

**White Paper for National Rural Water Association
The Relationship Between Household Financial Distress and Health:
Implications for Drinking Water Regulation**

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0. Executive Summary

Numerous studies during the past 20 years or more have explored the relationship between income and health at the household level. While there has been some debate over how to use this information in the process of setting health and safety regulations, there is little dispute that the relationship exists over a broad range of diseases, health prevention activities, and death itself; and that income is an important determinant of health at the household level.

Relying on income as a measure of financial distress, however, can be problematic. First, income is an imperfect measure of financial distress. It does not account for significant differences in expenditures on necessities (such as medical care) and it does not measure household wealth which can affect a household's available resources for current expenditures. Moreover, survey respondents are reluctant to provide income information, which can skew the results of any analysis.

Direct measures of financial distress have been developed by other researchers. Those studies develop a hierarchy of expenditures on household necessities. That is, from their work, we can answer questions such as: "What will a household give up first if it doesn't have enough money for all necessities?" and "What will a household do to try to keep food on the table?"

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These distress indicators may provide a better measure of household ability to pay than more traditional measures of income.

Data from the 2005 Behavioral Risk Factor Surveillance System (BRFSS), a data base maintained by the Centers for Disease Control and Prevention (CDC), were analyzed. For this analysis, the focus is on health care and health outcomes, using risk factors and socio-demographic variables as control variables. Importantly, the BRFSS also contains data on the household's income and two financial distress indicators: whether the person failed to see a doctor because of the cost, and whether the household lost telephone service for at least one week during the previous 12 months.

The results of the analysis indicate a strong correlation between financial distress and several illnesses and other adverse health outcomes (such as diabetes and cardiovascular disease). They also show, to a lesser but still significant extent, that people experiencing financial distress are less likely to engage in important disease prevention activities (such as receiving a flu vaccination or taking prescribed blood pressure medication).

Examining the effect of financial distress indicators on public health provides an important indication of the likely impact on low-income households of increasing costs for water service. Utility costs – particularly water and wastewater which have no substitutes – are likely to be among the last necessities to be eliminated by financially distressed households. If the amount that must be paid for water service increases, then a distressed household will need to eliminate other necessities that have a lower priority than water service. That is, increasing the cost of water service to a distressed household will increase the likelihood that the household will forego some other necessity. In the BRFSS data set, one out of every four households with incomes less than \$15,000 per year were forced to make such tradeoffs.

The magnitude of the change in water costs that would induce the elimination of other necessities can be estimated by using data on the cost of telephone service. The average cost of local telephone service varies throughout the country, but generally falls in the range of \$24 to \$36 per month. In 2004, 12% of households with incomes below \$18,000 per year did not have telephone service.

A cost in the range of \$24 to \$36 per month, therefore, is so unaffordable for a significant percentage of low-income households that it will force them to forego an essential service. Moreover, households that experience this type of hardship (lack of telephone service) are also less likely to engage in important disease prevention activities, and are more likely to experience poor health and various adverse health outcomes, such as cardiovascular disease, diabetes, asthma, and others.

The implications for drinking water regulation are clear. Increases in the cost of water service on the order of \$25 per month are likely to force more households into financial distress. That action, in turn, is likely to lead to less preventive health care and a higher incidence of illness and other adverse health outcomes.

1. Introduction

The regulation of specific contaminants in drinking water is justified by the effects of the contaminant on public health. One critical component of the decision to regulate a contaminant, including the particular level at which it will be regulated, is the cost that water utilities (and ultimately their customers) will incur to provide increased health protection. It is recognized that any increased cost might have some effect on public health, particularly if low-income households are affected by the cost of complying with the regulation. But it has been difficult to

quantify the public health impact associated with requiring low-income households to pay more for drinking water.

The purpose of this paper is two-fold. First, the scholarly published literature will be reviewed on the relationship between income and public health, including both health prevention activities (such as vaccinations) and adverse health outcomes (particular diseases or other indications of poor health).

Second, the results will be presented of an original analysis of health data, focusing on two important indicators of household financial distress. Rather than using income, which can be difficult to interpret for several reasons, the analysis uses two distress indicators that have been recognized in the literature for at least a decade: the inability to see a doctor when needed because of the cost, and the loss of telephone service for at least one week during the previous 12 months. Each of those factors is a strong indicator of household financial distress (roughly on par with going hungry) and using these variables avoids many of the issues that can arise from analyses based on income.

For the analysis of distress indicators, the working hypothesis is a simple one: Households that experience at least one of these distress indicators are less likely to engage in important health prevention activities and are more likely to experience adverse health outcomes.

After the results of this analysis are presented, the paper will conclude with a discussion of how these findings might affect the regulation of drinking water contaminants, along with recommendations for further research in this area.

2. Relationship Between Household Income and Health

For more than two decades, researchers have been studying the relationship between income and health at the household level. They have studied various prevention activities (such

as vaccinations), diseases, and mortality, controlling for numerous factors such as race, gender, age, education, tobacco use, alcohol consumption, and health insurance. This section will review some of that literature, including an earlier effort to incorporate income-based health effects into the federal rulemaking process.

2.1 1988 to 1994: National Longitudinal Mortality Study

In the 1980s, Rogot and Sorlie, researchers from the National Institutes of Health, oversaw a multi-year study of more than one million people, known as the National Longitudinal Mortality Study (NLMS). NLMS selected a random sample of respondents to U.S. Census surveys. These records were then matched against data in the National Death Index to determine the number and causes of mortalities during the follow-up period.

Among its many findings, the initial three-year study reached the following conclusion about the relationship between income and mortality: “Mortality ratios from all causes of death in white men age 25-64 with family incomes of less than \$5,000 per year are more than 3 times the ratios in men with incomes of \$50,000 or more per year” (emphasis added). (33)

The second iteration of the study continued to follow those selected in the original study and supplemented them with additional people, bringing the total to 1.3 million people, some of whom were followed for as long as seven years. (32) This study continued to find a strong correlation between income and mortality, and found this correlation to be strong regardless of race or gender. The seven-year study’s findings include:

- “For ages 25-64, mortality ratios varied inversely with family income for each race-sex group. In each group, the mortality ratio for persons with incomes of less than \$5,000 per year was at least twice the mortality ratio for persons with incomes of \$50,000 or more per year.”
- “For ages 25-64, a strong inverse relationship was observed for many causes of death. For whites (men and women), these included: cancer, diabetes, cardiovascular diseases, heart disease, ischemic heart disease, ill-defined heart disease, cerebro-

vascular diseases, respiratory diseases, pneumonia and influenza, and chronic obstructive pulmonary disease.”

In a 1992 paper in *The Lancet* discussing some of the major findings of the seven-year NLMS (37), Sorlie and Rogot highlighted these findings, among others:

- “The income gradient is especially strong for those [men] aged 45-64 years, with mortality varying over a three-fold range from lowest to highest income.”
- “Low income is a very strong ‘risk’ factor for death among both whites and blacks. The detrimental health consequences of low income were experienced uniformly by persons in the labour force, which suggests that this association is not confounded by effects of health status or disability on income level.”

(Emphasis added)

Another paper published by the investigators at the same time in *Public Health Reports* contains some additional detail, including this finding: “The relationship between income and average length of life is also a direct one – as income increases, life expectancy increases. For white men, the difference in life expectancy between the highest income and the lowest is about 10 years at age 25, 8 years at age 45, and 4 years at age 65. For white women, corresponding differences were much smaller, about 4 years at ages 25 and 45 and about 1 year at age 65.”

(emphasis added) (31)

Finally, in 1994 the authors published a paper that examined whether the relationship observed between mortality levels and income might be due to health insurance. (36) The authors concluded that within each group (those with or without health insurance), there remained a strong correlation between income and mortality. As they state: “Decreasing mortality was associated with higher income for each health insurance group.” For example, men with employer health insurance and income less than \$10,000 per year had a 1.9 times higher mortality rate than men with the same type of health insurance but income \$25,000 per year or more.

2.2 1992-1996: Health-Health Analysis

In 1992, the Occupational Safety and Health Administration (OSHA) broke new ground in the federal rulemaking process. In a proposed regulation dealing with air contaminants in the work place, OSHA considered the effect of compliance costs on workers' disposable incomes and then looked at the health effects associated with lowering those disposable incomes. (28) Relying on Rogot and Sorlie, among other analyses, OSHA posited that declines in workers' incomes could have off-setting adverse health consequences. This type of analysis came to be known as "health-health analysis." Using data supplied by the Office of Management and Budget (OMB) – and documented in a subsequent paper by two OMB researchers (23) – OSHA concluded that if the compliance costs exceed \$3 million to \$6 million per premature fatality avoided, then it is likely that the adverse health consequences of the income loss to workers would exceed the health benefits from the regulation.

Health-health analysis was based on an analysis of households' willingness to spend to avoid one mortality. After reviewing published studies, OMB concluded that a reasonable estimate of willingness to spend was between \$3 million and \$12 million per death avoided. (23) The study's authors noted some important limitations in their analysis, including their failure to "control for prior health status, a potentially important confounding variable."

In a separate paper published in 1994, Keeney (one of the other creators of health-health analysis) explained that the central purpose of the analysis is to determine "whether the cost of a proposed regulation, which de facto reduces the disposable income of individuals available for other purposes, would increase mortality risks and therefore produce more premature deaths than those purported to be saved by the proposed regulation." (19) In other words, the costs of complying with regulations are ultimately passed on to individuals, reducing their disposable income. The author continues: "These individuals, on average, use additional disposable

income in manners that reduce their health and safety risks and therefore reduce fatalities. Thus, regulatory costs induce fatalities.”

Keeney’s paper is also important because it contains a review of earlier studies from which the author concludes that the relationship between income and mortality is an exponentially decreasing function. In his words, this means that: “(1) the mortality risk increases as income decreases; (2) increases in the mortality risk due to a specific income reduction are greater at lower income levels; and (3) the effect of income on mortality risk is relatively insignificant at high income levels.” (emphasis added) (19) That is, for a given compliance cost, the potential health impacts associated with paying for compliance are expected to be much greater for an affected low-income household than they would be for a high-income household.

Health-health analysis proved to be very controversial and was viewed as a repackaged type of cost-benefit analysis that, in many cases, was prohibited by federal law. One of the more detailed critiques of health-health analysis was published by Portney and Stavins (29), who concluded that there were at least two fundamental problems with health-health analysis. First, it treats small costs incurred by many people as being equivalent to large costs incurred by a few people. They write:

The problem is that the theoretical relationship between income and health at the individual level is one which is most compelling for large changes in income, or, in the extreme, in the case of induced unemployment. In other words, the relationship between income and health at the individual level is highly nonlinear; indeed, it likely exhibits a threshold effect in which the marginal health loss becomes great only at very high income losses (or, in the limit, unemployment). Having said this, there is reason to doubt that slight real income losses, even if spread broadly across the population in the form of increased product prices, would translate into significant aggregate health impacts.

Second, they also discuss the need for health-health analysis to consider both the positive and negative economic impacts of a regulation. As they state: “If the job losses and reduced real

incomes that can result from regulation are to be translated into lives lost, so, too, should the higher incomes and jobs created by regulation be converted into life saving benefits.”

Despite these criticisms of health-health analysis, however, Portney and Stavins acknowledge that the analysis can serve an important purpose: to focus attention on the net health impacts of a regulation. Thus, they posit this question: “Could the economic burden associated with a proposed regulation so adversely affect some individuals or families that the health losses they might suffer as a consequence could actually offset the improvements in health enjoyed by the beneficiaries of the regulation?”

The health-health analysis debate continued for nearly a decade (see, for example, Viscusi (44), Chapman and Hariharan (6), Keeney (18), Lutter et al. (24), and Rascoff and Revesz (30)), but the analysis itself appears to have fallen into disuse. Coming out of the debate, however, are two important lessons that both sides appear to acknowledge:

- If a regulation significantly decreases the disposable incomes of those affected by the regulation, it could wholly or partially offset the health benefits of the regulation itself.
- Changes in the disposable incomes of low-income households will result in much greater health impacts than similar changes in the incomes of high-income households. For example, Chapman and Hariharan (6) found that imposing a cost on low-income households would result in a break-even cost that is roughly one-half of the break-even cost if the same regulation applied only to high-income households. (The break-even cost is the amount spent for regulatory compliance where the health benefits of the regulation equals the health detriments on those who pay for the regulation through reduced disposable income.)

2.3 Late 1990s to Today: Research Continues

While the health-health analysis debate was attracting the attention of policy makers, health professionals and statisticians continued to explore the relationship between income and public health. Among the important findings from studies conducted during the 1990s and 2000s are the following:

- Ettner studied the important question of whether the relationship between income and health was causal and, if so, in which direction. That is, did better health improve the potential for someone to earn more income, or did higher income improve someone's health, or were both effects present? After conducting a rigorous statistical analysis of federal data, she found that increasing monthly household income from \$2,843 to \$5,030 would lower the probability of certain health effects by more than 50%, and cause other positive health benefits. She concluded: "These effects are large enough to be of substantial clinical interest." (10)
- Backlund and colleagues found that the effects of income on health are much stronger at low incomes than they are at higher incomes. In analyzing mortality data from the NLMS, the authors concluded: "The decrease in mortality associated with an increase in income of a given dollar amount [is] significantly greater at low levels of income than at higher levels of income." (1)
- An 11-year update of the NLMS reinforced conclusions reached in earlier studies. This analysis also included analysis by racial and gender groups, as well as income. The income effects on health were present in nearly all cases, without regard to race or gender. Thus the authors concluded: "With few exceptions, individuals with incomes of \$25,000 and over had a substantially greater life expectancy compared to corresponding groups with incomes below \$10,000. For example, at age 25, the difference in estimated life expectancy between groups of these 2 income levels was 7.9 years for non-Hispanic White men, 3.3 years for non-Hispanic White women, 8.6 years for non-Hispanic Black men, 5.0 years for non-Hispanic Black women, and 5.1 years for Hispanic White men. These differences were statistically significant." (22)
- Several studies of the relationship between specific diseases or health-prevention activities and income found statistically significant relationships between the level of income and the incidence of the disease or prevention activity. These include: childhood mortality (34); diabetes in women (4); heart disease and stroke (15); influenza vaccinations in the elderly (21); malnutrition and hunger (14, 43); low birth weight, lead poisoning, tuberculosis, lung cancer, and diabetes (20).
- Numerous studies have found a relationship between income and both cancer survival rates and the quality of life of cancer patients. The author of one review article summarized these data as follows: "A wealth of data indicates an inverse relationship between cancer survival and socioeconomic status." (17) The same paper also noted: "Recently, a quality-of-life survey of 173 colorectal cancer patients ... found that, of several demographic and tumor variables, only low income was associated with worse ambulation, pain, and social and emotional well-being." (emphasis added)

The studies examining the incidence of influenza in the elderly are particularly noteworthy. Influenza is one of the United States' (and the world's) greatest public health problems. Dushoff and colleagues estimate that 41,400 deaths per year occur in the United

States from influenza. (7) Nichol concludes that in the elderly, influenza vaccinations reduce the level of hospitalizations for pneumonia and influenza by more than 30% and the number of deaths by almost 50%. (27) Yet, Lemon and colleagues found that the likelihood of a person age 65 or older receiving an influenza vaccine decreased significantly as income decreased. (21) Specifically, the authors found that only 58.5% of the elderly with incomes less than \$15,000 were vaccinated, compared with 71.2% of those with incomes of \$35,000 or more.

2.4 Conclusion

In summary, numerous studies during the past 20 years or more have explored the relationship between income and health at the household level. While there has been some debate over how to use this information in the process of setting health and safety regulations, there is little dispute that the relationship exists over a broad range of diseases, health prevention activities, and death itself; and that income is an important determinant of health at the household level.

3. Income is an Imperfect Measure of Financial Distress

While income is a readily available measure of a household's ability to purchase necessary goods and services, it is generally recognized that it is an imperfect measure, for at least three reasons that are explored below.

3.1 Income vs. Wealth

First, researchers recognize that a household's ability to pay depends not only on its current income, but also on wealth that might be accumulated over time. That is, income is a measure of money coming in during one year only, while wealth measures income and other resources over an extended period of time. Feinstein's review of early studies on health-income correlations includes an important discussion of the difference between household income and

household wealth. (13) Feinstein concludes that wealth or other measures of economic status might provide a better measuring stick than one year's snapshot of income. As he notes: "the problem of reverse causality [that is, the effect of health on the ability to generate income] is less likely to afflict household wealth than household income measures, primarily because wealth accumulates over time and hence is less affected by a single episode of sickness."

3.2 *Gross Income vs. Income Available for Discretionary Spending*

There also is an important difference between gross income and income that is available for discretionary spending. Two households with the same gross income might have very different standards of living and very different income available to spend on non-essential items. These differences can arise from numerous factors, including for example: location, number of dependents, medical needs, dependent care needs (such as a nursing home), transportation costs, and so on.

For example, the U.S. Bureau of Labor Statistics reports that the average household headed by a person under age 25 has approximately the same annual income and level of expenditures as the average household headed by a person age 75 or older (average income and expenditures in 2005 for both groups were in the range of \$27,000 to \$28,500 per year). Yet the elderly household spends approximately \$4,200 per year on healthcare, while the younger household spends only about \$700 in that category. (39)

3.3 *Reluctance to Report Income*

Finally, it should be recognized that survey respondents are reluctant to report their income, even when they are assured that the information is confidential. The U.S. Census Bureau and Bureau of Labor Statistics report that 12.4% of respondents to the Current Population Survey refuse to provide their income. In contrast, fewer than 2% refuse to answer questions about employment or basic demographic information. (41)

The same reluctance to provide income information is found in a primary database for health researchers: the U.S. Centers for Disease Control and Prevention's Behavioral Risk Factor Surveillance System (BRFSS). In the 2005 survey, 13.6% of respondents did not provide information about their household income. (42)

A recent study by Stocké was designed to assess survey respondents' reluctance to answer certain types of questions. The survey included questions on such controversial topics as racial attitudes, legalization of abortion, environmental issues, and attitudes toward homosexuality. The study found that more than 10% of respondents refused to answer the question about their income, compared with only 0.5% of respondents who refused to answer any other type of question. (38).

3.4 Summary

It appears, therefore, that relying on income as a measure of financial distress can be problematic. First, income is an imperfect measure of financial distress. It does not account for significant differences in expenditures on necessities (such as medical care) and it does not measure household wealth which can affect a household's available resources for current expenditures. Moreover, survey respondents are reluctant to provide income information, which can skew the results of any analysis.

4. Other Measures of Financial Distress

Direct measures of financial distress are evident from research conducted by Bauman (2, 3), Boushey (5), and others (9, 26). Their studies develop a hierarchy of expenditures on household necessities. That is, from their work, we can answer questions such as: "What will a household give up first if it doesn't have enough money for all necessities?" and "What will a

household do to try to keep food on the table?” Combining the work of these researchers results in the hierarchy shown in Figure 1.

Figure 1: Hierarchy of Household Necessities

First to be eliminated →	Do not have health insurance Do not pay utility bills in full Do not see dentist when needed Do not pay rent or mortgage in full Do not see doctor when needed Do not get enough to eat Telephone service disconnected Child cares for self Utilities disconnected
Last to be eliminated →	Eviction / foreclosure

Source: Authors' construct derived from Bauman (2-3), Boushey (5), and Energy CENTS (9)

In other words, households that have trouble paying for all of their necessities will do without health insurance first. According to Boushey, approximately 36% of households with incomes below 200% of the Federal Poverty Level (FPL) do not have health insurance. (5) Working down the list, distressed households will then fail to pay their utility bills in full (25% of 200% FPL households (5); 46% of households receiving heating assistance (9); 10% of all households (2)). Distressed households will effectively work their way down this list, on average, trying to avoid the last item on the list: the loss of their home.

5. Health Survey Data and Financial Distress

The Centers for Disease Control and Prevention (CDC), in conjunction with state health departments, has collected standardized survey data since 1984. The data set, known as the Behavioral Risk Factor Surveillance System (BRFSS), has grown each year and now contains hundreds of pieces of information from several hundred thousand respondents. BRFSS is an ongoing survey of behavioral risk factors in U.S. adults. The survey is administered via

telephone and asks questions related to health care, health outcomes, risk factors (e.g., alcohol consumption and tobacco smoking), and socio-demographics such as age, race, employment status, and education.

Importantly, the BRFSS also includes two of the key indicators of household financial distress:

- “Was there a time in the last 12 months when you needed to see a doctor but could not because of cost?”
- “During the past 12 months, has your household been without telephone service for one week or more? Do not include interruptions of phone service due to weather or natural disasters.”

As expected, survey respondents were much more likely to answer these questions than they were to provide information about their incomes. As noted above, 13.6% of BRFSS respondents did not provide information about their incomes. But only 0.2% (doctor) and 0.6% (telephone) of respondents did not answer these distress questions.

As discussed above, both the failure to see a doctor when needed and the loss of telephone service are important indicators of household financial distress. In the distress hierarchy, they are about on par with going hungry, and come just before a household would eliminate child care expenditures. While it might not be obvious, the loss of telephone service is a particularly important distress indicator. For the elderly, the telephone can be the only way to summon emergency medical care or to keep in touch with outside caregivers. Moreover, the telephone is also critically important for the non-elderly with low incomes. In a study of low-income single mothers, Edin and Lein found that the telephone serves as a life line between a working mother and her children, particularly when the children are left home alone. (8)

In using the BRFSS, it should be recognized that the data set under-represents low-income and financially distressed households. Because the survey is conducted by telephone, it

excludes some households that cannot afford telephone service. As discussed below, the Federal Communications Commission reports that nationally 12% of households with incomes less than \$18,000 per year did not have telephone service in March 2004; in some states the figure exceeded 20%. (11)

The analysis described in the following sections seeks to determine if there is a correlation between these distress indicators and various disease prevention activities and health outcomes, recognizing that any results will tend to understate the percentage of households in financial distress.

6. Methodology

Data from the 2005 BRFSS were analyzed. For this analysis, the focus is on health care and health outcomes, using risk factors and socio-demographic variables as control variables.

Table 1 summarizes the variables used in this analysis.

CDC provides the data in a very “clean” format, so very few manipulations or recodings were needed to adapt it for the analysis. The only significant recoding of data was to equate an answer of “don’t know” or “refused” to “missing.”

Finally, it should be noted that the data set contains an unusual coding convention. For any “yes/no” questions, “yes” is coded as a 1 and “no” is coded as a 2. Therefore a positive correlation with one of these variables means that it is less likely to occur (the higher the number, the more likely the answer is to be “no”). This point will be reiterated in the results discussion.

Table 1: Variables from BRFSS Used in Analysis

Health Outcomes	Health Care and Prevention	Income and Financial Distress	Control Variables
<ul style="list-style-type: none"> - # of days in last 30 in which physical health not good - # of days in last 30 in which mental health not good - rating of general health - # of days that poor mental or physical health kept you from usual activities - Diabetes - Hypertension - High cholesterol - Myocardial infarction - Angina - Stroke - Asthma - Physical, mental, emotional disabilities? - Osteoporosis 	<ul style="list-style-type: none"> - Any kind of health care access? - Do you have a personal doctor? - How long since visited a doctor for a routine checkup? - Flu vaccines? - Pneumonia vaccine? - Oral health and dentist visit - Mammogram and Pap smears - Prostate screening - Colorectal screening 	<ul style="list-style-type: none"> - Household income - Was there a time in the last 12 months when you needed to see a doctor but could not because of cost? - Has your household been without telephone service for at least 1 week within the past year? 	<ul style="list-style-type: none"> - age - race - marital status - education - employment status - tobacco smoking - alcohol ingestion

7. Results

7.1 Introduction

The BRFSS data set for 2005 contains data from approximately 356,000 respondents. Of those respondents, 43,672 (12.3%) stated that there was a time in the past 12 months when they failed to see a doctor because of the cost. Further, 12,846 (3.6%) of respondents said that they had lost telephone service for at least one week during the past 12 months.

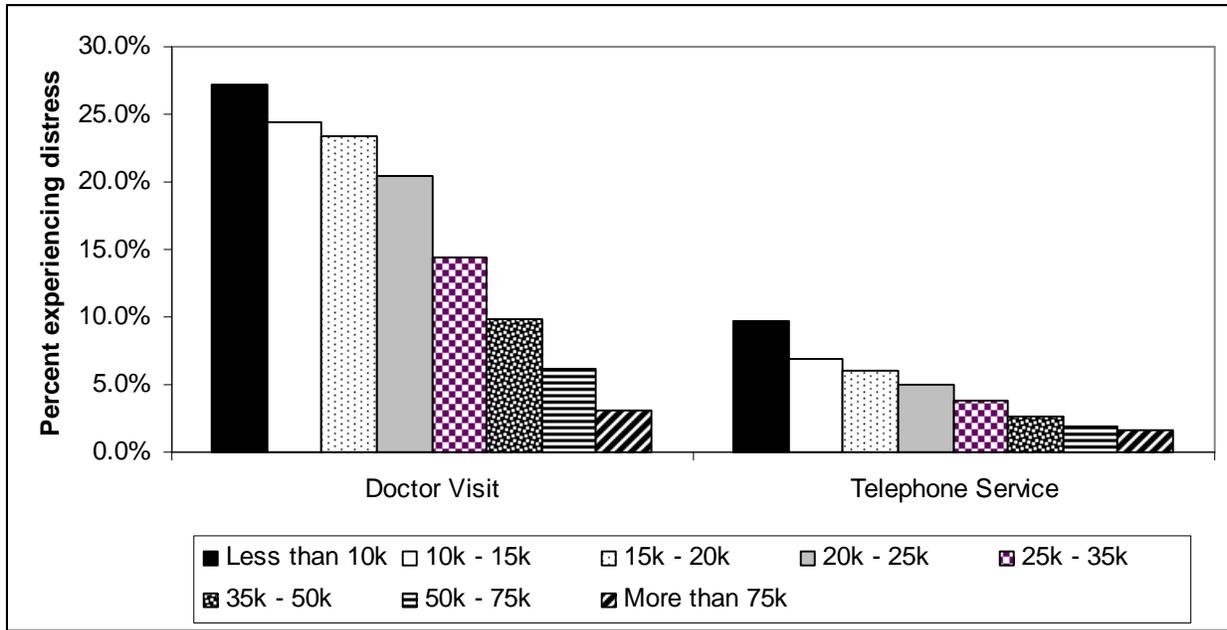
The presence of these distress variables is strongly correlated with income ($p < 0.001$), as shown in Figure 2.⁴ Importantly, though, income does not even come close to being the only factor determining whether a household is in distress ($R^2 = 0.09$ for doctor visit and 0.03 for telephone service).⁵ Indeed, there are thousands of households in the highest income categories

⁴ With correlation calculations, the p-value is equal to the probability that there is actually no correlation between the variables; therefore, the lower the p-value, the higher the probability that there is a relationship between the variables.

⁵ R^2 is the percentage of the variability in the distress measure that is explained by income. The higher the R^2 value, the better the model's explanatory power. In this instance, an R^2 of 0.09 indicates that while income is an important factor in determining whether a household cannot afford to pay for a doctor's visit, it is a relatively small factor – explaining only 9% of the variability in this distress factor.

that experienced these distress factors. This is consistent with the earlier discussion about the problems inherent in trying to collect and use income data, as well as a recognition of the factors other than income that can create household financial distress (such as high expenses for medical or dependent care).

Figure 2: Distress Factors by Income Group



To facilitate further analysis, a new variable called “DISTRESS” was created by combining the doctor visit and telephone service variables. DISTRESS was set equal to “yes” if either (or both) the doctor visit or telephone service variables had a “yes” answer. In total 52,413 (14.7%) respondents were coded as having DISTRESS equal to “yes.” As would be expected, DISTRESS is also highly correlated with income ($p < 0.001$).

7.2 Relationship Between Financial Distress and Disease Prevention Activities

The hypothesis is that the presence of financial distress will be associated with a reduced likelihood of pursuing prevention activities. To quantify this relationship, a linear probability (regression) model was used with DISTRESS as the key explanatory variable. A standard set of

control variables was used (including such factors as age, race, gender, and education), but those coefficients are not reported here for ease of presentation.

Table 2 summarizes results from this analysis, with bold entries indicating coefficients that were statistically significant at the 5% or better level. This means that the probability that distress actually has no effect on these prevention activities is less than 5%.

Table 2: Relationship Between Financial Distress and Prevention Activities

Prevention Activities	Scale	Distress Indicator
Bloodstool test for colorectal cancer	1=yes, 2=no	-0.049
Taking blood pressure medication	1=yes, 2=no	0.085
How long since last checkup	years	0.675
Flu shot in last year	1=yes, 2=no	0.089
Flu spray in last year	1=yes, 2=no	0.001
Had mammogram	1=yes, 2=no	-0.061
Had pap smear	1=yes, 2=no	-0.009
Sigmoidoscopy	1=yes, 2=no	0.004
Any kind of health care access	1=yes, 2=no	0.260
Last dentist visit?	years	-0.029
Have a personal doctor	1=yes, 2=no	0.133
Pneumonia vaccine?	1=yes, 2=no	0.018
Had PSA test for prostate screening	1=yes, 2=no	-0.432

For all prevention activities except those measured in years, the dependent variable is binary. Therefore, these parameters are interpreted in percentage terms. For example: those who have either lost telephone service or could not afford medical care were 8.5% less likely to take blood pressure medication than were people who had neither of these events occur.

A positive coefficient is expected on all coefficients for DISTRESS. Among the results that are statistically significant, the results deviate somewhat from this expectation in two instances: time since the last dentist visit and whether a male respondent had a PSA test for prostate screening. While statistically significant, the difference in time between dentist visits is quite small (0.029 of a year, or about ten days) and does not appear to represent a particularly meaningful difference from a public health perspective. The prostate screening question,

however, is important and shows a relatively large negative number, which would indicate that a man in financial distress is 43% more likely to have a PSA test than someone not in financial distress. It is unclear why this would be the case, but it could be explained if certain health care services are provided to members of the low income population through medical assistance programs.

Generally, though, the results are consistent with what would be expected: Someone in financial distress is less likely to engage in a wide range of disease prevention activities, including taking prescribed blood pressure medication, receiving a flu shot, and visiting a doctor in a timely fashion.

7.3 Relationship Between Financial Distress and Adverse Health Outcomes

The relationship between various health outcomes and financial distress also was quantified. In general there is a much stronger relationship between DISTRESS and the health outcomes than there is between DISTRESS and prevention activities, with statistically significant coefficients for all outcomes that were tested. Table 3 summarizes these results.

Table 3: Effects of financial distress on health outcomes

Health Outcomes	Scale	Distress
Asthma	1=yes, 2=no	-0.064
Angina	1=yes, 2=no	-0.023
Myocardial infarction	1=yes, 2=no	-0.029
Stroke	1=yes, 2=no	-0.024
Diabetes	1=yes, 2=no	-0.017
High cholesterol	1=yes, 2=no	-0.041
Rating of general health	1=Excellent, 2=Very Good, 3=Good, 4=Fair, 5=Poor	0.435
Days in last month in which physical health not good	1 – 30	2.800
Days in last month that poor mental or physical health prevented normal activity	1 – 30	2.445

These results all support the hypothesized relationship between health outcomes and financial distress. A negative sign is expected for coefficients evaluating the relationship

between outcomes and financial distress (that is, someone is more likely to have the disease or adverse health outcome if he/she is in financial distress). The reverse is expected for the three variables rating general health and counting the days in poor health. Interpreting the results for the linear probability models, respondents experiencing financial distress are 6.4% more likely to have asthma, 2.1% more likely to have angina, and so on. For the variables that involve ranking or counting, the interpretation is slightly different. For example, respondents experiencing financial distress experience 2.8 more days per month in poor health than those who are not in distress.

7.4 Conclusion

The results indicate a strong correlation between financial distress and several illnesses and other adverse health outcomes. They also show, to a lesser but still significant extent, that people experiencing financial distress are less likely to engage in important disease prevention activities.

8. Implications for Drinking Water Regulation

The concern over health-health tradeoffs arising from regulatory costs is especially relevant for drinking water standards applied to households served by small rural community water systems. In most other regulatory actions, compliance costs are borne by different individuals than receive the benefits, and the costs often are highly dispersed and thus quite low on a per household basis. For example, an occupational safety standard provides benefits to a well defined set of workers, and the costs usually are widely dispersed throughout the economy as small impacts on prices and profits (and, thus, the costs only marginally impact a very broad mix of consumers and corporate shareholders).

In contrast, for drinking water regulations, the same households that benefit from the regulation bear the full brunt of the compliance costs. Given that the health risk reduction benefits from a drinking water regulation may be overstated due to an array of conservative assumptions embodied in regulatory agency risk assessments, the potential exists that the negative health impacts arising from the regulatory costs may exceed the health benefits offered by some drinking water regulations. This is especially likely in small rural communities, where household incomes tend to be relatively low compared to national averages, and per household compliance costs tend to be high.

Further, examining the effect of financial distress indicators on public health provides an important indication of the likely impact on low-income households of increasing costs for water service.

The hierarchy discussed above shows that utility costs – particularly water and wastewater which have no substitutes – are likely to be among the last necessities to be eliminated by financially distressed households. If the amount that must be paid for water service increases, then a distressed household will need to eliminate other necessities that have a lower priority than water service. That is, increasing the cost of water service to a distressed household will increase the likelihood that the household will forego some other necessity.

In the BRFSS data set, one out of every seven respondents fell into this category. Among households with income less than \$15,000 per year, more than one out of every four were forced to make such tradeoffs.

The magnitude of the change in water costs that would induce the elimination of other necessities can be estimated by using data on the cost of telephone service. In March 2004, 12% of households in the United States with incomes below \$18,000 per year did not have telephone

service. (11) This figure, however, understates the level of financial distress in some parts of the country. For example, there were nine states where 20% or more of households at this income level did not have telephone service at that time.⁶

According to the Federal Communications Commission (FCC), the average cost of local telephone service (including any long-distance service packaged with local telephone service) in that year was \$36 per month. (12) The same report shows that in urban areas the cost for local telephone service, excluding all long distance service, was between \$24 and \$25 per month.

It is reasonable to conclude, therefore, that a cost in the range of \$24 to \$36 per month is so unaffordable for a significant percentage of low-income households that it will force them to forego an essential service. Moreover, as demonstrated in the previous section, households that experience this type of hardship (lack of telephone service) are also less likely to engage in important disease prevention activities, and are more likely to experience poor health and various adverse health outcomes, such as cardiovascular disease, diabetes, asthma, and others.

Indeed, the data for 2005 indicate that people in financial distress are 8.5% less likely to take prescribed blood pressure medication, 8.9% less likely to have a flu shot, 2-3% more likely to suffer from cardiovascular disease, and 4% more likely to have high cholesterol.

9. Conclusions

9.1 Recommendations for Further Research

The BRFSS data set is a rich source of information about certain diseases and disease-prevention behaviors. The data set now covers more than 20 years of information and it could

⁶ Alaska (28%), Arkansas (20%), District of Columbia (27%), Mississippi (21%), Nevada (22%), New Mexico (20%), South Carolina (25%), South Dakota (20%), and West Virginia (22%).

prove instructive to evaluate changes in various behaviors and diseases over time, with respect to income and/or financial distress.⁷

In addition, there are other large data sets with information about diseases and mortality, such as the National Longitudinal Mortality Survey (NLMS) and the Surveillance Epidemiology and End Results (SEER) system maintained by the National Cancer Institute. NLMS includes information on household income but does not appear to include other financial distress indicators. SEER does not include information on income, but it does include the patient's ZIP Code which researchers have linked to community demographic information.

These data sets could be useful for other types of analysis because they include information on numerous types of cancers (SEER) and causes of death (NLMS). This could be useful in gaining a better understanding of who might be affected by proposed drinking water regulations. For example, if a drinking water regulation is designed to lessen the incidence of a particular disease or health effect, NLMS or SEER could be analyzed to determine the characteristics of people who are likely to contract the disease, which could then be compared to those who are likely to pay for the drinking water treatment requirements.

9.2 *Conclusion*

Dozens of studies have found that people with lower incomes are less likely to engage in disease prevention activities, experience greater health problems, and have shorter life expectancies than people with higher incomes.

In the current study, it has been shown that similar trends exist for individuals who live in households that experience financial distress in the form of being unable to afford a doctor visit or telephone service (both of which can also afflict higher-income households). Households in

⁷ Income has been included in BRFSS since 1984. The distress questions did not appear in the survey until 1993 (not seeing a doctor because of cost) and 2003 (lack of telephone service for at least one week).

financial distress are less likely to engage in important prevention activities (such as vaccinations) and are more likely to experience adverse health outcomes, including cardiovascular disease, diabetes, asthma, and others.

The average cost of local telephone service ranges between \$24 and \$36 per month, indicating that increased expenditures in this range can be enough to force a household to choose among necessities, including those that have a direct bearing on their health and well being.

The implications for drinking water regulation are clear. Increases in the cost of water service on the order of \$25 per month are likely to force more households into financial distress. That action, in turn, is likely to lead to less preventive health care and a higher incidence of illness and other adverse health outcomes.

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