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**Saueracker, Edward George**

**ADOLESCENT HEALTH: 1966-1970. THE ROLE OF INCOME, RACE,  
FAMILY BACKGROUND AND PREVENTIVE CARE**

*City University of New York*

**PH.D. 1984**

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**ADOLESCENT HEALTH: 1966-1970**  
**The Role of Income, Race, Family Background**  
**and Preventive Care**

by

**EDWARD SAUERACKER**

A dissertation submitted to the Graduate  
Faculty in Economics in partial  
fulfillment of the requirements for the  
degree of Doctor of Philosophy, The City  
University of New York.

1984

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This manuscript has been read and accepted for the Graduate Faculty in Economics in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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**Abstract**

**ADOLESCENT HEALTH: 1966-1970  
The Role of Income, Race, Family Background  
and Preventive Care.**

by

**Edward Saueracker**

**Adviser: Professor Michael Grossman**

This study explores income and race differences in nine measures of health and two preventive care measures of adolescents aged 12 to 17 years during the late 1960's. Initially the findings reveal that blacks have lower health and do not take advantage of preventive care. But when one accounts for differences in socioeconomic characteristics, the differences are substantially lower, though they do not disappear. In the case of pediatric care, black youths, holding the socioeconomic characteristics constant, would be more likely to avail themselves of preventive care than would whites.

Income is also analyzed. White youths from low income families are more likely to show deficient health. They are also less likely to get a yearly preventive oral and physical check-up. Income differences are greatly diminished when socioeconomic characteristics are held constant. The black subsample

reveals that low income blacks have lower health, as measured by the parental assessment, when compared to blacks of higher income. This difference also declines when the socioeconomic variables are included.

Another objective is to examine selected family characteristics and the health of white adolescents. The partial effect of income is small and, in most cases insignificant, and is dominated by other characteristics. In most cases, children of more highly educated parents are healthier. Preventive care has an important impact on improving oral health, but is not an effective means of bettering the physical health of the adolescent. The mother's labor force status and family size have small effects on health. These results are important in light of the increasing labor force participation rate of women with children, and the trend toward families of smaller size.

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## CHAPTER I

### LITERATURE REVIEW AND STATEMENT OF THE PROBLEM

The 1984 annual report on the nation's health issued by the Public Health Service reveals that while the health of blacks and whites has improved, disparities remain: Life expectancy for blacks is 69.3 years but is 75.1 years for whites; blacks suffer proportionately more from cancer, heart disease, stroke and hypertension; and the black infant mortality rate continues to be about twice that of whites. Clearly the role of race and/or income is on the forefront of health discussions. In fact, it has long been studied by social, as well as biological scientists.

As far back as Thomas Malthus, economic philosophers attempted to explain income's role in fertility. For Malthus the relationship was a simple one. An increase in income induces a large increase in family size because of the increase in nutrition and health levels; as income increases child mortality declines. An increase in income then provides an incentive for people to marry earlier and abstain less while married. Ultimately, however, mortality rises due

to the interaction between the rise in population and the fixed amount of other resources. An increase in family size in year  $t$  will increase mortality (adult and infant) in year  $t + j$ , so that an increase in income would lower mortality in the short run, but not in the long run.

The analysis in the contemporary literature differs from Malthus' because child mortality has fallen so low that ordinary changes in income have little effect on the number of survivors out of a given birth cohort. Births can also now be controlled without abstinence, thus greatly reducing the psychic cost of birth control.

The literature has continued to focus on mortality as the appropriate measure of healthiness but has directed itself to differences both by income and race. Fuchs (1974) examines mortality in developed countries through three types of data: cross-section within countries, cross-section among countries, and time series, revealing that the negative association between mortality and per capita income is declining, tending to disappear, except for those at the lowest income levels. He also concludes that the marginal

contribution of medical care to life expectancy is small, unlike improvements in medical science which have had significant effects during the period 1930-1960. Fuchs attributes the differences in mortality, on an inter- and intra-country basis, to "life-style," which he describes as diet, exercise, smoking, drinking, psychological stress, etc.

Mortality studies of infants and older children cite a 50 percent higher rate for blacks than whites. Keniston (1977) cites that in 1975 the infant mortality rate for whites was 14.4 per 1,000 live births, but the rate for nonwhites was 22.9, the same rate that American whites showed in 1960. While from 1964 to 1976 the infant mortality rate in the United States declined at an annually compounded rate of 4.1 percent per year, there still tends to be a negative relationship between it and income.

Grossman and Jacobowitz (1981) examine the possible causes of this rapid decline in infant mortality rate in the United States in the period after 1963-- Medicaid, maternal and infant care projects, federally subsidized family planning for low-income women, the legalization of abortion, and the adoption

of oral and intrauterine contraception techniques on a wide-scale-- using a multi-variate scheme to measure their impacts. Their results show that for whites the percentage of births to poor mothers has a positive and statistically significant effect on neonatal mortality. For blacks, the negative schooling effect is significant. The single most important factor in the reduction is the increase in the legal abortion rate. In fact, it dominates schooling and poverty. The increase in the use of family planning services by low-income women is the second most important factor in reducing nonwhite neonatal mortality. Maternal and infant care projects have small effects while Medicaid has an insignificant effect. Although infant mortality is not under investigation in my study, the literature does suggest possible implications for the health of children and adolescents.

Research also indicates that low birth weight is more prevalent among the black and the poor. This is significant, for low birth weight is not only a negative indicator of survival, but is also a negative indicator of health and school achievement at later ages.

Edwards and Grossman (1982) explore income and race differences in eight permanent health measures; significant acquired abnormalities, poor binocular vision, high diastolic blood pressure, poor oral (periodontal) health, parents' assessment, allergy, tension, and school absences; for children aged 6 through 11 years in the early 1960's who live with both parents or with their mother only. Their study shows that income and race differences in health are much less pronounced than they are in infant mortality and birth weight data. While health differences are found between black-white and high-low income, these are primarily with respect to subjective assessment by the parents, and not the findings reported by the doctor, dentist or nurse conducting the examination.

Infant mortality data may then provide a poor, or misleading account of the difference by race and income of children aged 6 through 11 during 1963-1965. Edwards and Grossman report that there is no statistically significant difference by race or income for abnormalities, perhaps the most serious health problem measured. This is particularly interesting in light of the fact that these children were growing up in the

late 1950's and early 1960's; prior to the introduction of government health programs. Clearly the picture presented here is not unambiguous for socioeconomic factors do play a major role in the production of a child's health.

Edwards and Grossman (1981) continue their examination of the relationship between a number of family characteristics and the health of white children 6 to 11 years of age. During their investigation of gross income differences they found the difference is largely attributable to other factors. The implication is that income transfers would have small effects on health.

Their results indicate that parents' schooling is an important determinant of children's health, so that much of the gross difference due to income can be explained by differences in parents' schooling. The mother's labor force status and family size have small health effects and are strongly related to child's state of nutrition. Edwards and Grossman also find that the frequency with which the child receives dental care has large and significant impacts for the oral health measures. The absence of the father, or the fact that

foreign language is spoken in the home has a small impact on health. There are similar findings with regard to sex, twin status and first born. Regional and place-size (population) factors play an important but unexplained role.

This research emphasizes the multidimensional nature of children's health since the family characteristics can have positive impacts on some components of good health and negative impact on others. This multidimensional nature of health is also true for adolescents.

Edwards and Grossman (1983) further investigate what determines the oral and physical health of adolescents. They report the main results as (1) nurture plays an important role in determining oral health but less for the other health problems studied; (2) preventive care is efficacious in the case of oral health but not for the other health problems studied; and (3) the three physical health measures are largely unexplained by the family and preventive care variables used here.

Mother's schooling is an important component of the home environment, dominating father's schooling in

almost every case. This is a significant finding since equal effects would result if the schooling variables are proxies for some genetic endowments they are unable to measure. While the results for physical health are weak, an interesting conclusion is derived regarding obesity. Adolescents are more likely to be obese if they come from small families, and less likely to be obese if their mothers are highly educated.

A program to increase the availability of dentists per capita would improve oral health, but there is little evidence that increasing the availability of doctors would significantly improve their physical health. Clearly, the policy conclusion to be drawn from this study dictates that the government should employ selective programs to improve the health of adolescents.

Shakotko, Edwards and Grossman (1981) show that good health is also associated with higher levels of cognitive development. They use longitudinal data from Cycle II and Cycle III of the Health Examination Survey. Two multivariate equations are estimated - One relates adolescent health to childhood health, childhood cognitive development, and family background;

and the other relates adolescent cognitive development to childhood cognitive development, childhood health, and family background. The data reveal that there is feedback both from health to cognitive development, and from cognitive development to health; the stronger of two relationships being causality from cognitive development to health.

Cognitive development in childhood has a positive effect on health in adolescence, and is positively related to parents' schooling and family income. Nurture is important in cognitive development and health; mother's schooling being the crucial component of the home environment. This finding is important in obesity and oral health because they are not irreversible. Cognitive development in childhood has a positive effect on health in adolescence. Both findings imply that the health of adults is heavily dependent upon their home environment as youths.

Roghamann and Pless (1975) show that in the case of acute illness, income and race have an effect on the parents' assessment of their offsprings' health and their reaction to it. Parents were asked to rate their child's health over the last year as "good" or "poor."

Approximately 90% of all children were rated "good," while only 1% to 2% were assessed as "poor."

Different groups have different thresholds for restricting normal activity, as their data show. White mothers report more recent illness for their children but when black mothers do report an illness it is likely to be of greater severity. If black children were kept in bed, they had to stay there for about four days, compared with two and one-half days for white children. Income also has an important role for while the frequency of reported illness does not vary with income, the lower the income the greater the severity of the illness as measured by the length of required bed or home rest.

The general health rating for the last twelve months was also related to both race and income. Only 7.5% of the white children were rated "fair" or "poor," compared to 13.4% of the blacks. Among blacks and whites with incomes below \$6,000/year, whites and blacks had equally poor health ratings, whereas among those with incomes above \$10,000 blacks reported poorer health than whites. While the research of Roghmann and Pless may deal with "transitory" rather than

"permanent" health, the results are suggestive of likely findings in my study of adolescent health.

Inman (1976) statistically tests a model of the family as the provider-protector of the health of its children. Here he examines the fact that unlike consumption of other goods and services, the exact effect of consuming health related services can be uncertain. He specifies a model which structures the family's decisions to spend income and parents' time on three child health-related goods and services - curative care doctor visits, preventive care doctor visits, and parents' time with children. The focus of the model is the mother, for she is the decision maker and the provider of child health services. Inman incorporates four characteristics of the family environment (1) the level of insurance coverage, (2) the mother's work status, (3) the family's usual provider of doctor care, and (4) the number of children in the family into his analysis of data from a National Academy of Science, Institute of Medicine survey of Washington, D.C. families. This sample consists, predominantly, of black children aged six-months to twelve years from lower and middle income families.

The concentration here is on ear-nose-throat (ENT) infections since they are one of the most prevalent of childhood diseases. If left untreated, ear infections can lead to permanent hearing loss and/or damage to the child's central nervous system. Chronic ENT disease may mean poor school performance, poor adult health and loss of future earnings. Inman draws the following policy conclusions: Efforts to influence the family's health performance through economic parameters of price and income will yield only marginal improvement in children's ENT health. He suggests concentration on improving medical technology, parental health knowledge, and "the patterns of adult-child interaction."

As the health studies indicate, health services which are purchased in the marketplace serve an important role in the production of good health. The demand for medical care is then derived from the demand for health. Several studies have investigated medical inputs and their impacts on oral and physical health.

Colle and Grossman (1978) use multivariate techniques in their examination of pediatric care utilization for children 1 to 5 years old. The measures

investigated are the probability of contacting a physician within the past year, the probability of obtaining a preventive physical examination within the past year, the number of office visits to physicians in private practice by children with positive visits, and the average quality of these visits.

Family income has a positive and statistically significant effect on all four dependent variables. In terms of pediatric office visits, the policy implications derived suggests that it would be more efficient to increase these visits by means of direct cash subsidies rather than by means of national health insurance.

With regard to Medicaid, the welfare program almost eliminates income-related differences in two indices (the probability of an ambulatory contact and the probability of a preventive physical examination for children from low income families) in pediatric care between white and black children. The data also show that raising the number of physicians per capita has no impact on number of visits. It does, however, have positive impacts on the quality of pediatric visits, on the probability of a preventive physical

exam, and on the probability of an ambulatory contact.

Mother's schooling and family size are shown to be important determinants of pediatric care utilization. Colle and Grossman point out that black-white differences in use of services would be reduced if we could eliminate black-white differences in mother's schooling and in family size.

Liebowitz and Friedman (1979) employ a family investment model where parents allocate resources among their own consumption, health investments and financial bequests to children. They develop hypotheses, regarding children under six with no chronic conditions, which are tested on cross-sectional data.

They find that the demand for physician visits increases with family income up to the \$10,000 level in 1969 dollars, but does not increase for higher incomes. The derived demand also increases with maternal education throughout the range of schooling values observed. For infants there is a clear substitution of home care for hospital care that is associated with the education of mothers. Demand is more than proportionately greater for younger children, the higher the mother's education.

The results further demonstrate that the demand for care is likely to be greater if the mother is usually at home, and not working. While it is not significantly related to public assistance status for other children, it is significantly negatively related to the number of siblings a child has. In the case of adolescents, aged 16-18 years, there is a weak inverse correlation between severity of illness and the number of physician visits that a similar group of parents obtain for younger children.

Geographical and place-size variables are presented as important, evidenced by the fact that infants in small towns and rural areas receive fewer physicians visits in infancy, and at older ages have more hospital admissions. This is consistent with the finding of greater health investments in children not living in small towns and rural areas paying off in young adulthood in the form of fewer severe illnesses.

As the literature on the demand for medical care reveals, the decision to seek care and the volume of services received depends on many factors. Andersen (1975) points to three factors - the predisposition of the individual to use services, his ability to use

services, and his need for medical care. Some individuals have a propensity to use services more than other individuals. This depends on socioeconomic characteristics reflecting the status of the individual. Variables such as ethnicity, education, and occupation suggest the lifestyle of the individual - the physical, as well as the social environment. The enabling component is represented by the family income and the characteristics of the community or region. The need component depends on the perception of the individual with regard to illness or probability of same.

Kravits and Schneider (1975) examine differences by income and race. The differences for rich and poor, black and white, who go for care described as totally preventive or elective, are not great. In looking at preventive care as represented by physical examinations, blacks are at least as likely as whites to claim that they have had a "check-up" in the last year (56.7% for blacks versus 54.2% for whites). However, twice as many blacks reported they never had a check-up. Blacks and whites are also about equally likely to say that they had a check-up for preventive

reasons rather than for curative care. This finding lends further support to the hypothesis that while blacks are generally sicker, they do obtain more preventive care than is generally recognized.

The finding for routine preventive dental care differs significantly by race and income (13% of blacks versus 31% of whites). The conclusion is that blacks and whites regardless of income, go to the dentist for very different reasons and types of treatment, and that blacks go for more serious care and less often for purely preventive care.

Kravits (1975) finds no relationship between race and income, and discretionary physician and dentist use for the population as a whole, but did find a significant relationship for blacks and the aged. These are the groups which appear to experience the greatest barriers to obtaining preventive health care. In general, blacks and low income individuals have more negative attitudes than the remainder of the population. Race then appears to make the main determinant on some questions, while on others, income is the main determinant of differences. Attitudes appear to make a difference only if the individual has

to pay for elective care, at least in part, out of pocket.

Fuchs (1968) reinforces the need to remove the barriers to care and points to the fact that the most glaring inequity is the fact that millions of Americans with inadequate income either do not obtain any medical care at all or obtain it under conditions that are either degrading and inimical to good care. At the same time Benham and Benham (1975) suggest that the utilization by low income groups increased relatively during this period (1963-1970) and that in 1970 the relationship between income and physician utilization was weak.

Before discussing adolescent health, and differences by race and income, it should be noted that race is not a universal concept. A small group of sociologists and anthropologists argue that man is not differentiated into races. Even if this were true, the importance of this component is not diminished. If humanity indeed has no races, clearly it is not homogeneous. A great deal of the confusion about race comes from confusing hereditary traits with traits which are socially acquired (cultural).

The definition of race is not the only concept which warrants further clarification. The term "adolescent" is also not universal or easily measurable. It is difficult, if not impossible, to definitively determine when the process of maturing from child to adolescent begins. In this study the term "adolescence" will cover the years 12-17. This operationalization is used, though I am quite aware from the literature (Muuss, 1971) that there are individuals who, for psychological or cultural reasons may not mature into adolescents during these years.

The aim of this examination is then to investigate the extent to which the health of an adolescent is determined by income or race, and the extent to which is it determined by the socio-cultural, family characteristics discussed in the literature.

## CHAPTER II

### ANALYTICAL FRAMEWORK

There are a number of analytical frameworks within which adolescent health may be investigated. Roghmann (1975) discusses three models: 1) Suchman's 2) Rosenstock's and 3) Anderson's. They have all been used, with varying degrees of success, to examine adolescent health. Suchman uses a framework which was inductively developed from specific bodies of survey data. Suchman's links between health status, utilization and demographic variables are of a sociopsychological nature; "Social Organization" and "Individual Medical Orientation." His variables include knowledge about disease, skepticism of medical care, dependency in illness, friendship solidarity, ethnic exclusivity, family tradition and authority orientation, group support.

Work with this model supports Suchman's general reasoning about his variables, but the relationships were shown to be weak, frequently nonmonotonic, and mostly lacking in statistical significance. Use of Suchman's model in Rochester, New York yielded no

empirical evidence to support the model.

Rosenstock bases his approach on individual psychology. The well established relationships between personal and demographic variables, and health and illness behavior, fail to explain why some people use health services and others do not. He examines three groups of variables: Personal Readiness (perceived vulnerability and consequences); Perceived Benefits and Barriers (to actions); Cues or Triggers for Action. The first two groups are especially relevant for prevention. Rosenstock's approach is with regard to specific behaviors like dental check-ups, immunization programs or "Pap" smears. This model proved weak in predicting health or illness behavior in general, and does not explain utilization rates.

Anderson attempts to integrate the Rosenstock and Suchman models, as well as a number of economic models. He incorporates biological, psychological, social and economic variables into this scheme. The resultant model uses the family as a unit of analysis, separates social from economic factors, introduces community characteristics and considers health beliefs of family members. Anderson's variables are: social structure

variables such as family size, age and sex of head of household, and marital status of mother.

The model reveals that the age of the child, marital status, and family size affect utilization. Maternal education, maternal race, parental occupation are also significant.

As an economist I am concerned with examining the behavior of the various decision makers in the economy as they allocate scarce resources among alternative uses to satisfy human wants. Guided by self-interest, these decision makers seek to maximize their utility or satisfaction. Parents demand, and produce, offspring with a certain stock of human capital by allocating scarce resources in the production of their offsprings' human capital, and by so doing, they increase their own level of utility. The well being of an offspring then enters the utility function of the parent.

"Parents in rich countries acquire mainly future personal satisfaction from them, while in poor countries children also contribute substantially to the future real income of their parents by the work that children do in the household and on the farm, and by the food and shelter they provide for their parents

when they no longer can provide for themselves. Children are in a very important sense the poor man's capital."<sup>1</sup>

In order to examine the role of the parent, as well as biological and environmental factors involved in the production of an adolescent's human capital, a household production function is employed. The household in this analysis, is a small factory producing the consumer's basic objects of choice with inputs of goods and services purchased in the market and their own time. It is these commodities, rather than the goods, that are the arguments in the household's utility function. The household production function approach integrates time constraints, knowledge and interhousehold differences in consumption efficiency into choice theory.

The concept of investment in human capital derives from the idea that certain expenditures are made to create productive stocks. These stocks are embodied in human beings and provide future services. Health capital is one form of human capital in which a person inherits some stock of health that can be increased by investing. Health differs from other forms

of human capital for its impact is not on production, but on time available for market and non-market productivity. Good health represents one factor that constitutes their child's welfare. In order to achieve such healthiness, parents must allocate to their children part of their scarce resources which include market goods and services and their own time.

Adolescent health is examined here in the context of the Becker and Lewis model (1973). In this model there is a negative correlation between the quantity and quality of children per family. In other words, quantity and quality are substitutes in the household production function for child services. Any increase in the quality is more expensive if there are more children since the increase is spread out over more units.

"Families with excess children consume less of the other goods, especially of goods that are close substitutes for the quantity of children. Because quality seems like a relatively close substitute for quantity, families with excess children would spend less on each child than other families with equal income and tastes."<sup>2</sup>

The theory of human capital hinges on an understanding of time allocation in the household, as Becker (1965) describes. Time becomes important when one couples it with the production of household commodities. A mother's time is of vital importance in caring for children and is thus affected by the woman's wage rate. In infancy and early childhood, a child requires a great deal of time and the reward received is psychic in nature. The fact that in adolescence the youth may become relatively less labor-intensive does not dismiss the importance of time in the model. Clearly parents have alternatives to their child's welfare or quality. The parent's opportunity cost is represented by their forgone consumption, the consumption of others in the family, and of course, the number of children.

This approach enables an examination of the effects of several components--nature versus nurture, allowing investigation of the degree to which the family and local environment determine the level of adolescent health. Geographic or regional differences may affect the cost of a given child, as it is reasoned that it is cheaper to raise children on a farm. Since

the general demographic trend has been migration from farm to urban America, this would increase the cost, causing parents to choose fewer children of higher quality.

Emphasis is placed on the role of the household's technology, as well as its taste as a determinant of behavior. If the technological advance has been more rapid in the marketplace than in the home, the cost of parents' time spent on their children might have risen. This would also have the effect of causing parents to choose fewer children of higher quality. Children of many qualities are usually available, and the quality selected is determined by tastes, income and prices. It is precisely these tastes that are determined by a family's religion, race, age, etc. Clearly, the taste for the quality of an offspring has a cultural component to it.

There is one possible objection to using this framework in analyzing adolescent health. The objectives of the adolescent may not be identical to those of the parent. Becker analyzed this and concluded that parents have an incentive to allocate resources not only to their children but to the policing of their

consumption patterns. Following the lead of other researchers, (Edwards and Grossman) I stay clear of this conflict.

#### THE HEALTH PRODUCTION FUNCTION

In the analytical framework employed here the family uses the various inputs, dictated by theory, and evidenced in the literature, to produce good health. The household production function, the relationship between inputs and output, is given by the following:

$$H = \beta_0 + \beta_1 E + \beta_2 G + \beta_3 M + \beta_4 X + \beta_5 R + u_1$$

H represents one of the health measures, E is a vector of family efficiency components, G is a vector of the adolescent's endowed health, M is the medical or dental care input, X is a vector of other family inputs (nutrition, parents' time, etc.) R is a vector of relevant regional characteristics (city size, region of country), and  $u_1$  is a random error term normally distributed with a finite variance and a mean of zero.

In some cases economic theory suggests that the coefficients of a relation should obey a linear

restriction. Theory gives us no such direction here. A linear production function is used here, however, because of the arbitrary scaling of the adolescent health measures. The exact specification is unknown so that the benefits of experimenting with sophisticated functions would be very small.

The health production function actually estimated does not correspond exactly due to the inadequacy of the data; proxies must be used.

#### THE DERIVED DEMAND FOR PREVENTIVE CARE

The derived demand function for medical care is given by the following:

$$M = \alpha_0 + \alpha_1 F + \alpha_2 G + \alpha_3 P + \alpha_4 R + u_2$$

Note that the demand for medical care depends on the same set of variables as the demand function for health.  $F$  represents family income, education, family size, and other family characteristics affecting either the demand for health or the family's efficiency in producing health children;  $G$  is the vector of the adolescent's endowed health characteristics;  $P$  is a

vector of relevant direct and indirect input prices; and  $u_2$  is the random error term with the usual properties. Since we have inadequate information on P, proxies are used. We also do not have adequate information on curative care, so the medical care component investigated here is preventive in nature. As with previous studies I can thus, avoid the problem of modeling simultaneously determined health levels and curative care. The reader should remember that indeed, the demand for medical care is a derived demand; derived from the basic demand for health.

Finally, the results obtained in this research cannot be unambiguously interpreted as production functions or derived demand equations because the proxy measures employed represent endogenous inputs; theoretical variables are unavailable; and the fact that, as noted, family size, an endogenous variable from the structural demand equation, is included. The estimating equation is then a mixture of a structural demand equation, a reduced form equation, and a production function.

The analysis of adolescent health is conducted by use of SPSS (Statistical Package for the Social

Sciences) with Ordinary Least Squares (OLS) as the method of estimation. The multiple regression method of analyzing the data allows one to examine the collective and separate contributions of two or more independent variables to the variation of the dependent variable. Since one aim of "science" is to explain natural events, multiple regression is fundamentally oriented toward explanatory analysis. Here variables, as entered into the regression equations, reflect hypotheses that constitute a reasonable interpretation of the behavior under examination.

One of the problems with much of the work in human capital theory is the problem of multicollinearity, which arises when some or all of the explanatory variables are highly interrelated. One of the assumptions of the classical multiple regression model is that there is no exact linear relationship between the independent variables in the model. The consequences of such collinearity is such that it is difficult to separate out the relative influences of the various explanatory variables. The model can still be utilized as long as care is taken in analyzing the regression results.

In the case of dichotomous variables the OLS procedure is not the optimal method of investigation. But given the sample size and the number of variables, LOGIT or some other nonlinear estimation method is not feasible.<sup>3</sup> Although it may not be optimal, experimentation with Cycle II data revealed there are almost no differences between Ordinary Least Squares estimates and dichotomous logit estimates obtained by the method of maximum likelihood.<sup>4</sup> It should also be noted that when the variable is dichotomous the fitted equation can be interpreted as a linear probability function in which the regression coefficient of a given independent variable represents the change in the conditional probability of poor health or receipt of preventive care for a one-unit change in that independent variable.<sup>5</sup>

To reiterate, fundamentally embedded in the concept of a household production function is the notion that consumers produce their basic objects of choice with inputs of goods and services purchased in the market and their own time. This is relevant for the discussion of adolescent health since parents do not buy their child's health, the basic object of choice,

in the market. The adolescent's home environment, as well as the genetic endowment, is shown to be important in determining health.

The price of health depends upon the cost of the parents' time, prices of medical care, nutrition, and any purchased inputs used to improve their child's health. It also depends on the number of children since the more children in the family the more costly it is to raise their average health level. Since health is produced in the home the efficiency of the family, perhaps because of education, to produce health is also relevant.

The following then are expected to affect the level of adolescent health: the genetic endowment, family wealth, parents' wage rates, family size, parents' education and other measures of efficiency, and the costs of medical care and other market health inputs. As Edwards and Grossman (1983) indicate the use of the health production function, rather than merely a demand curve for health, allows investigation of the effect of preventive care. In order to evaluate efficiency, estimates of the production function are required.

Clearly this multivariate analysis, which is carried out in the framework of an economic model of the family not only accounts for the family as the health care provider but also captures its resource constraints and objectives.

## FOOTNOTES

<sup>1</sup>Theodore W. Schultz, "Fertility and Economic Values," in Economics of the Family: Marriage, Children and Human Capital, ed. Theodore W. Schultz (Chicago: University of Chicago Press for the National Bureau of Economic Research, 1974), p.6.

<sup>2</sup>Gary S. Becker, The Economic Approach to Human Behavior (Chicago: University of Chicago Press, 1976), p. 179.

<sup>3</sup>For further discussion of the Logit model consult - Marc Nerlove and S. James Press, "Notes on the Log-Linear or Logistic Model for the Analysis of Qualitative Socioeconomic Data." (Santa Monica: The Rand Corporation, 1973.)

<sup>4</sup>Linda N. Edwards and Michael Grossman, "Income and Race Differences in Children's Health in the Mid-1960's," Medical Care 20, no. 9 (September 1982) pp. 915-30.

<sup>5</sup>For a more detailed explanation on using dummies to develop a prediction equation, see J. Johnston, Econometric Methods, 2nd. ed. (New York: McGraw-Hill Book Company, 1972), p. 182.

## CHAPTER III

### DATA AND MEASUREMENT OF VARIABLES

The data are from the Health Examination Survey (HES) of United States youth 12-17 years of age determined by a nationwide sample of the population. The Health Examination Survey is a major program of the National Health Survey, a continuing public health survey conducted by the National Center for Health Statistics (NCHS).

The Survey consists of successive programs highlighting the health of specific age cohorts, referred to as "cycles." The emphasis here is on the third cycle, a study of the health of youths aged 12-17 years conducted from 1966-1970. Originally Cycle II was to sample youths 6-17 years inclusive, but it became apparent that the differences in the health of the youths justified separate programs. The youths are all between the age of 12 and 17 years inclusive, independent of school attendance or marital status and are citizens of the United States that are neither institutionalized nor residents of reservations for Native Americans. The survey is a multi-stage,

stratified probability sample of clusters of households in land-based segments which was designed to obtain data on the health status of the youth population with particular emphasis on factors and conditions related to their growth and development.

In order to obtain accurate information on specific health measures, the Health Examination Survey used medical and dental examinations and questionnaires to characterize the population. The Examinations were of two to three hours duration and conducted in forty different locations throughout the United States. Approximately 35 different physicians and five dentists were employed, with twelve technicians performing various procedures. Ancillary data were collected through the use of questionnaires and other records:

#### HOUSEHOLD QUESTIONNAIRE

This is the basic source document of demographic data concerning the population sample. A variety of data are obtained from all eligible households, including information on the age, sex and race of the eligible youth, as well as information on the school

attended. It also includes information on the parents' education, country of birth, working status, and marital status. Total family income and whether a foreign language is spoken in the home is also obtained from this document. Parents were also asked questions concerning the occurrence of certain specified potentially traumatic episodes in the life of a youth.

#### THE MEDICAL HISTORY OF YOUTH QUESTIONNAIRE

This was completed by the parent or guardian and is the document from which information is obtained on the health history of the adolescent. It is an important document in that it alerted the physicians to certain conditions, and served as a basis of comparison with the results obtained by the various procedures in the examinations.

#### HEALTH HABITS AND HISTORY QUESTIONNAIRE

This was left at home to be completed by the youth. Here health questions were chosen that could best be answered by the youth directly rather than by the parent. Questions such as whether the youth wears his or her glasses and the duration of wear is not

something that can be answered with a reliable degree of accuracy by the parent.

#### HEALTH BEHAVIOR QUESTIONNAIRE

This was completed by the adolescent while at the Examination Center. Some of the questions parallel the questions on the Health History Questionnaire completed by the parents. Examples include educational goals, behavior standards, amount of parental involvement in certain decisions concerning activities of the youth, and the importance attached to certain medical conditions.

#### SUPPLEMENTAL INFORMATION FROM SCHOOL

The data here were obtained from the school at which the youth is a student. This gives official information on the youth's grade placement, date of birth, grades skipped or repeated, absenteeism, and disciplinary problems. It also brings to attention any health problems that have come to the attention of the adolescent's teacher or other school officials.

## BIRTH CERTIFICATE

From the information obtained on the Household Questionnaire the authorities at the appropriate state or city's records office could be contacted. Permission to use this information was obtained from the parent. The birth certificate gives information on the age of the youth as well as the age of the parents. The information on birth weight is obtained from this document.

Before investigating the information obtained from the examinations and ancillary documents, it is important to examine the carefullness or carelessness with which the survey was conducted, since errors may enter into the collection of such data. There is sampling error which occurs because data were gathered from a sample rather than from the entire population; its appropriateness can be estimated, and there is non-sampling error. To reduce sampling errors the researcher can increase sample size. Unfortunately this is ineffective in reducing the effects of non-sampling errors. The HES represents national estimates of "the

highest attainable accuracy and precision within the usual limitations dictated by acceptable procedures and reasonable costs."<sup>6</sup>

Included in non-sampling errors are the following: Conceptual errors - errors due to survey design; Nonresponse errors - errors due to noncoverage; Measurement errors - errors due to a lack of environmental control, poorly worded questionnaire; and Processing and Analysis errors - errors in coding, computation etc.

In terms of nonresponse, the great majority of nonresponse in Cycle III was due to the fact that respondents died or moved away between the first census contact and the examination, or were unable to be examined due to illness or severe physical disability.<sup>7</sup> This type of error is particularly apparent when the participants are volunteers. The amount of bias introduced by nonresponse is generally, though not necessarily, variable with the amount of nonresponse. Even if the sample is perfectly representative of the population, bias will result if the nonrespondents are significantly different with respect to the characteristics measured, from those who responded.

In order to measure the bias, if one knows something about the characteristics of the nonrespondent, comparisons can be made. Unfortunately the value of the characteristic of interest for the nonrespondent is never known. By subsampling nonrespondents one can often obtain enough response to make estimates for all the nonrespondents. While this is better, it too is subject to nonresponse bias.

Missing data is another source of nonresponse bias. The NCHS used careful review techniques to reduce the problem of missing data. Unfortunately the questionnaires were left with schools during the summer and not reviewed until the survey had left the area so that the advantage of field review was lost in this case. This significantly reduces the pool from which the researcher can investigate information obtained from the school.

Measurement error is also a source of bias. Not only is it important to control and minimize this type of error but it is important to measure the amount. Extensive written instructions were provided and the forms were structured to reduce the measurement error. The use of machinery to obtain a "hard document" was

also employed. The control of the environment through temperature and light is also essential. The subject can also introduce error-- poor posture, lack of cooperation, misinterpretation of instructions. By using a second technician as a recorder who was responsible for seeing that the subject was in the proper position for all measurements, the occurrence of subject error was reduced. The replication of data would determine the extent of the measurement error.

Since most of the information was obtained by requiring the respondent to check a box and make written responses, processing errors also occur. By review and design much of this error was eliminated.<sup>8</sup>

In addition to being mindful of the possible errors that may occur, the scheduling of the survey is very important. The scheduling of the 40 exam locations was deliberately arranged so that the North was avoided in the winter and the South in the summer. From an operational point of view this may be desirable, but it makes the interpretation of any characteristics with a seasonal component very difficult. Fortunately the measures used here do not exhibit a tendency toward seasonable variation.

## HEALTH AND PREVENTIVE CARE MEASURES

Given that one wants to examine adolescent health one needs some definition of what health is, and some way of measuring it. A morbidity-oriented definition of health status is employed in this dissertation focusing on the incidence of particular physical conditions and parental assessment. This is in keeping with the way economists define health. Health determines the amount of time available for work in the home and the market. While such disability may be relatively easy to measure when dealing with adults who are members of the labor force - measured as days of work lost - it is not so easy if the adult is not a member of the labor force. This may also not capture lost consumption. Grossman (1972) uses the incidence of particular conditions and the individual's own assessment as supplementary measures to study adult health.

The issue of defining and measuring the health of minors is yet unresolved. The relevant notion of health is that of "permanent" health, reflecting the child's human capital or "future prospects for life preservation and normal lifetime functioning."<sup>9</sup> The health measures under observation were chosen to

reflect this concept of permanent health rather than "transitory" health - "those short-run deviations from one's normal state of health caused by the acute conditions of childhood."<sup>10</sup> The actual choice of components is controlled by the available Cycle III data and guided by the literature.

Since the health literature shows health to be multi-dimensional, a set of health measures, rather than a single index is used.<sup>11</sup> Edwards and Grossman (1982) indicate the use of a vector of measures avoids the problem of arbitrarily weighting the various components. Finally, such analysis allows for the possibility that the various aspects of adolescent health are differentially related to family income and race.

All of the health measures are negative correlates of good health, while the utilization measures are positively related to healthiness. See TABLE 1 for a complete listing.

TABLE 1

HEALTH AND PREVENTIVE CARE MEASURES

VARIABLE NAME	DEFINITION
<b><u>HEALTH MEASURES</u></b>	
<b>ABN</b>	Dichotomous variable that equals one if the physician finds a significant acquired abnormality
<b>HDBP</b>	Dichotomous variable that equals one if the youth's diastolic blood pressure is above the 95th percentile for his age and sex
<b>OBESE</b>	Dichotomous variable that equals one if the physician rates the youth as obese or very obese
<b>PVIS</b>	Dichotomous variable that equals one if youth wears glasses and his binocular distance vision is 20/40 or worse <u>or</u> if youth does not wear glasses and the uncorrected binocular vision is 20/40 or worse
<b>ANEMIA</b>	Dichotomous variable that equals one if the youth is a female whose hematocrit level more than two standard deviations below the mean for females 12 to 17 years of age <u>or</u> the youth is male whose hematocrit level is more than two standard deviations below the mean for his stage of sexual maturity

TABLE 1 continued

<b>VARIABLE NAME</b>	<b>DEFINITION</b>
<b>IDECAY</b>	Number of decayed teeth standardized by the mean and standard deviation of one-year age-sex cohorts
<b>APERI</b>	Periodontal index, standardized by the mean and standard deviation of one-year age-sex cohorts
<b>PFGHLTH</b>	Dichotomous variable that equals one if parental assessment of youth's health is poor, fair, or good and zero if assessment is very good or excellent
<b>SCHABS</b>	Dichotomous variable that equals one if youth has been excessively absent from school for health reasons during the past six months
<b><u>PREVENTIVE CARE MEASURES</u></b>	
<b>DRPREV</b>	Dichotomous variable that equals one if youth saw a doctor for a check-up within the past year
<b>DTPREV</b>	Dichotomous variable that equals one if youth saw a dentist for a check-up within the past year

ABN is a dichotomous variable that denotes the presence of one or more acquired abnormalities. These abnormalities include heart disease; neurological, muscular, or joint conditions; and other major diseases. Excluded are abnormalities resulting from accident or injury, for these would be more likely to reflect changes in transitory rather than permanent health. The presence of abnormalities was determined by the physician under physical examination.

Blood Pressure was measured as part of the cardiovascular examination. Since blood pressure has been found to vary considerably over a short period of time, three sets of readings were taken, and what is reported on the survey is the average of these three. The readings were taken by a nurse, the first two at the beginning and end of the physical exam given by the pediatrician with the adolescent in a prone position, while the third was administered immediately after the second with the youth in a sitting position. The measurements were indirectly taken by use of a standard clinical mercury sphygmomanometer.<sup>12</sup> One should also note that venipuncture (blood sampling) occurred after the first reading. The National Center for Health

Statistics cautions users of this data against using the absolute levels of blood pressure, but useful internal categorical comparisons can be made.<sup>13</sup>

Because of this, and because the mean diastolic pressure increases with age and differs in rate for changes in age for boys, as opposed to girls, a dichotomous age-sex adjusted variable, HDBP, was created. It indicates the presence of high diastolic blood pressure when the diastolic blood pressure exceeds the 95th percentile for his or her age and sex. Diastolic blood pressure is used because it measures pressure at rest - a better measure of health than systolic pressure. The systolic pressure varies with the time of day it is measured, higher for the afternoon than the morning.

Another problem, the problem of being overweight is an increasing one in society, possibly causing anguish as well as a threat to life. Obesity is represented by a dichotomous variable, OBESE, that equals one if the physician rates the youth as obese or very obese. It is assumed that the physician accounts for the adolescent's height, age and sex.

The literature on obesity is unclear as to

whether, in fact, juvenile obesity is a health problem.<sup>14</sup> It is also unclear whether obese adolescents are predisposed to suffering disease or evidence of future disease.<sup>15</sup> The literature (Stunkard and Burt, 1967; Stunkard and Mendelson, 1967) is, however, quite clear that the obese youth may suffer in terms of "personality, self-concept and body-image," and may be considered second-class citizens. Mayer (1968) suggests that the probability of having a fat child rises with parental fatness from 7 percent (with both parents of normal weight) to 40 percent (with one parent being obese) to 80 percent (with two parents being obese).<sup>16</sup> Obesity is examined for there is the suggestion that obesity is perpetuated within the family line because of a combination of genetic and environmental, social and economic factors.

Abnormal distance vision is denoted by a dichotomous variable, PVIS, that equals one if a youth wears glasses and his corrected binocular distance vision is 20/40 or worse or if a youth does not wear glasses and his uncorrected binocular distance vision is 20/40 or worse.<sup>17</sup> The information was obtained by vision tests which included those to detect and

classify color vision deficiencies, and monocular and binocular tests to determine the level of distance and near central visual acuity. Lensometer measurements of corrective lenses were also done for those who wear glasses. All tests, except color vision were done without correction. For those who had their glasses or contact lenses with them, tests at distance were also done with their usual correction. The vision examination was conducted by a dentist as he was the only member of the examining team with the available requisite time, ten minutes.

This is an important health measure for nearly 1/8 or 2.6 million U.S. youths aged 12 to 17 years indicate they do not wear, but need glasses. Parents are only aware of the need for only about half those youths. In addition, one fifth of those who owned glasses or contact lenses indicated they need a change in them.

Anemia is given by a dichotomous variable, ANEMIA that equals one if the adolescent's hematocrit level is "excessively" low. While some of the literature indicates use of a continuous measure of anemia, other literature negates the gain of such a measure.<sup>18</sup> The

hematocrit level of a female youth is considered to be excessively low if it is more than two standard deviations below the mean for all females aged 12 to 17 years. The hematocrit level of male youths is considered excessively low if it is more than two standard deviations below the mean for all males in his stage of sexual maturity.<sup>19</sup>

From each subject a blood sample was drawn, centrifuged at 12,500 r.p.m. for 5 minutes and was read immediately. Centrifuging separates the blood's cells from the plasma so that the resultant hematocrit packed red cell volume can be measured very accurately. The hematocrit value gives similar but not identical information on the hematological status as does a hemoglobin or red cell count. Hematocrit is the simplest and single most accurate measure of anemia.<sup>20</sup>

Finally, most of the data reported in the literature on anemia differ from those reported in HES because the HES data were obtained from a population at large with no omission of subjects who were anemic or suffered recent blood loss, poor nutrition and diseases of the blood.

Two oral health measures, IDECAY and APERI are

employed because it is one of the few health problems for which well-defined continuous health measures have been developed. The information on oral health was collected during a 10 minute examination by one of seven dentists. Since the HES does not include institutionalized people or persons residing on lands for American Indians, a portion of the population that may contain a higher degree of dental morbidity is not represented.

IDECAF is a measure of oral health in which the number of decayed teeth is standardized by age-sex. IDECAF is then measured as the difference between the actual and mean levels for his or her age-sex group, divided by the standard deviation for that age-sex group. APERI is based on the periodontal index which scores each tooth in the mouth provided it is not a root, according to the severity of periodontal disease. The periodontal index ranges from 0.0 (no inflammation or pockets) to 8.0 (all teeth with pockets and impaired function).<sup>21</sup> This measure suffers from intra-rater and inter-rater variability, though agreement between the examiners was high.<sup>22</sup> In order to minimize the variability the measure is adjusted by sex-age. APERI

is then measured as the difference between the child's actual periodontal index and the mean index for his or her age-sex group, divided by the standard deviation of the index for that group. While the number of decayed teeth may, in fact, be a more objective measure, in comparison the periodontal index reflects more serious oral health problems, such as nutritional and health habits.

Each Medical History form and Health Habits and History form was reviewed by the examining physician on the day before the scheduled exam. While this eliminates the blind-type design, NCHS felt that the advantages of an examination procedure more nearly like the clinical practice, outweighed any disadvantages.

PFGHLTH captures the parents' assessment of the offspring's current health. While this may be subject to measurement error it is important, as the literature indicates, for the researcher to understand the factors which affect the perception, by the parent, of the youth's health. It is this very perception which determines the amount of resources allocated to the production of the adolescent's health. This dichotomous variable indicates whether the parent views the youth's

health as poor, fair, or good (as opposed to very good/excellent). This breakdown was used because, while there are very few observations in the poor and fair categories, parents did make a distinction between good and very good/excellent.

Coleman (1965) points out that school performance is important for it is "massively" influenced by the social, economic, educational and cultural background of the child. Information provided by the school regarding excessive absence from school due to illness is given by the dichotomous variable, SCHABS. There is no school form for 811 of the youths in the HES which translates into 561 missing forms in the working sample. Since excessive school absences due to illness is the only variable taken from the school form, children without the school forms are eliminated from empirical analysis only when school absences is the dependent variable.

The medical care component is represented by DRPREV and DTPREV. DRPREV is a dichotomous variable equal to one if the adolescent saw a doctor for a check-up within the past year. DTPREV is a dichotomous variable equal to one if the adolescent saw a dentist

for a check-up in the past year. Both of the medical care measures are preventive in nature, distinguishing between those who received preventive care; and those who received no care at all or only curative care. These two measures of preventive care are preferred to alternatives like the number of dental or physician visits or the receipt of curative care alone, because these measures are less likely to reflect reverse causality from poor health to more medical care.<sup>23</sup>

#### EXPLANATORY VARIABLES

In addition to guiding the selection of the health and preventive care measures, the literature dictates, as previously stated, the variables needed to examine adolescent health: Family wealth, parents' wage rates, parents' education (these are used as measures of the efficiency of the household); the adolescent's health endowment; the cost of market health goods and services used as inputs in the production of good health, prices of other goods used to produce adolescent quality, the prices of other goods and services consumed by parents, and family.

As the theory indicates, health is a function of socioeconomic variables as well as market goods and services, and their respective prices. Unfortunately one can only work with the data available, so proxies are used for some of the family measures dictated by the theory. For a complete list of the measures see TABLE 2.

Family wealth and father's wage rate are represented by the family income measure, FINC. Family income is defined as the total income received during the past twelve months by the head of the household and all other household members related to the head by blood, marriage, or adoption. This is gross cash income excluding payments-in-kind, except in the case of a family owned farm and/or business in which net income was recorded.

The mother's wage rate is not given by the survey data but three variables are used to control for variations in her wage rate: MEDUCAT, MWORKFT, MWORKPT. Labor force participation (MWORKFT, MWORKPT) and educational attainment are used to represent the opportunity cost of the mother. More educated women, and women who are in the labor force, are more likely

TABLE 2

## EXPLANATORY VARIABLES

VARIABLE NAME	DEFINITION																								
<u>EXOGENOUS</u>																									
<b>FINC</b>	Continuous family income in thousands of dollars computed by assigning midpoints to the following closed income intervals \$250. to the lowest and \$20,000. to the highest. The closed income classes are:  <table style="margin-left: 40px;"> <tr> <td>\$ 500</td> <td>-</td> <td>\$ 999</td> </tr> <tr> <td>1,000</td> <td>-</td> <td>1,999</td> </tr> <tr> <td>2,000</td> <td>-</td> <td>2,999</td> </tr> <tr> <td>3,000</td> <td>-</td> <td>3,999</td> </tr> <tr> <td>4,000</td> <td>-</td> <td>4,999</td> </tr> <tr> <td>5,000</td> <td>-</td> <td>6,999</td> </tr> <tr> <td>7,000</td> <td>-</td> <td>9,999</td> </tr> <tr> <td>10,000</td> <td>-</td> <td>14,999</td> </tr> </table>	\$ 500	-	\$ 999	1,000	-	1,999	2,000	-	2,999	3,000	-	3,999	4,000	-	4,999	5,000	-	6,999	7,000	-	9,999	10,000	-	14,999
\$ 500	-	\$ 999																							
1,000	-	1,999																							
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4,000	-	4,999																							
5,000	-	6,999																							
7,000	-	9,999																							
10,000	-	14,999																							
<b>FEDUCAT</b>	Years of formal schooling completed by the father																								
<b>MEDUCAT</b>	Years of formal schooling completed by the mother																								
<b>FLANG</b>	Dichotomous variable that equals one if a foreign language is spoken in the home																								
<b>NEAST MWEST SOUTH</b>	Dichotomous variables that equal one if youth lives in Northeast, Midwest, or South, respectively; omitted class is residence in West																								

TABLE 2 continued

EXPLANATORY VARIABLES

VARIABLE NAME	DEFINITION
URB1 URB2 URB3 NURB	Dichotomous variables that equal one if child lives in an urban area with a population of 3 million or more (URB1); in an area with a population between 1 million and 3 million (URB2); in an urban area with a population less than 1 million (URB3); or in a non-rural and non-urbanized area (NURB); omitted class is residence in a rural area
MALE	Dichotomous variable that equals one if youth is male
FIRST	Dichotomous variable that equals one if youth is first born
AGE	Age of youth
TWIN	Dichotomous variable that equals one if youth is a twin
<u>LAGGED or EARLY ENDOGENOUS</u>	
HMAG	Dichotomous variable that equals one if the mother was more than 35 years old at birth of youth
LMAG	Dichotomous variable that equals one if mother was less than 20 when the youth was born
FYPH	Dichotomous variable that equals one if there was a medical difficulty with youth before age of one

TABLE 2 continued

EXPLANATORY VARIABLES

VARIABLE NAME	DEFINITION
EARLYH	Dichotomous variable that equals one if there was a medical difficulty with youth since age one
LIGHT1	Dichotomous variable that equals one if youth's birth weight was under 2,000 grams (under 4.4 pounds)
LIGHT2	Dichotomous variable that equals one if youth's birth weight was equal to or greater than 2,000 grams but under 2,500 grams (under 5.5 pounds)
BWUK	Dichotomous variable that equals one if youth's birth weight is unknown

CONTEMPORANEOUS ENDOGENOUS

LESS20	Number of persons in household 20 years of age or less
MWORKFT MWORKPT	Dichotomous variables that equal one if mother works full- or part-time, respectively

to have higher opportunity costs with regard to labor participation. As Keniston (1977) points out, in 1948 26% of married women with school age children worked at anything but the job of "keeping house" and raising children, whereas in 1976 that had risen to 54%. Even more dramatic is the fact that the percentage of married women who had preschool children, once considered too young to be without a parent during the day, rose from 13% in 1948 to 37% in 1976.

To measure the production efficiency of the household, five measures are used: (MEDUCAT) mother's education, (FEDUAT) father's education,<sup>24</sup> (LMAG) low mother's age at the time of birth, (FLANG) foreign language spoken in the home and (NOFATH) the absence of the father.

As discussed earlier, the framework rests on the notion that education affects nonmarket productivity; changes in education affect the household's output of the commodity. Michael (1973) argues that since education is positively related to wage rates and, since education is embodied in the individual, if it makes you more productive in the market it could make you more productive in nonmarket activities as well.

Education may also work as a technology variable where the level of managerial skill and the proficiency with which the household purchases and uses market goods, influence the level of efficiency in nonmarket production.

The education of the parent (MEDUCAT, FEDUCAT) is recorded as the highest grade completed in school. The only grades counted are those completed in "regular" school in which persons are given a formal education in graded or private schools, either day or night, full-time or part-time. A "regular" school is defined by HES as "a school that advances a person toward an elementary or high school diploma, or college, university or professional school degree." Education in vocational, trade, or business schools outside the regular system was not counted.

LMAG represents mothers under the age of twenty at the time of their child's birth. Young mothers are less efficient at contracepting and may also then be less efficient at producing health. FLANG is a proxy for cultural differences, taste differences. Families in which a foreign language is used as the primary language spoken in the home, may exhibit differences in

efficiency.

NOFATH indicates the absence of the father. Edwards and Grossman (1983) point to the importance of this variable because the husband's absence is likely to hinder the mother's efficiency. The absence of the father also reduces the amount of time a mother can spend with her children. While DeTray (1973) points out that male time is less important than female time in producing child services, he, the father, is a supplier of market goods and services. It is quite clear that while not reflected in this data set, the role of the father in child rearing has evolved, and is evolving, into an important area for research.<sup>25</sup>

The endowed stock of health the adolescent possesses is represented by variables relating to his or her early health. LIGHT1 and LIGHT2 represent the low birth weight of the subject. Birth weight was obtained from the birth certificate, but since approximately 25 percent of the sample is missing a birth certificate, the observations are not deleted but are also not focused upon. The variable BWUK indicates that the youth was missing a birth certificate. FYPH represents the fact that during the first year the

child had poor health. EARLYH indicates a serious health problem since age one. It must be recognized that these measures are subject to measurement error because they rely on the parents' memories. It is, however, likely that the health of their new-born or young child would be vivid in their minds and not subject to significant error.

HMAG indicates the mother was over thirty-five years old at the time of the birth. Since 1979 more than 155,000 first born children were born to women in their thirties. Since older mothers are more likely to bear children with birth defects, this is an important variable.<sup>26</sup>

There are other characteristics which may or may not be health related but may influence the investment decision of the parents. FIRST represents the birth order of the adolescent while TWIN represents twin status. These variables are included, for first-born or non-twin children may have greater access to their parent's time; parents' attention.

The sex of the child may also alter the parents' investment decision. Thus the variable MALE is used. Maleness may be desired and male children may receive

larger investments. Ben-Porath and Welch (1976) show that the sex of the offspring is of concern to the parent. This is evidenced by the observed demand for methods of controlling the sex of a child. Even if there is no sex concern as a taste component, there may still be different economic costs or benefits associated with boys and girls.<sup>27</sup> Thus the notion of ability to succeed will affect the investment decision. We may also have a bias toward male children based on our own desire for immortality since males carry on the family name.<sup>28</sup>

Information on prices of inputs in the household production function are not given. The use of regional (NEAST, MWEST, SOUTH) and place size (URB1, URB2, URB3, NURB) variables are employed to partially control for these prices. These variables will also control for other regional differences not heretofore in the model. The regional variables are divided as follows: NEAST-Maine, Vermont, New Hampshire, Connecticut, New York, Pennsylvania, New Jersey. MWEST includes Minnesota, Wisconsin, Michigan, Iowa, Missouri, Illinois, Indiana, Ohio. SOUTH is made up of Tennessee, Maryland, Virginia, Kentucky, Delaware, North Carolina,

South Carolina, Georgia, Florida, Alabama, Mississippi, Arkansas, Louisiana.

Family size is represented by the number of people in the household who are under twenty years of age, LESS20. This variable may, in fact, overstate or understate actual completed family size.

Some of the variables mentioned are not the exogenous measures called for in the theory but are, as mentioned, proxies. These proxy variables are in part endogenously determined, which means that they are outcomes of family decision making. MWORKFT, MWORKPT, LIGHT1 and LIGHT2, HMAG, LMAG represent choices made by the family, as well as exogenous components. Family size, LESS20, is endogenous in the model itself. In the theoretical model both family size and health of the offspring are simultaneously determined. Some of the exogenous variables may then not be truly exogenous. Women who plan large families may be less likely to invest in their education; MEDUCAT is not exogenous.

The problems of endogeneity creates a problem of bias in the estimates of the coefficients. This can be avoided with the use of simultaneous equations method of estimation but, given the data, the technique cannot

be used. As Edwards and Grossman (1981) state, in the case of the family size variable, for example, it is very difficult to identify exogenous variables that enter the family size structural equation or the children's health structural equation but not both. So that even if the appropriate data were available, one may not always be able to identify the coefficients.

## FOOTNOTES

<sup>6</sup>National Center for Health Statistics, Quality Control in a National Health Examination Survey, U.S. Department of Health, Education, and Welfare, Public Health Service, Vital and Health Statistics Series 2, no. 44, 1972, p.3.

<sup>7</sup>Ibid., p. 7.

<sup>8</sup>Ibid., p. 14.

<sup>9</sup>This is the definition employed in Linda N. Edwards and Michael Grossman, "Children's Health and the Family," in Volume II of Advances in Health Economics and Health Services Research, ed. Richard M. Scheffler (Greenwich, CT: JAI Press, Inc., 1981).

<sup>10</sup>Ibid.

<sup>11</sup>Sanders (1964) presents an index of health which measures "functional adequacy" as an indicator of the health status, measuring whether an individual is capable of fulfilling the requirements of a social role appropriate to his age-sex. The approach is similar to the economist's approach to health. Sanders' index is calculated over a year and used with information on mortality to create a "modified life table." Sanders uses the table to get "effective life years." Unfortunately it is unclear what constitutes "fulfilling the requirements of a social role."

Another index is Chiang's (1965). This is a weighted average of age-specific components derived from the death rate and a measure of average duration of illness within each age group during a year. While both indices are a better attempt at measuring health than merely looking at mortality, what they should measure is unclear.

<sup>12</sup>With regard to systolic pressure, the direct (intra-arterial) and indirect measurements closely agree. This is not the case with diastolic pressure. The indirect method used here in Cycle III may underestimate intra-arterial diastolic pressure. However, using the point at which the sound first becomes muffled, may produce a similar amount of bias in the opposite direction. National Center for Health

Statistics, Blood Pressure of Youths 12-17 Years, U.S. Department of Health, Education and Welfare, Public Health Service, Vital and Health Statistics, Series 11, No. 163, 1977, p. 3.

<sup>13</sup>Ibid. p. iv.

<sup>14</sup>For further discussion see: V.E. Stimbirt and K.R. Coffey, Obese Children and Adolescents (Knoxville, TN: University of Tennessee, 1972) ERIC no. 30.

<sup>15</sup>For further discussion see: S. Abraham, G. Collins, and M. Nordsleck, "Relationship of Children Weight Status to Morbidity in Adults," Public Health Reports 86 (1971): 273-284, and C.J. Gleuck, R.W. Fallat, and R.A. Tsang, "Pediatric Approach to Atherosclerosis Prevention" in Winnick (1975); G.M. Friedman, "Atherosclerosis and the Pediatrician" in Winnick (1975).

<sup>16</sup>For further discussion see: S.M. Garn and D.C. Clark, "Trends in Fatnes and the Origins of Obesity," Pediatrics, 57: 443-456.

<sup>17</sup>This definition is the one employed by the National Center for Health Statistics. See Series 11, No. 112, 1972.

<sup>18</sup>As pointed out in a footnote in Edwards and Grossman, "Adolescent Health , Family Background, and Preventive Medical Care" in vol. III of Research in Human Capital and Development eds. Asmail Strageldin, David Salkever, and Alan Sorkin (Greenwich, CT: JAI Press, Inc., 1983), Diana Dutton, in a paper presented to the American Public Health Association Meetings in Los Angeles, October 18, 1978 recommends the use of a continuous rather than discrete measure of anemia. Dutton conducted a multiple regression analysis of actual hematocrit levels of black children between the ages of six months and four years. The only statistically significant variables at the 5 percent level were age and sex.

<sup>19</sup>This procedure used in Edwards and Grossman (1983) is based on findings by W.A. Daniel, Jr. that 1) hematocrit values differ by sex; 2) these values depend on sexual maturity rather than age for male adolescents; and 3) hematocrit levels are independent

of age and sexual maturity for female adolescents. See Daniel, Jr., W.A. "Hematocrit: Maturity Relationship in Adolescence." Pediatrics 52, no.3 (September 1973).

It should be noted that NCHS reports hematocrit levels by age for males. The increase in hematocrit in boys reaches a maximum between 14 and 14.5 years of age, the age when many males are experiencing puberty. The reader should consult NCHS Series II, no. 146 (1974).

<sup>20</sup>National Center for Health Statistics, Hematocrit Values of Youths 12-17 Years, U.S. Department of Health, Education and Welfare, Public Health Service, Vital and health Statistics, Series 11, No. 146, p. 2.

<sup>21</sup>Idem, Periodontal Disease Among Youths 12-17 Years No. 141, p. 2.

<sup>22</sup>Ibid., p. 22.

<sup>23</sup>For further discussion see: Edwards and Grossman, "Adolescent Health, Family Background, and Preventive Medical Care" in vol. III of Research in Human Capital and Development eds. Asmail Strageldin, David Salkèver, and Alan Sorkin (Greenwich, CT: JAI Press, Inc., 1983).

<sup>24</sup>The coding here follows the coding of Edwards and Grossman (1983). Since the level of education for the absent father, NOFATH = 1, is unknown, FEDUCAT is coded at the race-specific mean level of father's education in the subsample of youths living with both parents. The assumption here is that father's education has the same relationship with adolescent health whether or not the father is actually present. Alternative coding schemes would alter the coefficient of NOFATH in a multiple regression but would have little or no impact on other coefficients. The most general way to specify the effects of absent fathers and father's schooling on health is

$$1) \quad H = a_0 + a_1 \text{NOFATH} + a_2(1 - \text{NOFATH})(\text{FEDUCAT}) + a_3(\text{NOFATH})(\text{FEDUCAT})$$

This allows for differences in intercepts if the father is absent (given by  $a_1$ ) and differences in slope effects. If  $a_3 = 0$ , then

$$2) \quad H = a_0 + a_1 \text{NOFATH} + a_2(1 - \text{NOFATH})(\text{FEDUCAT})$$

Equation 2 is identical to a regression of H on NOFATH and FEDUCAT\*, where FEDUCAT\* = 0 if the father is absent, and FEDUCAT\* = FEDUCAT if he is present. If  $a_2 = a_3$  then

$$3) \quad H = a_0 + a_1 \text{NOFATH} + a_2 \text{FEDUCAT}$$

Unbiased estimates of 3) can be obtained by coding the education of missing fathers at the mean of education when the father is present, provided the two means are the same.

By fitting 3) rather than 2) one computes the health differential directly as the coefficient of  $a_1$ . If it were assumed that the absent father's education has no effect, it would have been coded at zero.

<sup>25</sup>The changing role of the father, while not reflected in this data set, is a natural outgrowth of the women's movement. An increasing number of fathers are sharing in the daily problems of child rearing. This evolution is the subject of a current study by the Bank Street College of Education, Manhattan. A study by Dr. Kyle Pruett at Yale University found that babies whose fathers stayed home scored way above the norm on standardized tests of development. What distinguished these babies was the amount of attention they received from parents.

<sup>26</sup>S. Venture, "Trends in Vital Statistics," NCHS Monthly Vital Statistics Report. vol. 31 No. 2, Supplement (May 27, 1982).

<sup>27</sup>The inability of his five daughters to contribute to the family income, led Sholem Aleichem's lamenting milkman Tevye, of Fiddler on the Roof fame, to constantly question God's "blessing."

<sup>28</sup>In 1527 Henry VIII announced his desire to divorce his wife, Catherine of Aragon, his brother's widow, on the grounds that the papal dispensation making the marriage possible was invalid. The chief reason for the divorce was Catherine's failure to bear a MALE heir. Her only surviving child was Mary, whose

chances of ascending to the English throne were extremely doubtful. The desire for male progeny lead not only to divorce and the establishment of the Anglican Church, but also to executions, wars and a succession of marriages.

## CHAPTER IV

### RESULTS

The results in this chapter are based on a working sample of youths 12 to 17 years of age who live with both parents or mother only. Excluded are 18 year olds and those with guardians other than their parents or mother only. Cases missing information are also excluded. As previously mentioned, there are so many missing school forms that those cases are only excluded when SCHABS is the health measure under investigation.

#### GROSS RACE DIFFERENCES

The first area of investigation is health differences due to race, when socioeconomic characteristics are not controlled for. This is referred to as the gross race difference. In TABLE 3, the gross race difference for each health and preventive care measure is given. It is the difference between the mean value of the dependent variable for blacks minus the mean value of the dependent variable for whites. This gross race difference is also

TABLE 3

## GROSS RACE DIFFERENCES

Health or Preventive Care Measure	Black Mean (n=568)	White Mean (n=4238)	Gross Difference	t-Ratio	Adjusted t
ABN	0.2711	0.2034	0.0678	3.72	2.76
HDBP	0.0792	0.0535	0.0258	2.50	1.85
OBESE	0.0792	0.1041	-0.0249	-1.85	-1.37
PVIS	0.0669	0.0413	0.0256	2.78	2.06
ANEMIA	0.0282	0.0231	0.0051	0.74	0.55
IDECAV	0.4877	-0.1450	0.6327	15.86	11.75
APERI	0.2100	-0.1100	0.3199	7.91	5.86
PFGHLTH	0.5000	0.2846	0.2154	10.55	7.81
SCHABS	(n=457) 0.0613	(n=3833) 0.0600	0.0013	0.11	0.08
DRPREV	0.5246	0.5867	-0.0621	-2.82	-2.09
DTPREV	0.3996	0.6941	-0.2945	-14.20	-10.52

All calculations are described in the text.

The critical t-ratio at the 5 percent level of significance is 1.96 for a two-tailed test.

represented by the regression coefficient on BLACK, a dichotomous variable equal to one when the youth is black, in the simple regression:

$$H = \beta_0 + \beta_2 \text{BLACK}$$

As TABLE 3 shows, all of the health measures, with the exception of OBESE, have positive gross race differences. In order to make any statement about those differences one must examine the "t" to see if the difference is statistically significant or could have arisen by chance.<sup>29</sup> The "t" reveals that the gross race difference for OBESE, ANEMIA and SCHABS is not significant. In the case of the other measures, ABN, HDBP, PVIS, IDECAY, APERI, PFGHLTH, the black adolescent has significantly poorer health than the white counterpart since each measure is a negative correlate of good health.

The black youths in this working sample have a higher probability of physical abnormalities, high diastolic blood pressure, poor vision, decayed teeth and periodontal disease. Not only does the black adolescent exhibit poorer oral and physical health than

the white youth, the parents assess the health as poorer. While the data do show that the parents assess the health as poorer, they also show that blacks are less likely to take preventive measures. Blacks, at least on first approximation, do not frequent their doctors and dentists as often as do white youths. This is evidenced by the negative sign of the gross race difference, for DRPREV and DTPREV.

The "t" statistic itself deserves closer examination. The "t" statistic generated by the computer assumes that the Cycle III data were collected by use of a simple random sampling technique rather than the multi-cluster sampling procedure actually employed. The true standard errors for Cycle III can be approximated using the results of a Monte Carlo study from Cycle I HES as reported by McCarthy (1969).<sup>30</sup> The use of McCarthy's adjustment causes the previously significant gross race differences for HDBP to no longer be significant. Using the adjustment makes the reliability of statements about the gross race difference for HDBP questionable.

The other health measures, ABN, PVIS, IDECAY, APERI, PFGHLTH and the preventive care measures, DRPREV

and DTPREV still report significant differences by race when the adjustment is used. One can then unambiguously make the statement to the effect that black youths will, on average, have poorer health when these are the correlates of health used.

The gross race difference results for Cycle III are consistent with data on infant mortality and low birth weight which demonstrate that the health status of black infants is deficient with respect to white infants.

#### CHOW TEST

Before additional analyses are conducted it must be determined if it is appropriate to be using a pooled sample (the total working sample) or whether separate regressions must be run for blacks and whites. One uses a Chow test, an F test which will tell the researcher if differences in the slope coefficients for blacks and whites are statistically significant, or attributable to chance. The F statistic is given by the following ratio:

$$F = \frac{(SS_R - SS_U)/R}{SS_U/N_U}$$

$SS_R$  is the sum of squared residuals from the restricted (pooled) equation; the total working sample (i.e. where the null hypothesis is assumed to be true).  $SS_U$  is the sum of squared residuals from the unrestricted equation. It is the sum of the sum of squared residuals from the white-only and black-only regressions.  $N_U$  is the degrees of freedom of residuals in the white-only regression.  $R$  is the number of restrictions;  $N_U$  minus the degrees of freedom of residuals in the pooled regression.  $N_U$  is then equal to the number of independent variables in the working sample regression.

This  $F$  statistic is used to test the null hypothesis that there is homogeneity of slope coefficients by race, which means that all the slope coefficients are statistically the same for a given health measure regardless of the race of the youth. If at least one differs, the null hypothesis is rejected. The Chow Test used here allows the intercept to vary by race so that I am testing the hypothesis, that the slope coefficients, not the intercepts are the same for both races.

"The practical procedure is to fit the restricted model in which the hypothetical equality is imposed, all other coefficients being allowed to vary from class to class, and calculate the corresponding residual sum of squares. The unrestricted model is fitted in which this subset of coefficients is allowed to vary from class to class and the resultant sum of squares is calculated. The equality of the subsets is tested by contrasting the reduction in the residual sum of squares in going from the restricted to the unrestricted model against the unrestricted sum of squares."<sup>31</sup>

TABLE 4 shows that ABN, HDBP, IDECAY, APERI, SCHABS, DRPREV, AND DTPREV have sufficiently high F values such that the null hypothesis of identical slopes can be rejected at a significance level of 0.05. This means that separate regressions must be run for the black and white subsamples. The differences reported for OBESE, PVIS, ANEMIA, and PFGHLTH could have arisen by chance. The set of coefficients used to conduct the F test is the full model where all the explanatory variables are entered into the regression equation.

**TABLE 4**

**CHOW TEST**

Health or Preventive Care Measure	$SS_R$	$SS_U$	$N_U$	R	F
ABN	773.03350	766.53883	4799	25	1.62*
HDBP	255.95898	254.08328	4803	23	1.54*
OBESE	431.45151	428.88293	4799	25	1.15
PVIS	201.27422	199.75566	4799	25	1.46
ANEMIA	111.09745	110.69793	4803	23	1.11
IDECAY	3503.94129	3355.59941	4803	23	9.23*
APERI	3730.39456	3663.65095	4803	23	3.80*
PFGHLTH	910.76683	904.12823	4799	25	1.41
SCHABS	237.28811	234.64318	4238	25	1.91*
DRPREV	1096.22794	1085.58794	4801	24	1.9*
DTPREV	898.52678	890.00665	4801	24	1.92*

All calculations are described in the text.

\* Statistically significant at the 5 percent level of signifiacnce.

### NET RACE DIFFERENCES

Now that more is known about the black and white subsamples, the investigation can be continued. The gross race data (TABLE 3) show, that indeed, differences do exist in the health status of black and white adolescents. But are these differences uniquely attributable to race or can they be explained by a set of socioeconomic factors? To investigate this, one must examine the net race difference, the residual race difference when the full set of socioeconomic variables are held constant. All the explanatory variables listed in TABLE 2, are entered into each multiple regression and the dependent variables under investigation are the health and preventive care measures.

The net race difference (TABLE 5) is calculated differently depending on whether the variable shows slope coefficient differences by race. If there are no significant differences in the slope by race (OBESE, PVIS, ANEMIA, PFGHLTH) the net race difference is given by the regression coefficient on BLACK (the race dummy) from the working sample, full-model equation. In reviewing the results the reader should remember that

TABLE 5

## NET RACE DIFFERENCES

Health or Preventive Care Measure	Gross Race Difference	Net Race Difference
ABN	0.0678*	0.0217
HDBP	0.0258	0.0160
OBESE	-0.0249	-0.0113
PVIS	0.0256*	0.0090
ANEMIA	0.0051	-0.0124
IDECAV	0.6327	0.4767
APERI	0.3199*	0.0796
PFGLTH	0.2154*	0.0870
SCHABS	0.0013	-0.0032
DRPREV	-0.0621*	0.0201
DTPREV	-0.2945	-0.0622

All calculations are described in the text.

The NET RACE DIFFERENCE equals the difference in health levels predicted for blacks and whites assuming that all the explanatory variables are at their mean values for the full working sample. The results of significance tests are not reported due to computational difficulty.

\* Significant GROSS RACE DIFFERENCE, as measured by adjusted t, at 5 percent level of significance.

the gross race difference for OBESSE and ANEMIA is not statistically significant.

When there are significant race difference in the slope coefficients (ABN, HDBP, IDECAY, APERI, SCHABS, DRPREV, DTPREV) the net difference is computed as:

$$\text{NET RACE DIFFERENCE} = (a_B + b_B X) - (a_W + b_W X)$$

where  $a_B$  and  $b_B$  respectively, represent the intercept and vector of slope coefficient estimated using the black subsample, and  $a_W$  and  $b_W$  represent the white subsample intercept and vector of slope coefficients.  $X$  is a vector of means of the explanatory variables for the entire working sample. The net race difference is interpreted as that portion of the gross race difference that would remain if both racial groups had the same mean values of the explanatory variables. For ABN, HDBP, PVIS, IDECAY, APERI, PFGHLTH, and DTPREV the net difference is smaller than the gross. This implies that if both black and white adolescents had the same socioeconomic characteristics, black youths would still be more likely to exhibit the above mentioned health correlates, than would whites. They would also still be

less likely to visit a dentist for a routine check-up. Since the magnitude of the difference has decreased, clearly some of the poorness in health is attributable to factors other than race. The reader should remember that the gross race difference for HDBP is not significant when the adjusted t is used.

The SCHABS coefficient changes signs, from "+" to "-", revealing that blacks may be less likely to be absent from school due to illness if we account for the differences in the socioeconomic characteristics. This should be interpreted in light of the lack of significance of the gross race difference for the SCHABS variable.

The physical health preventive care measure, DRPREV, also shows an opposite relationship from the one reported by the gross race difference. The gross race difference indicates that black youths in the United States are less likely to visit a physician for a preventive check-up than are whites. The net, on the other hand, reveals that if the youths had the same socioeconomic characteristics, blacks would be more likely to practice preventive medicine than their white counterparts.

### GROSS INCOME DIFFERENCES

The gross income differences for the health and preventive care measures are given by the mean value of the dependent variable for the low income sample minus the mean value of the dependent variable for the high income sample. This gross income difference is also computed by a simple regression of health on LFINC where LFINC = 1 if the family's income is less than \$5,000 per year:

$$H = \beta_0 + \beta_1 \text{LFINC}$$

This gross income difference calculated over the entire working sample is given in TABLE 6.

The data show that adolescents from low-income families have, as measured by t, a statistically significant higher incidence of abnormalities, high diastolic blood pressure, poor vision, anemia, poor oral health and absence from school due to illness but are less likely to see a doctor or dentist for preventive care. These results are interesting in light of the fact that the parents also assess the health as

**TABLE 6                      GROSS INCOME DIFFERENCES - Working Sample**

Health or Preventive Care Measure	Mean from Low Income Subsample (n=1970)	Mean from High Income Subsample (n=2881)	Gross Income Difference	t-Ratio	Adjusted t
ABN	0.2426	0.1899	0.0528	4.43	3.28
HDBP	0.0665	0.0496	0.0169	2.50	1.85
OBESE	0.1107	0.0948	0.0159	1.80	1.33
PVIS	0.0579	0.0351	0.0228	3.80	2.81
ANEMIA	0.0315	0.0184	0.0131	2.94	2.18
IDECAY	0.1800	-0.2425	0.4225	16.19	11.99
APERI	0.1182	-0.2029	0.3211	12.24	9.07
PFGHLTH	0.4188	0.2353	0.1834	13.83	10.24
	(n=1647)	(n=2643)			
SCHABS	0.0704	0.0537	0.0167	2.24	1.66
DRPREV	0.5127	0.6251	-0.1124	-7.84	-5.81
DTPREV	0.5010	0.7681	-0.2671	-20.06	-14.86

All calculations are described in the text.  
 The critical t-ratio for the 5 percent level of significance is 1.96 for a two-tailed test.

inferior. Of the health measures which exhibit significant gross income differences, all but ANEMIA and SCHABS also exhibit gross race differences. These results are as one would suspect since income and race are highly correlated. OBESE is neither significantly different by race nor income.

When the adjusted "t" is used for the examination of significance, one finds that HDBP and SCHABS are no longer significant. Statements made with regard to these variables must be interpreted in light of the sample design used in data gathering and cannot be made unambiguously. When the adjustment factor is used there is even greater agreement between the variables that exhibit gross income differences and gross race differences. Only ANEMIA, which exhibits gross income differences does not exhibit significant differences by race. Again, this high degree of agreement is not surprising given the high degree of correlation between race and income.

Gross income differences are also reported by race. Since the Chow test shows differences in some of the coefficients by race, in order to make meaningful comparisons to the net income differences, the gross

income differences are also reported on a race-specific basis. The gross income differences for whites are shown in TABLE 7, while TABLE 8 reports them for black adolescents.

The examination of white adolescents yields predictable results. A white youth who comes from a low-income family is more likely to show deficient health status, except in the case of HDBP where the "t" is not significant. White adolescents are also less likely to get a yearly preventive oral and physical check-up if their family has a low level of income. When the group under examination is restricted to white-only, the gross income difference on OBESE is significant. This significance soon disappears when the adjustment is made for the sample design - OBESE and SCHABS are no longer statistically significant at the 5 percent level. One cannot rule out the possibility that the differences in the health status of white low-high income adolescents, as measured by OBESE and SCHABS, arose by chance.

In the case of black adolescents, the only significant gross income differences are for ABN, HDBP, PFGHLTH, and DTPREV. Black low-income youths are thus,

**TABLE 7                      GROSS INCOME DIFFERENCES - White only**

Health or Preventive Care Measure	Mean from Low Income Subsample (n=1512)	Mean from High Income Subsample (n=2771)	Gross Income Difference	t-Ratio	Adjusted t
ABN	0.2269	0.1905	0.0363	2.82	2.09
HDBP	0.0589	0.0505	0.0083	1.16	0.86
OBESE	0.1190	0.0960	0.0231	2.36	1.75
PVIS	0.0536	0.0346	0.0189	2.98	2.20
ANEMIA	0.0317	0.0184	0.0133	2.78	2.06
IDECAY	0.0735	-0.2642	0.3377	12.82	9.50
APERI	0.0827	-0.2151	0.2979	11.04	8.18
PFGHLTH	0.3836	0.2306	0.1530	10.74	7.96
SCHABS	(n=1278) 0.0720	(n=2555) 0.0540	0.0180	2.44	1.81
DRPREV	0.5126	0.6272	-0.1146	-7.33	-5.43
DTPREV	0.5377	0.7795	-0.2418	-16.95	-12.56

All calculations are described in the text.  
 The critical t-ratio for the 5 percent level of significance is 1.96 for a two-tailed test.

**TABLE 8**                      **GROSS INCOME DIFFERENCES - Black only**

Health or Preventive Care Measure	Mean from Low Income Subsample (n=458)	Mean from High Income Subsample (n=110)	Gross Income Difference	t-Ratio	Adjusted t
ABN	0.2948	0.1727	0.1220	2.60	1.93
HDBP	0.0917	0.0273	0.0644	2.26	1.67
OBESE	0.0830	0.0636	0.0193	0.67	0.50
PVIS	0.0721	0.0455	0.0265	1.00	0.74
ANEMIA	0.0306	0.0182	0.0124	0.70	0.52
IDECAV	0.5318	0.3044	0.2274	1.75	1.30
APERI	0.2352	0.1049	0.1303	1.01	0.75
PFGHLTH	0.5349	0.3545	0.1804	3.43	2.54
SCHABS	(n=369) 0.0650	(n=88) 0.0455	0.0195	0.94	0.70
DRPREV	0.5131	0.5727	-0.0596	-1.12	-0.83
DTPREV	0.3799	0.4818	-0.1019	-1.96	-1.45

All calculations are described in the text.  
 The critical t-ratio for the 5 percent level of significance is 1.96 for a two-tailed test.

more likely to exhibit more abnormalities and high blood pressure than are high-income black youths. They are also less likely to seek preventive oral care. Yet the gross income difference data for blacks indicates no significant difference with regard to the oral health measures. Preventive dental visits may not be the primary factor in determining good oral health; oral healthiness being produced primarily in the home.

The use of the adjusted "t" for the black subsample reduces the number of significant variables to one, PFGHLTH, the parents' assessment. Income then, doesn't appear to explain the variation in black health. The results indicate that although the health of the low-income adolescent is not statistically different from the high-income black adolescent, low-income parents perceive it as deficient.

#### NET INCOME DIFFERENCES

Since there are many other factors which affect health, they need to be controlled for in order to measure differences in health due to income, net of socioeconomic and cultural factors. The net income differences are calculated in a manner similar to the

method used for the net race differences. If there are no significant race differences in the slope coefficients the net income difference can be calculated as:

$$HL - HH = a_2(\overline{YL} - \overline{YH})$$

where HH is the value of the health or preventive care measure for the high income subsample (income greater than to equal to \$5,000 per year) and HL is the value of the health or preventive care measure for the low income subsample;  $a_2$  is the regression coefficient on the family's income, calculated over the entire working sample;  $\overline{YH}$  is the mean income value in the high income subsample and  $\overline{YL}$  is the mean income value in the low income subsample.<sup>32</sup>

If there are significant slope differences by race, then the net income difference (as was the case with the gross income difference) is calculated for the black and white youths separately. The net income differences for whites is given by:

$$HL_W - HH_W = a_2^W(\overline{YL}_W - \overline{YH}_W)$$

The corresponding equation for blacks is:

$$HL_B - HH_B = a_2^B (\overline{YL}_B - \overline{YH}_B)$$

where  $a_2^W$  and  $a_2^B$  are the coefficients on the income measure obtained from a regression of the respective white and black subsamples.

TABLE 9 reports the findings for white adolescents. Of those variables that have significant gross income differences (measured by t) ABN, OBESE, PVIS, IDECAY, APERI, PFGHLTH, SCHABS, DRPEV, and DTPREV, the income difference when the full set of socioeconomic characteristics are held constant, is greatly diminished. If the adjustment is used the reader should remember the gross income differences of OBESE and SCHABS are not significant.

The net income differences for the black subsample is reported in TABLE 10. For those with statistically significant gross income differences (measured by t) ABN, HDBP, PFGHLTH, and DTPREV show a reduction in the magnitude of the effect of income on the above mentioned health or preventive care measures.

TABLE 9

## NET INCOME DIFFERENCES - White only

Health or Preventive Care Measure	Gross Income Difference	Net Income Difference	Ratio of Net to Gross
ABN	0.0363*	0.0187	0.52
HDBP	0.0083	0.0142	1.71
OBESE	0.0231	0.0166	0.72
PVIS	0.0189*	0.0081	0.43
ANEMIA	0.01333*	0.0059	0.44
IDECAY	0.3377*	0.1120	0.33
APERI	0.2979*	0.0619	0.21
PFGHLTH	0.1530*	0.0513	0.34
SCHABS	0.0180	0.0207	1.15
DRPREV	-0.1146*	-0.0385	0.34
DTPREV	-0.2418*	-0.0961	0.40

All calculations are described in the text.

The NET INCOME DIFFERENCE equals the difference in health levels for low income whites assuming that all the explanatory variables are at their mean levels for the white sample. The results of significance tests are not reported due to computational difficulty.

\*Significant GROSS INCOME DIFFERENCE, as measured by adjusted t, at 5 percent level of significance.

TABLE 10

## NET INCOME DIFFERENCES - Black only

Health or Preventive Care Measure	Gross Income Difference	Net Income Difference	Ratio of Net to Gross
ABN	0.1220	0.1008	0.83
HDBP	0.0644	0.0275	0.43
OBESE	0.0193	0.0455	2.36
PVIS	0.0265	-0.0187	-0.71
ANEMIA	0.0124	0.0171	1.38
IDECAY	0.2274	0.1586	0.70
APERI	0.1303	0.0262	0.20
PFGHLTH	0.1804*	-0.0992	-0.55
SCHABS	0.0195	0.0513	2.68
DRPREV	-0.0596	-0.0247	0.41
DTPREV	-0.1019	0.0453	-0.44

All calculations are described in the text.

The NET INCOME DIFFERENCE equals the difference in health levels predicted for low income whites assuming that all the explanatory variables are at their mean levels for the white sample. The results of significance tests are not reported due to computational difficulty.

\*Significant GROSS INCOME DIFFERENCE, as measured by adjusted t, at 5 percent level of significance.

The sign changes on the parents' assessment variable and on the utilization measure indicate that when the socioeconomic variables are held constant lower income blacks are less likely to rate the adolescent's health as poor-fair-good and more likely to seek preventive dental care than are high income blacks. If the adjustment factor is used PFGHLTH is the only measure with a significant gross income difference.

#### **ANALYSIS OF WHITE ADOLESCENTS**

The black subsample is too small for reliable results so only the health of white adolescents is studied further. TABLES 12 - 22 report the OLS estimates for the multiple regressions of the nine health measures and the two preventive care measures for the white-only subsample. This allows estimation of a health production function for each health measure and a derived demand function for each care measure because of the dichotomous nature of the measures, for a discussion of changes in the conditional probability of poor health or receipt of preventive care for a one-unit change in the explanatory variable. The dependent and independent variables are the same as

those used earlier, and are reproduced in TABLES 11A and 11B, giving the means and standard deviations.

If the correlations among the independent or explanatory variables are zero it is possible to state unambiguously the portion of the variance in the dependent variable accounted for by each of the independent variables. Ideally, whatever variance is shared should be taken out so it is not redundant. Kerlinger and Pedhauer (1973) regard the assessment of the relative contributions of independent variables as a "shaky and undependable business." I am fully aware of the correlations and given that, proceed with caution.

#### ABN

As TABLE 12 shows, the variables that are significant are MEDUCAT, NOFATH, MALE, AGE, HMAG, FYPH, LIGHT2, EARLYH, and DRPREV. The mother's education has the expected sign(-) indicating that adolescents with more highly educated mothers have a little over one half percentage point smaller probability of having abnormalities. The absence of the father also contributes to the health (or lack thereof) of the

**TABLE 11A**  
**HEALTH AND PREVENTIVE CARE MEASURES**

<b>VARIABLE NAME</b>	<b>MEAN</b>	<b>STANDARD DEVIATION</b>
<b>ABN</b>	<b>0.203</b>	<b>0.403</b>
<b>HDBP</b>	<b>0.054</b>	<b>0.225</b>
<b>OBESE</b>	<b>0.104</b>	<b>0.306</b>
<b>PVIS</b>	<b>0.041</b>	<b>0.200</b>
<b>ANEMIA</b>	<b>0.023</b>	<b>0.150</b>
<b>IDECAY</b>	<b>-0.145</b>	<b>0.840</b>
<b>APERI</b>	<b>-0.114</b>	<b>0.857</b>
<b>PFGHLTH</b>	<b>0.285</b>	<b>0.451</b>
<b>SCHABS</b>	<b>0.060</b>	<b>0.238</b>
<b>DRPREV</b>	<b>0.588</b>	<b>0.492</b>
<b>DTPREV</b>	<b>0.697</b>	<b>0.460</b>

TABLE 11B

## EXPLANATORY VARIABLES

VARIABLE NAME	MEAN	STANDARD DEVIATION
FINC	9.614	5.112
FEDUCAT	11.327	3.227
MEDUCAT	11.142	2.843
NOFATH	0.099	0.299
FLANG	0.139	0.347
NEAST	0.253	0.435
MWEST	0.291	0.454
SOUTH	0.203	0.402
URB1	0.193	0.395
URB2	0.132	0.339
URB3	0.194	0.396
NORB	0.146	0.353
MALE	0.528	0.499
FIRST	0.498	0.500
AGE	14.335	1.663
TWIN	0.023	0.150
HMAG	0.096	0.294
LMAG	0.077	0.267
FYPH	0.117	0.321
EARLYH	0.123	0.329
LIGHT1	0.010	0.098

TABLE 11B continued

VARIABLE NAME	MEAN	STANDARD DEVIATION
LIGHT2	0.032	0.177
BWUK	0.245	0.430
LESS20	3.360	1.853
MWORKFT	0.268	0.441
MWORKPT	0.154	0.361

TABLE 12

Ordinary Least Squares Estimate of ABN  
Production Function<sup>a</sup>

Independent Variable	Regression Coefficient	t-Ratio
FINC	-0.002	-1.62
FEDUCAT	-0.002	-0.70
MEDUCAT	-0.006	-2.09
NOFATH	0.045	2.05
FLANG	-0.028	-1.49
NEAST	-0.027	-1.51
MWEST	0.011	0.66
SOUTH	0.031	1.61
URB1	0.027	1.42
URB2	-0.026	-1.27
URB3	0.039	2.20
NURB	0.034	1.74
MALE	0.027	2.18
FIRST	-0.008	-0.61
AGE	0.011	2.80
TWIN	0.002	0.05
HMAG	0.046	2.13
LMAG	-0.014	-0.59
FYPH	0.040	2.07
LIGHT1	0.035	0.50

TABLE 12 continued

Independent Variable	Regression Coefficient	t-Ratio
LIGHT2	0.069	1.85
BWUK	-0.028	-1.95
EARLYH	0.151	7.99
LESS20	-0.004	-1.02
MWORKFT	-0.011	-0.72
MWORKPT	-0.010	-0.41
DRPREV	0.054	4.25
CONSTANT	0.098	
Adjusted R <sup>2</sup>	0.035	
F	7.15 <sup>b</sup>	

<sup>a</sup>The critical t-ratios at the 5 percent level of significance are 1.64 for a one-tailed test and 1.96 for a two-tailed test.

<sup>b</sup>Statistically significant at the 1 percent level of significance.

child. Offspring with no father are about one half percentage point more likely to have abnormalities than youths from a two-parent household. This may be explained in terms of mother's time. When two parents are in the household the mother may be able to devote more time, or focus more attention on the adolescent since there is someone else in the household to share the other responsibilities.

Youths with low birth weight, higher mother's age, and health problems in earlier years, have higher probabilities for them to have abnormalities. The findings are as expected; suggested by the literature. The results also reveal that male adolescents have a higher probability of the doctor finding a significant abnormality. Age is also positively related to abnormalities, which indicates that as the adolescent ages there is a higher probability that he or she will have an abnormality.

The coefficient on DRPREV shows a relationship opposite of that which is expected. While the result can be written off to multicollinearity problems, perhaps there may be more interesting interpretations. Youths who saw a doctor in the last year for a

preventive care check-up are more likely to show abnormalities. The problems that arise here involve the fact that indeed, some curative care takes place during a routine check-up thought to be preventive in nature. If children with abnormalities visit the doctor more regularly, the distinction to the parent between preventive and curative may be, at best, cloudy. The interpretation of this variable may prove more difficult than anticipated.

#### HDBP

Here, in the case of HDBP (TABLE 13), fewer variables are significant in explaining high diastolic blood pressure among white adolescents. FINC, FIRST, TWIN, LMAG are significant. Youths from higher income families are therefore less likely to be hypertensive. This may be explained by improved diet, greater recreation opportunities and perhaps reduced stress in those families. The first born have a 1.6 percentage point higher probability of having higher blood pressure than other siblings. This may be explained by the stressful role that often confronts the first-born, or it may be that parents are less efficient with the

TABLE 13

Ordinary Least Squares Estimate of HDBP  
Production Function<sup>a</sup>

Independent Variable	Regression Coefficient	t-Ratio
FINC	-0.002	-2.19
FEDUCAT	0.002	1.15
MEDUCAT	-0.001	-0.68
NOFATH	-0.007	-0.53
FLANG	0.016	1.46
NEAST	0.007	0.73
MWEST	0.017	1.78
SOUTH	0.006	0.53
URB1	0.020	1.81
URB2	0.030	0.25
URB3	0.005	0.50
NURB	-0.019	-1.71
MALE	-	-
FIRST	0.016	2.14
AGE	-	-
TWIN	0.038	1.63
HMAG	-0.009	-0.75
LMAG	-0.027	-2.03
FYPH	-0.011	-1.01
LIGHT1	-0.021	-0.59

TABLE 13 continued

Independent Variable	Regression Coefficient	t-Ratio
LIGHT2	-0.014	-0.71
BWUK	0.007	0.85
EARLYH	0.015	1.43
LESS20	-0.004	-1.90
MWORKFT	0.011	1.28
MWORKPT	-0.008	-0.53
DRPREV	-0.007	-1.04
CONSTANT	0.061	
Adjusted R <sup>2</sup>	0.006	
F	2.08 <sup>b</sup>	

<sup>a</sup>The critical t-ratios at the 5 percent level of significance are 1.64 for a one-tailed test and 1.96 for a two-tailed test.

<sup>b</sup>Statistically significant at the 1 percent level of significance.

first child than with the subsequent offspring. The learning process allows parents to correct all the mistakes made with child number one.

Twins also exhibit higher probability of hypertension. This can be explained in terms of the parent's time divided between the two children and the psychological costs incurred by some twins in dealing with their "twinness."

The sign on LMAG is again negative, which is not in keeping with the results theory predicts. The variable LESS20 has the opposite sign, also, but offers the researcher evidence that perhaps, as will be seen with OBESE, youths from large families are, in some instances, "healthier." A great deal of hypertension in adolescence is, in fact, related to obesity. If the youth is less likely to be obese, there is a very good chance that the youth will also be less likely to be hypertensive. As the reader can see, MALE and AGE have been removed from the set of variables. This was done because HDBP is a sex-age adjusted measure.

#### **OBESE**

The OLS estimate of the production function for

OBESE is given in TABLE 14. Adolescents, whose mothers are more educated, are 0.4 percentage points less likely to be obese. Since this variable, OBESE, captures nutrition, more educated mothers are more aware of the components of a well-balanced diet, the problems associated with adolescent obesity, and the importance of exercise for their child. Adolescents who had early health problems are shown here to have a higher probability of obesity. This may be related to restricted activity, medication, or indulgence by the parents.

The family size variable, LESS20, has a perverse sign in the obesity equation. Here, as with HDBP, children from larger families are healthier; children from lower income families are shown less likely to be obese. The negative sign on LESS20 and the positive coefficient on FINC may be explained, as Edwards and Grossman (1983) point out, in terms of a joint production function among various aspects of quality, so that families with fewer children or higher income may consume more rich and caloric foods. This consumption may raise some aspects of quality, but at the same time may contribute to the problems of

TABLE 14

Ordinary Least Squares Estimate of OBESE  
Production Function<sup>a</sup>

Independent Variable	Regression Coefficient	t-Ratio
FINC	-0.0002	-0.18
FEDUCAT	0.0001	0.06
MEDUCAT	-0.004	-1.91
NOFATH	0.029	1.71
FLANG	0.010	0.67
NEAST	0.038	2.75
MWEST	0.037	2.90
SOUTH	-0.019	-1.29
URB1	-0.015	-1.00
URB2	0.015	0.96
URB3	-0.010	-0.76
NURB	0.018	1.19
MALE	-0.051	-5.46
FIRST	0.020	1.88
AGE	-0.002	-0.75
TWIN	0.005	0.15
HMAG	0.018	1.12
LMAG	0.016	0.89
FYPH	-0.008	-0.54
LIGHT1	-0.001	0.00

TABLE 14 continued

Independent Variable	Regression Coefficient	t-Ratio
LIGHT2	-0.010	-0.36
BWUK	0.0004	0.00
EARLYH	0.039	2.67
LESS20	-0.008	-2.72
MWORKFT	0.001	0.11
MWORKPT	-0.024	-1.23
DRPREV	0.003	0.34
CONSTANT	0.199	
Adjusted R <sup>2</sup>	0.017	
F	3.87 <sup>b</sup>	

<sup>a</sup>The critical t-ratios at the 5 percent level of significance are 1.64 for a one-tailed test and 1.96 for a two-tailed test.

<sup>b</sup>Statistically significant at the 1 percent level of significance.

adolescent obesity. Male adolescents are also less likely to be rated obese by the physician. Perhaps this is related to growth and maturation factors, or the level of relative physical activity. As with HDBP, OBESE is unaffected by preventive pediatric care.

#### **PVIS**

The regression coefficients, reveal very little about the impact of the variables on PVIS since so few are significant. Youths, in whose homes a foreign language is spoken are, as shown in TABLE 15, to be 2 percentage points more likely to have poor vision. This variable might explain cultural attitudes toward the wearing of glasses. Since males are also less likely to have poor vision, it could also reflect a concept of beauty or attractiveness. Fragile self image may lead the adolescent to disguise the need for glasses, or if detected, prevent her from wearing them as instructed.

Another possible explanation has to do with the detection of the poor vision. If the adolescent is not fluent in English, that child's inability to perform in school, etc. will, in many cases, be explained away in terms of a language problem without further

TABLE 15

Ordinary Least Squares Estimate of PVIS  
Production Function<sup>a</sup>

Independent Variable	Regression Coefficient	t-Ratio
FINC	-0.001	-1.35
FEDUCAT	-0.001	-1.06
MEDUCAT	0.0007	0.50
NOFATH	0.005	0.50
FLANG	0.020	2.12
NEAST	-0.0004	-0.04
MWEST	0.014	1.66
SOUTH	0.012	1.22
URB1	0.002	0.18
URB2	0.012	1.18
URB3	-0.006	-0.66
NURB	-0.007	-0.75
MALE	-0.025	-4.05
FIRST	0.006	0.81
AGE	-0.008	-4.23
TWIN	0.018	0.86
HMAG	0.0001	0.00
LMAG	-0.011	-0.91
FYPH	0.005	0.52
LIGHT1	-0.020	-0.84

TABLE 15 continued

Independent Variable	Regression Coefficient	t-Ratio
LIGHT2	-0.100	-0.73
BWUK	-0.013	-2.39
EARLYH	0.012	1.22
LESS20	0.006	2.95
MWORKFT	0.003	0.37
MWORKPT	-0.004	-0.31
DRPREV	-0.0007	-1.08
CONSTANT	0.161	
Adjusted R <sup>2</sup>	0.012	
F	3.23 <sup>b</sup>	

<sup>a</sup>The critical t-ratios at the 5 percent level of significance are 1.64 for a one-tailed test and 1.96 for a two-tailed test.

<sup>b</sup>Statistically significant at the 1 percent level of significance.

investigation, so that the child's vision problem goes undetected, therefore uncorrected.

The sign on LESS20 is as expected. If the child comes from a large family he is more likely to have poor vision. This, of course, is related to the mother's time spent with the child and the subsequent lack of time possible to detect the vision problem. Preventive medical care also proves to have no significant impact on the probability that the youth will have vision worse than 20/40.

#### **ANEMIA**

As with the other health measures mentioned so far, few, in fact only two, variables provide significant explanation of their impacts on ANEMIA - MEDUCAT and LESS20 (TABLE 16). Children of more educated mothers are 2 percentage points less likely to be anemic, since more educated mothers know more about proper nutrition and are able to prevent the onset of anemia. The larger the family the more likely it is the youth will be anemic. This may reflect diet/nutrition, as well as the allocation of the mother's time to her children.

TABLE 16

Ordinary Least Squares Estimate of ANEMIA  
Production Function<sup>a</sup>

Independent Variable	Regression Coefficient	t-Ratio
FINC	-0.001	-1.39
FEDUCAT	-0.001	-0.65
MEDUCAT	-0.002	-2.08
NOFATH	0.006	0.73
FLANG	0.001	0.08
NEAST	-0.010	-1.50
MWEST	-0.008	-1.24
SOUTH	0.002	0.30
URB1	0.008	1.10
URB2	0.011	1.46
URB3	0.016	2.43
NURB	0.014	1.91
MALE	-	-
FIRST	0.002	0.42
AGE	-	-
TWIN	-0.024	-1.56
HMAG	0.0003	0.04
LMAG	0.004	0.47
FYPH	-0.0003	-0.04
LIGHT1	-0.020	-0.84

TABLE 16 continued

Independent Variable	Regression Coefficient	t-Ratio
LIGHT2	-0.010	-0.73
BWUK	-0.013	-2.39
EARLYH	-0.008	-1.18
LESS20	0.003	2.34
MWORKFT	0.002	0.34
MWORKPT	-0.011	-1.12
DRPREV	0.002	0.46
CONSTANT	0.046	
Adjusted R <sup>2</sup>	0.006	
F	2.24 <sup>b</sup>	

<sup>a</sup>The critical t-ratios at the 5 percent level of significance are 1.64 for a one-tailed test and 1.96 for a two-tailed test.

<sup>b</sup>Statistically significant at the 1 percent level of significance.

Preventive care, as with other physical health measure, is not significant in producing (preventing) anemia. In the case of anemia perhaps the healthiness is then produced primarily in the home by the mother and not by the market medical input of preventive care. Since ANEMIA is adjusted for age and sex, those variables are not entered into the regression.

#### IDECAF

There are many more significant variables in the IDECAF production function than in the production function of the physical health measures. The most striking result (TABLE 17) is the very large impact prevention, DTPREV, has on the decay index. The adolescents who did not visit the dentist for a check-up in the last year have decay scores that are 0.3 of a standard deviation worse than adolescents who received preventive care.

The parents' education, family income, family size, foreign language, labor force participation by the mother, birth weight and infant health are all significant, so that children of more educated parents have less decayed teeth, as do children from families

TABLE 17

Ordinary Least Squares Estimate of IDECAY  
Production Function<sup>a</sup>

Independent Variable	Regression Coefficient	t-Ratio
FINC	-0.014	-4.68
FEDUCAT	-0.013	-2.59
MEDUCAT	-0.026	-4.41
NOFATH	0.145	3.29
FLANG	-0.193	-5.10
NEAST	0.281	7.88
MWEST	0.145	4.31
SOUTH	0.160	4.20
URB1	-0.071	-1.89
URB2	-0.024	-0.58
URB3	-0.128	-3.64
NURB	-0.099	-2.54
MALE	-	-
FIRST	-0.015	-0.58
AGE	-	-
TWIN	0.105	1.28
HMAG	-0.041	-0.95
LMAG	-0.033	-0.69
FYPH	-0.080	-2.08
LIGHT1	-0.130	-0.91

TABLE 17 continued

Independent Variable	Regression Coefficient	t-Ratio
LIGHT2	0.123	1.73
BWUK	0.063	2.08
EARLYH	-0.059	-1.56
LESS20	0.023	2.96
MWORKFT	0.079	2.64
MWORKPT	0.040	0.78
DTPREV	-0.277	-9.70
CONSTANT	0.460	
Adjusted R <sup>2</sup>	0.107	
F	23.27 <sup>b</sup>	

<sup>a</sup>The critical t-ratios at the 5 percent level of significance are 1.64 for a one-tailed test and 1.96 for a two-tailed test.

<sup>b</sup>Statistically significant at the 1 percent level of significance.

with higher incomes. Children with either low birth weight, poor infant health, large families, or full-time working mothers are more likely to have poorer health as measured by the decay index. The perverse sign on FLANG is most likely the result of multicollinearity. AGE and MALE have also been eliminated from this regression, and for the following APERI regression.

#### APERI

As with IDECAY, the most notable result is the large impact that preventive dentist visits, DTPREV, has on APERI (TABLE 18). Youths who did not see a dentist for prevention have periodontal indices that are 2.5 of a standard deviation worse. Family income and the parents' educational achievement are significant in explaining APERI. FINC, MEDUCAT, and FEDUCAT all have the predicted impact. Children of more educated parents have lower periodontal indices, as do children of higher income families. The impact of LESS20, family size, is also as expected: lower oral health, as measured by the periodontal index, if they come from large families.

TABLE 18

Ordinary Least Squares Estimate of APERI  
Production Function<sup>a</sup>

Independent Variable	Regression Coefficient	t-Ratio
FINC	-0.008	-2.55
FEDUCAT	-0.018	-3.34
MEDUCAT	-0.028	-4.57
NOFATH	0.041	0.90
FLANG	-0.068	-1.70
NEAST	0.046	1.23
MWEST	-0.089	-2.54
SOUTH	-0.036	-0.90
URB1	0.011	0.28
URB2	0.030	0.70
URB3	-0.065	-1.80
NURB	-0.012	-0.30
MALE	-	-
FIRST	-0.012	-0.43
AGE	-	-
TWIN	0.017	0.19
HMAG	0.035	0.78
LMAG	-0.010	-0.21
FYPH	0.041	1.03
LIGHT1	0.034	0.22

TABLE 18 continued

Independent Variable	Regression Coefficient	t-Ratio
LIGHT2	-0.007	-1.05
BWUK	0.012	0.45
EARLYH	-0.036	-0.91
LESS20	0.032	4.00
MWORKFT	0.037	1.21
MWORKPT	0.010	0.18
DTPREV	-0.250	-8.46
CONSTANT	0.570	
Adjusted R <sup>2</sup>	0.075	
F	16.05 <sup>b</sup>	

<sup>a</sup>The critical t-ratios at the 5 percent level of significance are 1.64 for a one-tailed test and 1.96 for a two-tailed test.

<sup>b</sup>Statistically significant at the 1 percent level of significance.

## **PFGHLTH**

It is clear from examining the regression coefficients so far that the concept of health has a socioeconomic, as well as, a biological component. TABLE 19 reveals that higher income or more educated parents have a higher probability of rating the health of their child as good or excellent. Parents also rated the health of male children higher, where males are 4 percentage points less likely to be viewed in poorer health. Health problems in the early life of the child and low birth weight also have a negative impact on the parental assessment of the adolescent's health.

Children from larger families are also more likely to be rated in poorer health. They have about a 1 percentage point higher probability of being rated in poorer health than children from smaller families. The preventive care measure is significant and shows that children who visited a doctor for prevention are less likely to be rated "poor-fair-good." The parents who take their child for a preventive check-up may have more information to make the assessment or assume that since the youth went to the doctor he is healthier.

TABLE 19

Ordinary Least Squares Estimate of PFGHLTH  
Production Function<sup>a</sup>

Independent Variable	Regression Coefficient	t-Ratio
FINC	-0.006	-3.99
FEDUCAT	-0.014	-4.94
MEDUCAT	-0.017	-5.42
NOFATH	0.002	0.06
FLANG	-0.004	-0.21
NEAST	-0.044	-2.29
MWEST	-0.015	-0.83
SOUTH	0.054	2.65
URB1	0.019	0.95
URB2	0.010	0.46
URB3	0.030	1.61
NURB	0.031	1.46
MALE	-0.039	-2.95
FIRST	0.004	0.29
AGE	0.006	1.49
TWIN	-0.047	-1.06
HMAG	-0.022	-0.96
LMAG	-0.041	-1.58
FYPH	0.048	2.33
LIGHT1	-0.038	-0.56

TABLE 19 continued

Independent Variable	Regression Coefficient	t-Ratio
LIGHT2	0.075	2.01
BWUK	-0.006	-0.39
EARLYH	0.265	12.95
LESS20	0.011	2.72
MWORKFT	-0.003	-0.17
MWORKPT	-0.020	-0.73
DRPREV	-0.026	-1.90
CONSTANT	0.526	
Adjusted R <sup>2</sup>	0.102	
F	20.61 <sup>b</sup>	

<sup>a</sup>The critical t-ratios at the 5 percent level of significance are 1.64 for a one-tailed test and 1.96 for a two-tailed test.

<sup>b</sup>Statistically significant at the 1 percent level of significance.

## SCHABS

The regression of SCHABS on the explanatory variables reveals both expected and unexpected results (TABLE 20). The data show that adolescents are less likely to be absent from school if the family's income is higher, the mother is more educated or is older, the family is large, the youth is male, or a foreign language is spoken in the home, while the probability a youth will be absent from school due to illness rises with the age of the youth. These results reflect cultural and societal attitudes of not only school, but of healthiness. More educated mothers can discern the difference between illnesses that require absence from school and are also better at preventing the onset of illness in the first place. It may also be that the attitude of the child in the higher income family toward school is different. Even if he, or she, is not feeling well he may desire to attend school because of the psychic benefits derived from a nice school and good courses, etc. In lower income areas perhaps the atmosphere is poor in school so the child uses the illness as an excuse to stay out of school.

If the parent reported there were problems early

TABLE 20

Ordinary Least Squares Estimate of SCHABS  
Production Function<sup>a</sup>

Independent Variable	Regression Coefficient	t-Ratio
FINC	-0.003	-2.85
FEDUCAT	0.001	0.86
MEDUCAT	-0.006	-3.42
NOFATH	0.006	0.46
FLANG	-0.036	-3.06
NEAST	-0.006	-0.54
MWEST	0.006	0.57
SOUTH	0.003	0.28
URB1	0.019	1.64
URB2	-0.004	-0.30
URB3	0.018	1.65
NURB	0.015	0.96
MALE	-0.020	-2.63
FIRST	-0.007	-0.85
AGE	0.008	3.38
TWIN	-0.014	-0.54
HMAG	-0.040	-2.91
LMAG	-0.004	-0.25
FYPH	0.002	0.14
LIGHT1	-0.003	-0.06

TABLE 20 continued

Independent Variable	Regression Coefficient	t-Ratio
LIGHT2	-0.006	-0.25
BWUK	0.00	-0.47
EARLYH	0.038	3.23
LESS20	-0.004	-1.82
MWORKFT	0.016	1.72
MWORKPT	0.004	0.24
DRPREV	0.026	3.30
CONSTANT	0.029	
Adjusted R <sup>2</sup>	0.018	
F	3.825 <sup>b</sup>	

<sup>a</sup>The critical t-ratios at the 5 percent level of significance are 1.64 for a one-tailed test and 1.96 for a two-tailed test.

<sup>b</sup>Statistically significant at the 1 percent level of significance.

in childhood or if the mother works full-time, the child is more likely to be absent excessively from school due to illness. The preventive care component, DRPREV, indicates that those students who visited a doctor for prevention were excessively absent from school. The justification for the sign is not easy to establish. It may be due to the curative-preventive distinction problem or multicollinearity.

#### **DRPREV**

The family characteristics tend to be much stronger in the derived demand function for preventive pediatric care, DRPREV, than in the physical health production functions (TABLE 21). With the exception of MWORKFT and MWORKPT the other family variables have significant and predicted impacts on the probability of the youth visiting a doctor for prevention. If the families have higher incomes, or the parents are more highly educated, then the youth is more likely to obtain preventive care. If the youth is male or first born the probability is higher that preventive care is received. If the family is large, he is less likely to do so. The coefficient on EARLYH reveals that if the

TABLE 21

Ordinary Least Squares Estimate of DRPREV  
Demand Function<sup>a</sup>

Independent Variable	Regression Coefficient	t-Ratio
FINC	0.005	2.76
FEDUCAT	0.013	4.25
MEDUCAT	0.009	2.56
NOFATH	-0.066	-2.49
FLANG	0.022	0.98
NEAST	0.075	3.55
MWEST	-0.037	-1.81
SOUTH	-0.012	-0.54
URB1	0.030	1.33
URB2	0.053	2.16
URB3	0.004	0.17
NURB	-0.035	-1.51
MALE	0.068	4.63
FIRST	0.060	3.68
AGE	0.005	1.07
TWIN	-0.007	-0.14
HMAG	-0.049	-1.93
LMAG	-0.029	-1.01
FYPH	0.027	1.17
LIGHT1	-0.036	-0.44

TABLE 21 continued

Independent Variable	Regression Coefficient	t-Ratio
LIGHT2	0.050	1.12
BWUK	0.001	0.10
EARLYH	0.103	4.55
LESS20	-0.017	-3.68
MWORKFT	0.018	1.00
MWORKPT	0.040	1.31
CONSTANT	0.188	
Adjusted R <sup>2</sup>	0.069	
F	14.240 <sup>b</sup>	

<sup>a</sup>The critical t-ratios at the 5 percent level of significance are 1.64 for a one-tailed test and 1.96 for a two-tailed test.

<sup>b</sup>Statistically significant at the 1 percent level of significance.

child had early health problems he is more likely to visit the doctor on a yearly basis. The absence of the father, NOFATH, also decreases the probability that the youth will receive preventive pediatric care.

#### **DTPREV**

In the case of the preventive dentist visit, DTPREV, TABLE 22 shows all six of the family variables to be significant. Children from families with higher incomes, more educated parents, or with mothers who work part-time, have a higher probability of receiving preventive oral care. Youths from larger families or where the mother works full-time are less likely to visit a dentist yearly for a check-up visit.

The regression coefficient on LMAG is also significant, revealing that youths with younger mothers are less likely to visit a dentist yearly for a preventive examination. This reinforces the belief that younger mothers may be less efficient at producing good health. Clearly this preventive care measure has a large impact on APERI and IDECAY, so that if the mother does not demand the medical care, then higher APERI and IDECAY could possibly result.

TABLE 22

Ordinary Least Squares Estimate of DTPREV  
Demand Function<sup>a</sup>

Independent Variable	Regression Coefficient	t-Ratio
FINC	0.012	7.68
FEDUCAT	0.009	3.18
MEDUCAT	0.025	8.13
NOFATH	-0.023	-0.96
FLANG	-0.030	-1.48
NEAST	0.074	3.89
MWEST	0.045	2.50
SOUTH	-0.010	-0.48
URB1	0.022	1.06
URB2	0.027	1.24
URB3	0.019	1.02
NURB	-0.012	-0.56
MALE	-0.024	-1.87
FIRST	0.003	0.20
AGE	-0.007	-1.61
TWIN	0.021	0.47
HMAG	-0.026	-1.11
LMAG	-0.070	-2.74
FYPH	0.011	0.56
LIGHT1	0.037	0.79

TABLE 22 continued

Independent Variable	Regression Coefficient	t-Ratio
LIGHT2	0.070	1.84
BWUK	0.005	0.32
EARLYH	0.022	1.08
LESS20	-0.034	-8.36
MWORKFT	-0.043	-2.72
MWORKPT	0.054	2.00
CONSTANT	0.392	
Adjusted R <sup>2</sup>	0.146	
F	31.624 <sup>b</sup>	

<sup>a</sup>The critical t-ratios at the 5 percent level of significance are 1.64 for a one-tailed test and 1.96 for a two-tailed test.

<sup>b</sup>Statistically significant at the 1 percent level of significance.

At first glance the reader will observe that the  $R^2$  in each of the equations is low, but that is expected with dichotomous variables. This is not of major concern since the F's reveal that the equations are indeed significant and did not arise by chance.

The data show different results for the physical and oral health measures. The OLS estimate of the production functions for IDECAY and APERI, the oral health measures, show clearly that the family variables have a powerful impact on oral health. As Edwards and Grossman (1983) point out, this should not be viewed as strong testimony on the impact of "nurture" because it is likely there are positive correlations first between these family characteristics and the parents' health and second, between the genetically determined components of parents' and children's health.

If, indeed, the effect of education were principally genetic (nature), the equal contribution of both the mother and father would be evidenced by equal coefficients, but if the effect were environmental (nurture), MEDUCAT would have a larger impact than FEDUCAT.

With the oral health measures, the coefficient on mother's education, MEDUCAT is larger and statistically different from the coefficient on FEDUCAT. The OLS estimate of the preventive dental care derived demand reveals that the coefficient on MEDUCAT is, not only statistically different from FEDUCAT, but almost three times larger.<sup>33</sup>

The physical health measures are less amenable to statistical analysis as evidenced by far fewer significant variables in the regressions. Therefore, luck or chance plays a far greater role than in the case of oral health. The relationship between family characteristics and health is much weaker also. The results here, do not clarify the nature-nuture controversy by examining of the regression coefficients on MEDUCAT and FEDUCAT.<sup>34</sup>

Since the FINC coefficient in the regressions of physical health is insignificant with the exception of HDBP, SCHABS, and PFGHLTH, policies whose design is to raise family income will do little to effect a change in the physical health of white adolescents. Clearly then, nonmarket productivity is the principal ingredient. This is reinforced by the statistical

significance of the coefficient on MEDUCAT.

Unlike the case of DTPREV, there is little evidence that preventive medical care has an impact on reducing the incidence of poor physical health. Policies designed to increase preventive medical care would then yield poor results, while policies to increase preventive dental care would yield excellent results. The family characteristics work through the production function in the case of DRPREV, unlike the case of DTPREV where the effects are both direct and indirect.<sup>35</sup>

FOOTNOTES

<sup>29</sup>As pointed out in Edwards and Grossman (1982) for the dichotomous health and preventive care measures the appropriate test uses the binomial distribution. With samples as large as this one, the binomial distribution approximates the normal distribution (See footnote on p.919).

<sup>30</sup>This technique is used by Edwards and Grossman (1982) though incorrectly, as Grossman has since pointed out. McCarthy (1969) finds that the true standard error of sample means in Cycle I, on average, to be 1.8 times the value computed under the assumption of simple random sampling. He also estimates that the true standard error of regression coefficients computed, on average, to be 1.35 times the standard error computed under the assumption of simple random sampling. The 1.35 rather than 1.8 adjustment should be used throughout because gross race difference standard error pertains to the standard error of the difference of the means, not the standard error of the mean.

<sup>31</sup>J. Johnston (1972) p. 199

<sup>32</sup>For those variables (OBESE, PVIS, ANEMIA, PFGHLTH) which do not exhibit significant slope differences by race, the results are given below.

Health Measure	Gross Income	Net Income
OBESE	0.0159	0.0064
PVIS	0.0228	0.0057
ANEMIA	0.0131	0.0066
PFGHLTH	0.1834	0.0546

The GROSS INCOME DIFFERENCE for OBESE is not significant, so further discussion would contribute little. For the remaining three variables, the net is substantially smaller than the corresponding gross difference.

<sup>33</sup>The coefficients of MEDUCAT and FEDUCAT are statistically different in the case of oral health as evidenced by the critical ratios: APERI(1.98), IDECAY(2.66), and DTPREV(6.14).

<sup>34</sup>No clear concensus: ABN(1.66), HDBP(2.23),  
OBESE(2.19), PVIS(0.13), ANEMIA(0.33), PFGHLTH(1.14),  
SCHABS(4.62), and DRPREV(0.42).

<sup>35</sup>For a complete discussion of direct and  
indirect effects see Edwards and Grossman (1983).

## CHAPTER V

### CONCLUSION

If one looks to the gross race difference for the health and preventive care measures used here, it reinforces the picture presented by the infant morality data. This is in contrast to the study of younger children, 6 to 11 conducted by Edwards and Grossman (1981) where no significant difference existed for the objective measures of health. While not all of the measures used are identical to mine, the results serve to stress the difference between children and adolescents, and the fact that some health problems may not manifest themselves until the maturation to adolescence begins.

The gross race differences for the Cycle III data show that black adolescents have poorer health than white adolescents and, are less likely to frequent their doctor and dentist for preventive care. When the socioeconomic differences are controlled for, blacks still, for the most part, have inferior health, though the magnitude of the differences is reduced.

In terms of difference in income, the gross income difference shows inferior health for the

low-income youths. These youths are also less likely to seek preventive care, even though their parents assess their health as poorer. Most of the measures that exhibit gross income differences also exhibit gross race differences. Since race and income are highly correlated, this is an expected result.

The examination by income (gross and net) of white adolescents yields the expected results: a white youth from a low-income family is more likely to show deficient health and less likely to receive preventive oral care. The results for the black subsample indicate deficient physical health for the low-income group only with respect to the parents' assessment.

Given that one accepts the concept of race, are the differences in health evidenced by the Cycle III data due to race alone, or can they explained by various socioeconomic characteristics? The results suggest a reduction in the size of the differences but, that in most cases the differences do not fall to zero. The implication then is that blackness contributes to the deficiency in health.

Although disparities remain, there is overlap in the variation in health and utilization, and the fact

that human beings possess a capacity for improvement.<sup>36</sup>  
As Darwin stated, "Although the existing races of man differ in many respects...yet if their whole organization be taken into consideration they are found to resemble each other closely in a multitude of points..."<sup>37</sup>

The reader should note that heritability is not a fixed parameter. Obviously environment plays a role. The extent to which I have been unable to completely capture, with the data, the environmental difference, contributes to the remaining differences. The reader should be careful not to assume that the difference in health by race and income is explained away by those socioeconomic family or regional variables. I have merely tried to control for them and investigate the net effects.

Given the small size of the black subsample, further investigation of the impacts of the various socioeconomic characteristics was restricted to the white subsample. The principal results show that the environment (nurture) has an important role in the production of oral healthiness but is not as important in many of the physical health measures, which are not

as conducive to statistical study.

In most of the health and utilization equations the mother's education, MEDUCAT, is the dominant factor. Only in the case of DRPREV, IDECAY, and HDBP does FINC have a larger impact. In comparison, the mother's education has a larger impact on health and utilization than does the father's education which substantiates the belief that effects are, in fact, environmental (nurture) rather than genetic (nature).

The reader should also note some other interesting results: the absence of the father, NOFATH is only significant in the production of obesity and poor vision; and that foreign language, FLANG is significant in the production function of poor vision and the derived demand for preventive pediatric care. These health components may then be primarily produced in the home so that mother's time is very important. The absence of the father implies that the mother has less time which she can devote to her children. The foreign language component captures not only attitudes but the ability to follow a prescribed regime of care, etc.

Thus, programs which educate mothers to the

dangers of ill health and the methods of prevention in the home will have major impact on the household's productivity in producing healthy adolescents. In terms of national health insurance as Edwards and Grossman (1983) point out, and this data substantiate, payoffs to national health insurance for physician's services will yield weak results whereas payoffs to coverage of dental care would be significant in the case of adolescents.

In conclusion, nature and nurture are both important components in the production of good health reinforcing the multidimensional nature of health. The results recommend that programs to improve the health of adolescents need to be targeted by race and type of health concern.

FOOTNOTES

<sup>36</sup>An investigation of the health variable and preventive care measure distributions clearly shows that there is a great deal of overlap between blacks and whites.

	<u>Black</u>		<u>White</u>	
	<u>Mean</u>	<u>Standard Deviation</u>	<u>Mean</u>	<u>Standard Deviation</u>
ABN	0.2711	0.4449	0.2034	0.4025
HDBP	0.0792	0.2703	0.0535	0.2250
OBESE	0.0792	0.2703	0.1041	0.3055
PVIS	0.0669	0.2501	0.0413	0.1991
ANEMIA	0.0282	0.1656	0.0231	0.1503
IDECAY	0.4877	1.2257	-0.1450	0.8395
APERI	0.2100	1.2180	-0.1140	0.8554
PFGHLTH	0.5000	0.5004	0.2846	0.4513
SCHABS	0.0613	0.2401	0.0600	0.2375
DRPREV	0.5246	0.4998	0.5867	0.4925
DTPREV	0.3996	0.4903	0.6941	0.4608

<sup>37</sup>Theodosius Dobzhansky "Genetics and the Races of Man," in Man in Adaptation, ed. Yehudi A. Cohen (Chicago: Aldine Publishing Company, 1974), p. 197.

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