Intel Science and Talent Search Article for $E=mc^2$ :
**"Poor Health" or a "Healthy Income":**
**The Bidirectional Relationship of Health and Different Measures of Income**
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I

Living in a New York City and having traveled to countries like India, Ecuador, and Brazil makes it impossible to ignore the gross disparities in income and health status between the rich and the poor across the globe. It is also impossible to ignore that these disparities are found together: where there is poverty, there is illness, and vice versa.

I have always been taught, and truly believe, that disparities in income and health are not right, fair, or inevitable. When I obtained data about New York City residents from the Columbia School of Social Work I took it as an opportunity to better understand the relationship between poor health and poverty in New York City. Recognizing that solving the health and poverty crisis around the world, or even in my own city, is far from a simple task, I undertook this project as a chance to study the issues, not solve them.

During the course of this project I came to the conclusion that scientific analysis can be used to help shape social policy discussions generally, and in the case of my research, to promote policies and practices to improve health status and combat poverty. As I conducted more research and analyzed my data further, I realized that if there is a relationship between poverty and health status, efforts to improve health outcomes could help in the efforts toward eradicating poverty, or working toward eradicating poverty could simultaneously result in advances in the

health of the population. Proving that the strong relationship between poverty and health status exists is half of the battle of effectively fighting both problems. Proving the importance of this relationship gives government and private organizations a reason to incorporate this dynamic connection between health and income into the development of more integrated public policies in these fields. Combining forces of the groups that work towards ending poverty and those that work towards improving public health could result in more complete and effective solutions to these very troubling social issues.

My work on this project has made me see the connection between science and the social policy and historical issues that are so important to me. I did not understand before how valuable and critical social science analytical tools could be in understanding what I consider to be key moral issues of our time, such as what I studied here -- how to reduce health and poverty in this country and abroad. Now I appreciate that through carefully collected and studied data, we can learn much to improve the quality and effectiveness of the policies implemented to address poverty and health. But these tools are bigger than even this issue. I now feel that looking at history and public policy through the additional lens of social science analysis would add to any debate on social welfare issues.

In addition to appreciating the worth of scientific research, I found a higher level of independence through the completion of this project than I realized possible in high school. Free of assignments and grades, I took on this project to experiment and learn for my own pleasure and increased knowledge. It surprised me to find myself not only spending hours obsessing over the project itself, but also enjoying

learning a data analysis program called STATA in which I coded data, cleaned data, ran regressions, and analyzed results. Before undertaking this project I would have said that I was not "the type" to master statistical thinking or analysis, but I was wrong. Mastering this sort of technical program as well as incorporating creative thoughts into developing a research question is what made the Intel Science and Talent Search project so worthwhile and is why I would recommend it to all high school students, even those who do not characterize themselves as math or science students.

II

Using randomly collected social, demographic and economic data from New Yorkers from the years 2002 and 2004, my study explores the hypothesis that both income and health status can be predictors of each other. When developing the research question, I found it difficult to pinpoint a singular definition of poverty. Different cities, states, and countries choose to define poverty in different ways, leaving scientists to interpret the definition best suited for their particular study. I chose to incorporate this idea into my study by developing two variables for income—Total Income, meaning the income of the entire household, and Spendable Income, meaning the Total Income variable minus the costs of living (such as house costs and tuition expenses). The Total Income variable is consistent with the Census' measure of poverty, while the Spendable Income variable is more consistent with some of the alternative measures of poverty such as the National Academy of Sciences' definition.

I hypothesized that if income status predicts health status than Spendable Income would be a stronger predictor of health status than would Total Income. This hypothesis is due to the fact that the more liquid income, or Spendable Income, one has, the more one is able to support healthy habits such as nutritional eating, and the cost of prescription medicine.

Conversely, I hypothesized that if health status predicts income, health would be equally strong in predicting both Spendable and Total Income variables. This hypothesis stems from the idea that a problematic health condition diminishes all forms of income because it can prevent an individual from working or limit the kinds of jobs an individual can get or keep. In addition, the cost of medical care required by a serious health problem will often eat into money set aside for basic living costs, such as rent.

To test these two hypotheses I used a command called regression. Regressional analysis generates values whose coefficients demonstrate the strength of the relationship being tested. This means if the coefficient generated when health factors are "regressed on" (or used to predict) Spendable Income is higher than the coefficient generated when health is regressed on Total Income, health is a better predictor of Spendable Income than it is of Total Income.

The final hypothesis of the project is that health problems specifically predict income deficiencies when those health problems are chronic. To test this hypothesis I controlled for chronic health problems when testing health as a predictor of income (Spendable and Total), assuming that the strength of the relationship would diminish.

The outcomes of the study were somewhat consistent with the hypotheses. When health was regressed on the two income measures, or the income measures were tested as predictors of health status, both proved to be significant predictors of health status. As expected, Spendable Income was found to be a slightly more powerful indicator of health than Total Income, because it had higher coefficients across every regression in both waves of data. A second test, called a Wald Test measures the differences between the regressional analysis coefficients against each other to determine "statistical significance." When something has statistical significance it means that the relationship being tested is not due to chance. The Wald Test revealed that the difference in the predictability of health status of Spendable Income versus Total Income was not statistically significant. This means that the fact that Spendable Income better predicted health status than did Total Income may or may not have been due to chance.

When the income measures were regressed on health, or health status was used to predict income levels, health status better predicted Spendable Income in one wave, or one year of the data, while health better predicted Total Income in the second wave of data used. This is consistent with the hypothesis that neither Spendable Income nor Total Income is better predicted by health status.

Although these results leave room for more in-depth study of this topic, my findings have policy implications for governmental responses to health and poverty issues. Federal, state and local agencies generally treat health prevention and anti-poverty programs separately, with unique and often disconnected strategies. This means that governments often perform cost-benefit analyses taking into account the

benefits in *either* the health *or* the poverty sphere, but not looking at both together. The findings of this study suggest that because poor health and poverty may exacerbate one another, it would be more efficient to combine efforts to combat both conditions.