

**FAMILY BEHAVIOR AND THE ECONOMIC VALUE  
OF PARENT AND CHILD HEALTH**

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# FAMILY BEHAVIOR AND THE ECONOMIC VALUE OF PARENT AND CHILD HEALTH

## Abstract

This paper examines how families react to acute illnesses affecting individual family members, and investigates relationships between behavioral reactions and values for avoiding illness. Acute illnesses considered reflect outcomes of air pollution exposure. Empirical analysis focuses on relationship between illness-induced use of medical care and absence from work or school, and parents' valuations of their own and their children's health. Health valuations are measured by willingness to pay (WTP) and by a marginal rate of substitution (MRS) that quantifies a parent's valuation of her child's health *relative to* her own. The estimated MRS significantly exceeds unity, implying that parents value their children's health more highly than their own. Estimates of WTP to avoid acute illnesses affecting parents are consistent with prior research, but WTP is significantly larger for illnesses affecting children. However, estimates of WTP and the MRS are quite sensitive to the treatment of behavioral responses to illness. Results indicate that ignoring endogeneity of behavior causes over-estimation of WTP for both parents and children, and causes substantial under-estimation of the value of child health relative to parent health. For both children and adults, WTP increases less than proportionately with symptoms or duration of illness, increases with income, and reflects a quantity-quality tradeoff by declining with the number of children in the household. Holding income constant, single parents and black parents are willing to pay more for health than their married or white counterparts.

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## 1. INTRODUCTION

Protecting human health is a central goal of environmental policy, with the health of children receiving greater emphasis in the US since Executive Order #13045 [11]. The effectiveness and economic efficiency of environmental health policies depend partly on how families act to protect the health of their members, and on the tradeoffs made between the health of family members and other goods. This paper examines how families react to acute illnesses affecting individual family members, and investigates the relationship between these behavioral reactions and the value of avoiding illness. The acute illnesses considered reflect outcomes of short-term exposure to air pollution.

An extensive literature on family health, mainly in developing countries, implies that inferences about the benefits of public health policies are likely to be biased unless proper account is taken of resource allocations families make in response to changes in their environment. Ignoring behavioral reactions to illnesses experienced by family members may yield under-estimates of the benefits of improved child health [21], and ignoring the *endogeneity* of family behavior may bias inferences in a direction that may vary with circumstances considered [24]. Yet most health valuation research, including cost-of-illness studies and many stated-preference surveys, either ignores behavioral reactions to illness or else treats choices about medical care and work loss as exogenous outcomes of illness.

Health studies in developing countries also imply that families do not treat the health of each family member equally [22,23]. Researchers have examined how resource allocations vary between boys and girls, and between family members who differ in health status or earning capacity, but have not focused specifically on health tradeoffs between parents and children.

While most health valuation studies ignore potential differences health values between family members, a few recent studies suggest that parents may value their children's health more highly than their own [1,10,18]. But none of these studies have accounted for endogenous resource allocations made in response to illness.

Results obtained in this paper underline the importance of accounting for endogenous family behavior when estimating economic benefits of improving the health of parents and children. Empirical analysis focuses on the relationship between behavioral reactions to illness – use of medical care and absence from work or school – and parents' valuations of their own and their children's health. Health valuations are measured by the willingness to pay to improve health and by the marginal rate of substitution between child and parent health. The marginal rate of substitution (MRS) measures a parent's valuation of her child's health *relative to* her valuation of her own health. A parent's preference for avoiding illness favors her child or herself as this rate of substitution is greater than or less than one. Although the MRS is a health-health tradeoff that is not measured in monetary units, its value has important implications for benefit-cost analyses of environmental policies affecting the health of children and adults. An MRS significantly greater than unity, for example, would indicate that members of one generation favor a *higher* valuation of the health of another generation, and thus would lend support to controversial proposals for applying distinct values to the health of different age groups.

Estimates of the MRS presented in this paper significantly exceed unity, indicating that parents value their children's health more highly than their own. However, the estimated size of the premium placed on child health varies markedly with the treatment of family behavior. Accounting for the endogeneity of behavioral responses to illness boosts the estimated MRS by

80 percent, relative to treating family behavior as exogenous. As explained more fully in Section 3, this outcome occurs because parents spend more resources to alleviate an illness when a child, rather than a parent, is affected. Viewing this variation in resource allocations between parent and child as an exogenous outcome of illness “explains away” some of the premium placed on child health. Parents appear willing to pay more to protect the child’s health because the child’s illness imposes higher resources costs on the family, not because they value the child’s health more highly. But this explanation ignores the fact that costs of illness are partly chosen rather than imposed. It is the parents’ choice to whether to seek medical attention, to miss work, or to keep the child home from school. Viewing the variation in resource allocations as a choice suggests that parents devote more resources to mitigating a child’s illness *because* they value the child’s health more highly than their own. Accounting for this additional allocation of family resources to the child’s health implies a higher relative valuation of child health. In any event, because the MRS is a relative valuation, an 80 percent variation is potentially important for policy. The usual practice of treating behavioral reactions to illness as exogenous may result in large under-estimation of the relative value of child health.

Results indicate that choices to use medical care or to miss work or school are sensitive to economic and demographic factors and thus cannot be viewed as exogenous outcomes of illness. Also, estimated values for avoiding episodes of acute illness are sensitive to the symptoms experienced, the duration of the episode, the degree of discomfort it causes, and the extent of interference with activities. Estimates of parents’ mean willingness to pay (WTP) to avoid acute illness are broadly consistent with prior research, but parents appear willing to pay significantly larger amounts to avoid illness episodes affecting their children. For both children and adults,

WTP increases less than proportionately with the number of symptoms and the duration of illness avoided. WTP increases with income, and reflects a quantity-quality tradeoff by declining with the number of children in the household. At a given level of income, single parents and black parents are willing to pay more for health than their married or white counterparts.

The next section of the paper describes the stated preference, contingent behavior survey employed and the data collected. Section 3 presents results and conclusions follow in Section 4.

## **2. DATA COLLECTION**

Data were collected using a stated-preference survey in Hattiesburg, Mississippi, an area with a population of about 115,000 persons, about one-quarter of whom are African-Americans. To support tests for differences in health preferences and behavior between blacks and whites, African-American households were sampled in proportion to their share of the local population (approximately double their share of the national population). Racial differences in health behavior and valuation have been found by previous researchers [12,17] and are of interest from an environmental justice perspective because many environmental health hazards disproportionately affect children living in minority households.

Respondents were recruited by dialing local telephone numbers at random during daytime and evening hours on both weekdays and weekends. Persons contacted were informed of the study about how health, health care and health costs affect families. Eligible persons (adult residents who were parents or guardians of at least one child aged 3 to 17 years living at home) were offered \$20 to complete the survey. The 25-minute survey was administered in-person to 295 parents (or guardians) on the campus of the University of Southern Mississippi.<sup>1</sup>

The survey collected general demographic and economic information about the household and its members, and more detailed information about the adult respondent and one child. This “sample child” was selected at random from households with multiple children.<sup>2</sup> Detailed information was not collected about other children in the household to limit the length of the interview and to avoid repetitive questioning. Information was collected for the respondent and a spouse or partner, if any, on employment status, hours of work, and on the consequences of illness-induced work loss. Data on health insurance coverage and on the money and time costs of medical care were collected. Money and time costs of health-care utilization often are not assessed in health and child-development surveys, yet theory predicts that these costs affect health-related behavior. To assess time costs for the child, the survey inquired which household member, if any, would take the child to the doctor, or stay home with the child if sick, and whether work would be missed for either of these reasons. Data were collected on the chronic health status of the respondent and sample child, including presence of chronic impairments, activity limitations, and subjective health rating (excellent, very good, good, fair, poor). The survey included a valuation component to assess the parent’s stated preferences and contingent behavior in response to acute illness episodes affecting the parent or the child, and concluded with questions about family income.<sup>3</sup>

In the valuation component of the survey, each respondent was given a sequence of four descriptions of acute illnesses. These descriptions differed in (1) the symptoms that would be experienced (cough with phlegm, shortness of breath with wheezing, chest pain on deep inspiration, and/or fever with muscle pain and fatigue); (2) the duration of the condition (two days to a week); (3) the person experiencing the condition (parent or child); and (4) the price of a

hypothetical medication to treat the condition. The health effects to be valued were chosen because evidence from health sciences indicates that exposure to air pollution increases incidence of upper respiratory symptoms and acute bronchitis among children, and because existing monetary valuations for avoiding these effects in the US are based on decades-old studies of adults [28, Tables 10 and 14].<sup>4</sup>

Previous research on acute health valuation indicates that values are sensitive to the symptoms experienced, duration, the extent of activity restriction including work loss, and the person affected [2,8-10,15,16,18,19,25]. The illness descriptions assigned to respondents were designed to address each of these issues. In particular, each description had four parts. The first part indicated the symptoms that would be experienced, their duration, and the person affected (parent or child). In the second part, the respondent would describe the subjective impact of the illness by rating (on a one-to-ten scale) the discomfort the affected person would experience, and the extent to which the illness would interfere with the person's and the family's usual activities. Third, the respondent would indicate the behavioral reaction to the illness: whether a doctor would be visited and, for those employed or in school, whether work or school would be missed (and if so, for how many days). Fourth, the respondent was asked whether he or she would pay a stated price out-of-pocket for a hypothetical medication to treat the condition. The medication would be taken on the first day of symptoms and would prevent any remaining days of symptoms that would otherwise have occurred. It would be available in liquid, tablet or capsule form and would be FDA-approved, safe and effective for adults and children three years of age and older. Respondents were reminded that if they purchased the medication, they would have less money for all the other things their family needed. A follow-up question then assigned the

respondent a higher or lower price depending on whether the medication would or would not have been purchased at the initial price.<sup>5</sup>

The interviewer then would continue with the next illness description until the set of four assigned to the respondent had been completed. The four illnesses assigned to the respondent were presented in random order and were selected randomly from a set of 16, subject to two constraints. First, each respondent received two descriptions of an illness he or she would experience, and two descriptions of an illness the child would experience. Second, the “adult illness” and “child illness” descriptions assigned to a given respondent always included a different package of symptoms and duration.

Four features of the valuation procedure warrant comparison to previous research. First, respondents value illnesses assigned to them [16], not illnesses they have recently experienced [2,8,18]. Symptoms were assigned to respondents to insure that the data would support precise estimation of tradeoffs between parent and child health corresponding to *identical* health outcomes. A disadvantage of assigning illnesses to respondents would arise if respondents do not have enough information about the health outcomes to place a value on them. However, the symptoms considered here are fairly common, and statistical tests indicate that recent experience with the symptoms does not affect valuations [10].

Second, health valuation surveys which assign illnesses to respondents usually provide information about the extent of activity restriction and work loss, and whether medical care would be needed [16]. The present survey in contrast views the decision to miss work or school or to seek medical care as a choice. Parents who have varying degrees of concern and

knowledge about health or who face different economic circumstances may allocate time and money differently in response to acute illness.

Third, stated-preference health valuation surveys rarely specify concretely the mechanism through which payment of money would prevent adverse health effects. Rather, respondents may be reminded in general terms of tradeoffs between money and health, for example that expenditures on medical treatment may improve health. This approach was rejected after pretests of the present survey in favor a valuation scenario involving the purchase of a specific commodity whose attributes are described in some detail.<sup>6</sup>

Fourth, respondents valued four illnesses in the “double-bound,” discrete-choice with follow-up framework. In other research, respondents may value only one illness in a triple-bound framework [2] or as many as eight illnesses with a single valuation question for each [16]. The methods taken here were chosen with the aim of balancing gains from additional questioning against respondent burden.

Table I provides summarizes the data used in the empirical analysis. As in most surveys that inquire extensively about children, the majority of respondents (76 percent) were female. About 24 percent of respondents were African-American, and 32 percent were single parents. The average respondent was 37 years old and had 1.8 children less than 18 years old living at home. While these figures closely match statistics for the local area [26,27], the educational attainment of the sample is higher than expected, with almost half of respondents having graduated from college. Almost 80 percent of respondents were employed outside the home, and the sample median family income more closely matches national than local figures (about \$47,000 relative to \$49,000 nationally).

### 3. EMPIRICAL ANALYSIS OF FAMILY HEALTH BEHAVIOR AND VALUATION

Theoretical frameworks developed elsewhere [10,16] imply that WTP to avoid illness is a function of attributes of illness and characteristics of households. Empirical specifications of illness attributes often include measures of the symptoms experienced, duration, and indicators of medical care and activity restriction including work loss [16,18].

Estimated WTP functions are presented in Table II, where the natural logarithm of WTP is specified as a linear function of alternative sets of covariates. Only the interval in which the WTP lies is observed, not the actual WTP itself. Errors are assumed to be normally distributed. Each specification includes the natural logarithm of symptom-days experienced (computed from the product of the number of symptoms and the number of days). When the (logs of) the number of symptoms and duration are entered separately, coefficients of both variables are significantly different from zero, but are statistically indistinguishable from one another. Also, symptoms were aggregated because preliminary statistical analysis revealed little variation in values over the separate symptoms. Previous research also has indicated that WTP to avoid illness depends less on the specific symptoms experienced than on other factors like activity restrictions. Each specification in Table II also includes variables indicating whether the illness affects the parent or the child, family income, household composition (marital status of the parent and the number of children), race, whether the individual affected by the illness has asthma, and a constant term.

In each of the four specifications presented in Table II, WTP to avoid acute illness increases at a decreasing rate with symptom-days: the elasticity of WTP with respect to symptom-days is significantly greater than zero and less than unity. The “child” indicator takes a

positive and statistically significant coefficient in each case, implying that parents are willing to pay more to avoid an acute illness when it affects the child rather than the parent. Family income has the expected positive impact on WTP, while greater fertility is associated with lower WTP, reflecting the well-established quantity-quality tradeoff of family economics [14]. WTP is higher for parents or children with asthma, and single or black parents are willing to pay more to avoid illness, net of effects of income, than their married or black counterparts. An illness presumably is a greater burden in a single-parent family, while the larger WTP among blacks is consistent with previous findings by Joyce et al. [17].

Results presented in column (2) indicate that discomfort and activity restriction are important determinants of the value of avoiding acute illness. The estimated symptom-days elasticity falls when these factors are accounted for, because illnesses with more symptoms and/or longer duration are associated with greater discomfort and activity restriction. The estimated coefficient of the “child” indicator also falls, relative to column (1). Thus, some of the premium for avoiding a child’s illness reflects parents’ perceptions that the same symptoms and duration cause more discomfort and interference with activities when the child is affected than when the parent is affected.

Columns (3) and (4) account for effects of medical and work or school absence on preferences for avoiding illness. The usual practice of taking behavioral reactions to illness as exogenous outcomes is followed in column (3). As shown, this treatment markedly reduces the estimated effects of symptom days, discomfort, and activity restriction on WTP, and reduces the estimated premium for avoiding a child illness relative to a parent illness. This outcome occurs because, for example, doctors visits are more likely to occur for illnesses that are more severe or

that affect the child than for illnesses that are less severe or that affect the parent. Taking the behaviors as exogenous outcomes rather than choices, the interpretation would be that some of the premium parents place on avoiding illnesses that are more severe or that affect the child reflect a preference for avoiding the costs of a doctor's visit, not a preference for the child's health. However, this interpretation neglects the fact that going to the doctor is itself a choice that may reflect a preference for the child's health.

In column (4), doctor's visits and work or school absence are treated as endogenous variables. The simultaneous equations estimator developed by Amemiya [3,4] for discrete and censored random variables is used to estimate the model. This method is analogous to two-stage least squares, but yields more efficient estimators than the more common approach of replacing observed, endogenous variables on the right hand side of the equation with their predictions from reduced form equations. As shown in column (4), accounting for endogenous behavioral reactions to illness increases the estimated effects of symptom days, discomfort and activity restriction on WTP, and increases the estimated premium for avoiding a child illness, in comparison to avoiding the behavioral reactions or treating them as exogenous. This outcome supports the conclusion that doctor's visits are more likely to occur for more severe illnesses or when the child is sick because these are the illnesses parents are most anxious to mitigate or avoid altogether. Accounting for this parental behavior reinforces rather than weakens the conclusion that parents are willing to pay relatively more to prevent illnesses affecting the child than to prevent illnesses affecting themselves.

The last row of Table II summarizes parents' marginal valuation of their children's acute health status relative to their own. The marginal rate of substitution between child and parent

health is computed following the theoretical framework in Dickie and Ulery [10]. In each case, the MRS is significantly greater than unity, implying a relatively higher valuation of child health than parent health. The estimated MRS is about 2.1 in column (1), implying that the average parent values her child's acute health status about twice as highly as her own. This value is similar to MRS estimates presented in recent working papers by Agee and Crocker [1] and Dickie and Ulery [10], and is consistent with results obtained by Liu et al. [18], who do not estimate a MRS. Remaining columns show the sensitivity of the estimated MRS to subjective perceptions of illness severity and to behavioral reactions to illness. The estimated MRS falls to 1.8 when subjective perceptions of illness severity are accounted for in column (2). This outcome occurs because illnesses affecting the child are perceived to involve greater discomfort and activity interference than illnesses affecting the parent. Thus, part of the premium parents place on avoiding the child's illness reflects the higher perceived severity rather than a higher value for the child's health. Accounting for behavioral reactions to illness but treating them as exogenous outcomes reduces the MRS to 1.5 in column (3), while recognizing the endogeneity of behavior boosts the MRS to 2.7.

Willingness-to-pay estimates to avoid one symptom-day based on results in Table II are presented in Table III. While the MRS estimates in Table II show how inferences about intra-family health-health tradeoffs are sensitive to the treatment of subjective perceptions of illness and to behavioral reactions, the WTP estimates in Table III, reveal that the same factors affect inferences about health-dollar tradeoffs. But for each specification in Table II, WTP for the child is significantly larger than WTP for the parent.

Results from the preferred specification in column (4) of Table II, which accounts for the endogeneity of family behavior, imply that parents are willing to pay about \$35 to avoid a symptom day themselves, and about \$95 to avoid a symptom day for their children. The parental values are comparable to results obtained for adults in previous research, while few previous studies have estimated values for children. Six studies that have estimated values for avoiding acute illness for adults include three early, “first-generation” efforts [8,9,19,25] and a meta-analysis of the morbidity valuation literature [15], based partly on the three first-generation studies. Two more recent efforts were conducted outside the U.S. [2,16] in Taiwan and in Canada).

Results of the three first-generation studies have been re-analyzed many times in academic and policy settings. Typically analysts have adjusted the original estimates of these studies, for example by trimming tails of the WTP distribution or by selecting a subset of the original results. Taking values for these three studies from the Johnson *et al.* meta-analysis [15; Table 1], and inflating to year 2000 dollars using the all-items CPI-U, estimated WTP to avoid one symptom for one day for adults ranges from about \$10 to \$100. Alberini *et al.* [2] converted their values to 1992 USD using the exchange rate. The Johnson *et al.* [15] values were converted to 1997 USD at purchasing power parity for that year (\$1 US = \$1.19 Canadian). Inflating these values to US\$2000 yields WTP of about \$15 to \$25 per symptom-day. While this range is somewhat below the \$35 parental value reported in Table III, income levels were markedly lower in the Taiwanese and Canadian samples.

Estimated reduced-form equations to explain decisions to seek medical care or to miss work or school in response to illness are shown in Table IV. As expected, people are more likely

to visit a doctor or to miss work or school for more severe illnesses, involving greater numbers of symptom days, more discomfort, or more interference with activities. Parents are more likely to take their children to a doctor than to see a doctor themselves, for a given level of symptom days, discomfort and activity restriction. Whites are less likely to see a doctor or to miss work or school than blacks, while those with asthma are more likely to seek medical attention. Families are less likely to visit the doctor at higher prices. Thus, behavioral reactions to illness are sensitive to the severity of illness, but also respond to economic and demographic factors.

#### 4. CONCLUSIONS

This paper examines how families react to acute illnesses affecting individual family members, and investigates the relationship between these behavioral reactions and the value of avoiding illness. The acute illnesses considered reflect outcomes of short-term exposure to air pollution. Empirical analysis focuses on the relationship between behavioral reactions to illness – use of medical care and absence from work or school – and parents' valuations of their own and their children's health. Health valuations are measured by the willingness to pay to improve health and by the marginal rate of substitution between child and parent health. The marginal rate of substitution (MRS) measures a parent's valuation of her child's health *relative to* her valuation of her own health.

Results obtained underline the importance of accounting for endogenous family behavior when estimating economic benefits of improving the health of parents and children. Ignoring the endogeneity of behavior apparently yields very misleading inferences about the health-dollar and health-health tradeoffs parents are willing to make. Specifically, ignoring the endogeneity of

behavior appears to cause substantial over-estimation of willingness to pay to avoid illness, but substantial under-estimation of the value of child health relative to parent health.

Estimates of the MRS presented in this paper significantly exceed unity, indicating that parents value their children's health more highly than their own. However, the estimated size of the premium placed on child health varies markedly with the treatment of family behavior. Accounting for the endogeneity of behavioral responses to illness boosts the estimated MRS by 80 percent, relative to treating family behavior as exogenous. In addition, results indicate that preferences for avoiding episodes of acute illness are sensitive to the symptoms experienced, the duration of the episode, the degree of discomfort it causes, and the extent of interference with activities. Estimates of parents' mean willingness to pay (WTP) to avoid acute illness are broadly consistent with prior research, but parents appear willing to pay significantly larger amounts to avoid illness episodes affecting their children. For both children and adults, WTP increases less than proportionately with the number of symptoms and the duration of illness avoided. WTP increases with income, and reflects a quantity-quality tradeoff by declining with the number of children in the household. All else equal, single parents and black parents are willing to pay more for health than their married or white counterparts. Results also indicate that choices to use medical care or to miss work or school are sensitive to economic and demographic factors and thus cannot be viewed as exogenous outcomes of illness.

These results bear on the likely effectiveness and economic efficiency of public policies affecting children's health. For example, simple selfishness on the part of parents would not appear to be a major impediment for efforts to improve children's health. If parents are not taking appropriate protective actions, for example not insuring that asthma medications are taken as

prescribed, the cause may more likely be found in a lack of understanding than in a lack of concern for the child's health. Moreover, when assessing the economic benefits of improved children's health, for example through reductions in ambient air pollution, a benefits transfer of estimates of adult health values to children would risk substantially understating benefits.

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**Table I.** Means (and standard deviations in parentheses) or Proportions.

	Parents	Children
Annual Family Income (\$12000)	5.693 (5.258)	5.714 (5.279)
Parent is Married (1=Yes)	0.679	0.674
Number of Children in Household	1.774 (0.895)	1.778 (0.899)
Race (White=1)	0.728	0.725
Asthma (Yes=1)	0.099	0.183
Price of Doctor Visit (\$100/visit)	0.525 (0.849)	0.447 (0.932)
Time Required for Doctor Visit (Hours)	2.047 (1.029)	2.093 (1.104)
Wage (\$100/Hour)	0.172 (0.244)	0.175 (0.248)
Parent Employed (Yes=1)	0.789	0.789
Paid Sick Leave (Yes=1)	0.451	0.451
Problem if Miss Work (High=1)	0.423	0.419
Child is in School (Yes=1)	0.920	0.921
Symptom Days High Discomfort (=1 if Index > 6)	11.163 (8.324)	11.218 (8.312)
High Activity Interference (=1 if Index > 6)	0.458	0.650
Would Go To Doctor (Yes=1)	0.400	0.618
Would Miss Work or School (Yes=1)	0.615	0.873
Would Buy Medication at Initial Price(Yes=1)	0.435	0.813
Number of Observations	0.341	0.528
	563	568

**Table II. Estimated Log WTP Function.**  
(Asymptotic z-statistics in parentheses).

Parameter	(1)	(2)	(3)	(4)
<i>ln</i> (Symptom Days)	0.350 (6.061)	0.248 (4.259)	0.1191 (2.146)	0.515 (2.650)
Discomfort (High=1)		0.338 (3.305)	0.1092 (1.126)	0.745 (2.358)
Activity Restriction (High=1)		0.221 (2.170)	0.1034 (1.075)	0.452 (2.106)
Would See Doctor (Yes=1)			1.0591 (9.341)	-1.894 (-1.391)
Would Miss Work or School (Yes=1)			-0.0046 (-0.047)	-0.0755 (-0.180)
Child (=1) or Parent (=0) is Ill.	0.726 (9.240)	0.612 (7.810)	0.4154 (5.268)	0.998 (3.566)
Annual Family Income (\$12000)	0.0456 (5.462)	0.0510 (6.044)	0.0465 (5.705)	0.0576 (4.662)
Parent is Married (1=Yes)	-0.151 (-1.595)	-0.195 (-2.068)	-0.1723 (-1.951)	-0.230 (-1.720)
Number of Children	-0.129 (-2.597)	-0.148 (-2.997)	-0.151 (-3.277)	-0.126 (-1.934)
Race (White=1)	-0.497 (-5.198)	-0.444 (-4.605)	-0.380 (-4.219)	-0.552 (-3.750)
Asthma (Yes=1)	0.293 (2.554)	0.258 (2.326)	0.1596 (1.559)	0.437 (2.159)
Constant	4.423 (24.243)	4.402 (24.399)	4.1635 (24.043)	4.747 (13.498)
<b>s</b>	1.140 (33.763)	1.112 (33.188)	1.025 (31.336)	1.214
MRS	2.066 (12.732)	1.844 (12.762)	1.515 (12.683)	2.713 (3.573)

**Table III. Willingness-to-Pay Estimates.**  
 (Asymptotic  $z$  -statistics in parentheses). Estimates based on  
 Logarithmic Surplus Functions in Table II.

Regression	Total Willingness to Pay to Avoid First Symptom Day		
	Parent	Child	Difference
Table II, Column (1)	\$56.40 (7.304)	\$116.53 (7.509)	\$60.14 (5.976)
Table II, Column (2)	\$74.53 (7.144)	\$137.44 (7.466)	\$62.91 (5.601)
Table II, Column (3)	\$108.99 (7.316)	\$165.00 (7.913)	\$56.00 (4.645)
Table II, Column (4)	\$34.59 (1.841)	\$93.85 (3.102)	\$59.26 (3.926)

**Table IV. Estimated Reduced-Form Equations for Medical Care And Work Loss.**

(Asymptotic z-statistics in parentheses).

Parameter	Medical Care	Work or School Absence
<i>ln</i> (Symptom Days)	0.133 (8.084)	0.0866 (4.946)
Discomfort (High=1)	0.211 (7.170)	0.116 (3.713)
Activity Restriction (High=1)	0.121 (4.114)	0.197 (6.321)
Child (=1) or Parent (=0) is Ill.	0.181 (8.047)	0.311 (12.942)
Annual Family Income (\$12000)	-0.00564 (-0.201)	-0.00442 (-1.477)
Parent is Married (1=Yes)	-0.0174 (-0.653)	0.0582 (2.050)
Number of Children	0.0115 (0.916)	-0.00351 (-0.263)
Race (White=1)	-0.0492 (-1.813)	-0.0492 (-1.704)
Asthma (Yes=1)	0.0932 (2.914)	0.0118 (0.347)
Constant	0.190 (2.878)	-0.351 (-5.001)
Price of Doctor Visit (\$/visit)	-0.00424 (-1.615)	0.00361 (0.272)
Time Required for Doctor Visit (Hours)	-0.00424 (-0.398)	0.0178 (1.569)
Wage (\$/Hour)	0.127 (2.134)	0.100 (1.581)
Employed (Yes=1)	-0.0379 (-1.019)	0.153 (3.876)
Paid Sick Leave (Yes=1)	0.0252 (0.999)	0.0249 (0.927)
Problem if Miss Work (High=1)	-0.0407 (-1.623)	-0.00191 (-0.072)
Child is in School (Yes=1)	0.0512 (1.243)	0.333 (7.594)
<b>S</b>	0.365	0.388
<b>R<sup>2</sup></b>	0.31	0.36

## Endnotes

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<sup>1</sup> Response rates were similar to rates obtained in other health surveys using telephone recruitment followed by in-person interviews at a central location [16]. Of the 11,018 calls to presumed working residential numbers (numbers not determined to be businesses, facsimile machines, modems or the like or non-working numbers), 19.7% yielded no contact with a human after the maximum of three calls. Of the 8,852 adults contacted, 55.9% declared their household ineligible, a reasonable figure since children are present in only about one-third of households. Interviews were scheduled with 487 persons, representing 12.5% of eligible contacts or 4.4% of working residential numbers dialed. Of these, 295 arrived for the interview. Thus, approximately 13 percent of eligible respondents agreed to participate, and 61 percent of those completed the survey

<sup>2</sup> Asthmatic children were over-sampled to support tests for differences in parental preferences between children with and without asthma. Childhood asthma is a major public health problem and appears to be exacerbated by air pollution exposure.

<sup>3</sup> Two focus groups with six parents each were conducted during initial development of the survey, and four rounds of pre-tests with a total of 12 subjects were conducted in revising the survey into the form finally administered.

<sup>4</sup> Acute bronchitis is characterized by lower respiratory symptoms and a fever of less than 101° F. Its symptoms include a cough with phlegm, possibly accompanied by chest pain below the breastbone when breathing deeply or coughing, and by shortness of breath with wheezing. It typically lasts about one week, but the duration can vary from a few days to two weeks.

<sup>5</sup> Respondents were told that drug companies were working on treatments for illnesses causing respiratory symptoms and fever. The influenza drugs released the previous autumn were used as examples. If taken soon after symptoms start, these drugs (brand names Relenza and Tamiflu) may reduce the duration of illness. Respondents were advised that these were examples only because the survey was not about influenza or drugs currently available. Prices for the new drug were based on recent research on symptom valuation. Prices used for a study in Taiwan [2] and in Canada [16] were adjusted for differences in price levels (using exchange rates for Taiwan and purchasing power parity for Canada), in income levels between those countries and Mississippi using an income elasticity of 0.33 (roughly mid-range of the estimates in [2, 18, 20]). There are four prices for the initial discrete choice question: \$40, \$200, \$400, \$600. Prices for the follow-up question ranged from \$10 to \$750.

<sup>6</sup> Some respondents objected to the idea of avoiding an illness outright. How would one know that an illness had been avoided? How would one know to make a payment to avoid a specific illness, unless he were already experiencing the illness? Other respondents wanted to know the mechanism between payment and illness avoidance such as a visit to the doctor or a pill.