009; Strauss and Knight 1999), it is conceivable that these factors are driving this difference. (Note: It may also be that they lost weight upon divorce, like you said before, right, and therefore not a genetic thing that is passed on.

The unweighted means of the outcome variables of interest as a function of the duration of time in a single-parent family is shown in Figure 1. For most of the outcome variables, health and health investments tend to deteriorate as adolescents spend more time in a single-parent family, but this effect is non-linear, which makes it difficult to specify econometrically. For instance, in Figure 1, the mean rate of obesity and fair/poor health status increases slightly as

time in a single-parent household increases for both males and females. Fair/poor health status seems to parallel obesity more in girls than it does in boys, suggesting that fair/poor health status may be measuring slightly different things in boys and girls.

In terms of routine physicals, there is no apparent linear or non-linear trend. The relationship is more linear in the case of private insurance status, where the likelihood of having private insurance decreases significantly, at a fairly constant rate, with increases in time in a single-parent family. Because many of these variables do not have an obvious linear relationship with time in a single-parent family, we specify duration in a single-parent home as two binary variables, as described above.

[INSERT TABLES 3 AND 4 ABOUT HERE]

Univariate Probit Models for Adolescent Health Investments

For the adolescents in our sample, we run two sets of univariate models for health investments (i.e., private insurance status and routine physicals) for males and females at Wave I. As discussed above, we include two binary variables indicating whether a child spent part or all of their life in a single-parent household, along with other variables for child- and household-level heterogeneity. The full set of results are shown in Tables 3 and 4.

In the case of not having a physical in the past year (as measured at the time of the Wave I interview in 1995), single-parent family structure plays a relatively weak role. For boys, living in a single-parent family for one's entire life is actually protective, lowering the probability of having no physical visit by approximately 10%. However, boys living in a household where the mother never had a marriage or marriage-like relationship were approximately 15% more likely to have no physical. Therefore, there is a positive (i.e. adverse) net effect for boys who spent

their entire life in a single-parent household if the mother had never married. Income (and income-squared) for both boys and girls is highly significant in determining whether or not the child had a routine physical. However, maternal education is generally insignificant in determining this outcome, with the exception of the mother completing college or better significantly reducing the chance of having no physical for boys.

Single-parent family plays a very large role in determining whether or not a child is covered under a private insurance policy. In boys, living in a single-parent family for a portion of one's life lowers the probability of being covered under a private insurance policy by about 9%; living in a single-parent family for one's entire life lowers this probability by 13%. This trend is similar, albeit smaller, for girls, with these probabilities falling by 7 and 6 percent, respectively. The effect is compelling because living in a single-parent family has a strong negative effect, which is *independent* of the effect of income (which is highly significant) on private insurance. Maternal factors, including obesity and age, seem to play just a small role in explaining these health investment behaviors. Mother's obesity raises a girl's chances of having had no physical in the previous year, suggesting the potential for indirect intergenerational consequences of a mother's problems with excessive overweight.

Overall, the univariate probit models suggest that single-parent family status has a direct effect on two specific health investment decisions that the mother (or parents, in the case of two-parent households) choose to make for the child. Tables 3 and 4 suggest that children living in single-parent families may receive lower investments than those in their two-parent counterparts.

[INSERT TABLES 5 AND 6 ABOUT HERE]

Multivariate Probit Models for Adolescent Health Outcomes

In order to ascertain the combined effect of family structure, health investments, and household-level demographic covariates, we employ a trivariate probit model that can account for the unobserved components that jointly explain investments and outcomes (this is denoted as the correlation between the error components, or ρ). The results are shown in Table 5 for boys, and Table 6 for girls.

Examining the values of ρ for males (Table 5), we observe a strong positive correlation in the unobserved components that relate to an adolescent boy reporting fair/poor health status as well as them having private insurance. There is a small positive, but insignificant correlation, between obese status and private insurance. Neither obesity nor fair/poor health status was correlated with not having a physical in the last year. However, there is a negative and significant correlation between having had no physical and private insurance coverage in both the obesity and fair/poor health specifications, indicating that the unobserved components involved in a child private health insurance coverage are related to a child not receiving a physical, which is an intuitive result.

In girls, there are no significant correlations reported between either outcome variable and private health insurance or not having a physical. This model still increases efficiency as compared to the univariate model, as the hypothesis of $\rho = 0$ for the entire model is rejected, suggesting that there is a non-zero correlation between these unobserved components.

Single-parent family status seems to play a relatively small direct role in explaining adolescent health outcomes, and these effects are mostly seen for males. In boys, spending some time in a single-parent family raises the probability of reporting fair/poor health by about 2%.

While this may seem relatively small, this is only slightly lower than the 3% reduction in probability of fair/poor health that a child receives if his/her mother completed college or better. Therefore, the 2% is on par in magnitude with other socioeconomic factors. However, in comparison to genetic factors (e.g. maternal obesity), the effect size is smaller.

Also in boys, spending one's entire life in a single-parent family is marginally significant for lowering the probability of obesity. However, it should be noted that while the mom never married variable is insignificant, the likelihood is that if there were a larger sample of adolescents in this group, this coefficient would be significant. If this were the case, there would be no net effect of spending time in a single-parent family with a never-married mother on obesity.

In both boys and girls, the health investment behavior variables, though correlated with the unobserved components of the health outcomes, do not significantly determine either obesity or fair/poor health status. In the obesity specification of both boys and girls, parental obesity (especially maternal obesity) plays a significant role in explaining childhood obesity as well as fair/poor health status. This can best be rationalized by the large genetic component to obesity. Since this indicator for maternal obesity is self-reported, it is a noisy measure, but it is useful as a proxy for maternal health, which can be an important predictor of adolescent health outcomes. Furthermore, parental obesity may contribute indirectly to child outcomes as well, since obesity can affect human capital variables and employment and therefore, income. Being Black significantly raises the probability of being obese and having self-reported fair/poor health for girls, but not boys. With the exception of obesity in boys, income does not play a significant role in these outcomes after including the health investment variables. This is most likely due to the

very high correlation between income and health status and doctor visits (indeed, there is a very strong positive coefficient for income in Tables 3 and 4).

The results from the univariate and multivariate probit models suggest that some time, but not one's entire life, in a single-parent family are most deleterious to adolescent health outcomes and inputs, including self-reported health status and health insurance status, respectively. Given that the children who spend some of their life in a single-parent family spend six years, on average (Tables 1 and 2), it is likely that some of the negative effects of living in a single-parent family are driven by stress associated with the transition from a two-parent to a single-parent family structure. Likewise, it is known that single mothers have somewhat less favorable mental health and anxiety profiles than married or cohabiting women (Booth and Amato 1991; Crosier et al. 2007), which can affect the ability of the mother to invest in the child and contribute negatively towards the child's own health. These effects on health outcomes, however, are mild and do not seem to be related directly to obesity or fair/poor health status.

Additionally, this study expands the notion that females and males respond differently to the health/socioeconomic gradient, including living in a single-parent family. We find that males have a greater negative response to living in a single-parent family, which is consistent with Krein and Beller's (1988) finding that the educational attainment of males is more sensitive to single-parent family status than females' educational attainment. This also is consistent with the observation that boys respond more negatively to parental divorce than girls do (Hetherington et al. 1985).

The results of this study indicate that single-parent status has a larger effect on the "flows" into child health, such as insurance and doctor visits, than on the health "stocks," like

obesity and fair/poor health status. However, there is a small (2%) significant effect on self-rated health status at least for boys, suggesting that there may be some long-term adverse consequences of the stress involved in spending time in a single-parent family. While the effect is only significant for boys, for girls, the magnitude of the effect is similar to that for those spending their entire life in a single-parent family. The lack of significance for this group (some time in single-parent family) may be due to the small sample size.

This study has several limitations. First, we observe children from varying age ranges, making the potential exposure of time in a single-parent family slightly different for each individual. Further, the survey item that we use to generate time in a single-parent family is based on recall of relationships from 1977 to 1995, which may introduce recall error into the relationship. Additionally, income is only observed at the point of the interview; a better measure would be of permanent income that the child faced throughout the time he/she was in a single-parent family. Finally, household information is only collected at one time (during Wave I), making it difficult to employ fixed-effects or other longitudinal methods to address time-invariant unobserved heterogeneity. Since it is also difficult to find instrumental variables that are related to time in a single-parent family and unrelated to health, some bias due to omitted variables may remain, even after the use of a multivariate probit model. However, we would argue that the methodological contributions in this study provide less biased estimates for the effects single-parent family status on health than those previously reported in the literature.

5. CONCLUSIONS

The number of single-parent families has been rising for several decades. Further, the health conditions that begin in childhood and adolescence can persist throughout the lifetime.

This paper estimated a recursive health production function using a multivariate probit model to analyze the relationship between family structure, health investments, and health outcomes. We demonstrated that spending time in single-parent families lowered the likelihood of an adolescent being covered by private health insurance, and raised their risk of having only fair or poor health status. These effects are much stronger for males than females.

The results of this study suggest that children and adolescents spending time in single-parent families face adverse health consequences; however, they show that spending *some* time in a single-parent family may be more detrimental than always living in this family type. Stress associated with family disruptions may play a role in mediating this relationship.

These results suggest that policies encouraging better health practices, such as proper insurance coverage and routine doctor visits, can be targeted at adolescents whose family structure is in transition or who have been living in a single-parent family for a relatively short period of time, rather than all adolescents spending time in single-parent families. Unfortunately, it was a common problem at the time of this survey, with regard to child support from non-custodial fathers, that health insurance was not provided. It continues to be a concern today.

Our results also suggest that employing a binary indicator variable for whether the child is *currently* living in a single-parent family, as is often done in these types of studies, might be capturing both children who spent some time, and children who spent all their time in a single-parent family while these may have differing effects. Depending on the outcome of interest, this may systematically affect the results of those studies.

This paper adds to the literature supporting the importance of the household and family in predicting subsequent socioeconomic and health outcomes in adolescents and young adults.

Future studies can further examine the mechanisms that underlie the link between family structure, health investments and health status, including the role played by child support and other indicators of father involvement, which may mitigate any deleterious effects of life in a single-parent family.

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