UKCPR

UK Center for Poverty Research

UKCPR Discussion Paper Series
#2004-04
http://www.ukcpr.org/Publications/DP2004-04.pdf

September 2004

Does Regional Variation in Multiple Measures of Health Status Differ Across Income Levels?

Janet M. Bronstein
Shailender Swaminathan
Joshua Klapow
University of Alabama at Birmingham

This project was supported with a grant from the University of Kentucky Center for Poverty Research through the U.S. Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation, grant number 02ASPE417A. The opinions and conclusions expressed herein are solely those of the author and should not be construed as representing the opinions or policy of the UKCPR or any agency of the Federal government.

Does Regional Variation in Multiple Measures of Health Status Differ Across Income Levels?

Janet M. Bronstein, Ph.D., University of Alabama at Birmingham, 1665 University Boulevard, Birmingham Alabama 35294-0022. phone (205) 975-8962, fax (205) 934-3347, email jbronste@uab.edu

Shailender Swaminathan, Ph.D., University of Alabama at Birmingham

Joshua Klapow, Ph.D., University of Alabama at Birmingham

Acknowledgements

This study was supported by a grant through the Regional Small Grants Program at the University of Kentucky Center for Poverty Research.

Does Regional Variation in Multiple Measures of Health Status Differ Across Income Levels?

Abstract

This study examines whether regional variations in health status measures are consistent across the income gradient, or whether they are more pronounced at the lowest income levels. We use data from the Community Tracking Survey, a large randomized telephone survey of residents in 60 U.S. communities. Controlling for individual risk factors and county level income inequality, lowest income individuals have poorer scores on counts of chronic diseases, global health ratings, and the physical and mental components of the SF-12. Residents of the South have poorer scores on chronic disease counts, global health and physical health than residents of the Northeast, and poorer scores on physical and mental health than residents of the Midwest. Regional variations in the first three measures persist across the income gradient, and are more pronounced in the population group just above the poverty level. However, the lowest income group of residents of the South had poorer mental health scores than residents of all other regions, while the highest income group had better mental health scores than residents of all other regions. These findings suggest that a wide variety of community level factors influence health status across the income gradient, while a separate set of community level factors may interact with income in

communities to increase particularly mental health risks for a subset of the population.

Keywords: Poverty, U.S. South, health status, mental health, regional variation

Word count of abstract: 219

Full word count: 4,820

Introduction

Residents of the U.S. South have higher infant and age adjusted mortality rates (Matthews et al 2002, Zopf 1992, Kaplan et al 1996) and disability levels (Porrell and Miltiades 2002, Lin 2000) than residents of other regions in the United States. In part this may be explained by lower incomes and higher poverty rates in the region, since extensive evidence indicates that higher incomes are positively associated with better health status and lower mortality rates (Lynch et al 2004a). Racial/ethnic composition also plays a role; more residents of the South have African-American heritage, and African-Americans have higher age-adjusted mortality rates from a wide variety of health conditions (Williams 2001). The South has more rural areas than some other regions, and rural residence has also been associated with poorer health status in some studies (Cutler and Coward 1988, Rowland and Lyons 1989). Beyond these factors, survey data suggests a higher prevalence of some high risk health behaviors among residents of the South (Holtzman et al 2000).

Recently, Lynch et al (2004b) have presented evidence showing both that the higher age-adjusted mortality rates in the U.S. South are associated with greater levels of income inequality (lower shares of total income held by the poorest 50% of the population) in the region, and that the association between mortality and income inequality is weakest in that region, compared to other regions in the U.S. The purpose of this study is to assess whether regional variations that generally reflect poorer health status among residents of the South are consistent across income levels when other risk factors are taken into account. Are low income residents of the South much worse off in terms of health than low income residents of other regions, and is this the explanation for poorer health measures in the region as a whole, or are there health deficits across regions all along the income gradient? Health deficits by region across the income gradient suggest that a wide variety of community level factors influence health across the population, while regional variation concentrated at the lowest income level suggests that community level factors interact with income to produce negative effects on health status (Wing et al 1992, Hillemeir et al 2003). We also examine whether regional variation patterns are consistent across measures of different aspects of health status, and whether health gaps between the highest and lowest income groups are consistent across regions.

Methods

Data

We use Round Three of the Community Tracking Study (CTS) household survey, sponsored by the Robert Wood Johnson Foundation and conducted by the Center for Studying Health System Change, as the primary data source for this study. This round was administered in 2000-2001 and includes 46,792 adults residing in 60 identified communities. County of residence is provided with the survey data, so additional census and other secondary data can be linked to the individual responses. The sampling scheme is stratified by site, with weights provided so the survey responses can be weighted to represent each site (Kemper et al 1996).

We grouped the 60 communities into regions as shown in Figure 1. We used the broadest definition of the Southern region, including all states whose governors belong to the Southern Governor's Association. Northeast, Midwest and Western regions are defined based on census divisions. Appendix Table 1 lists the 60 sites in the Community Tracking Survey, grouped into the regional definitions used in the study.

While the CTS survey was designed to be representative of the 60 communities and the nation as a whole, it was not designed to represent geographic regions. To assess whether the communities included in the CTS are fair representations of the region, we compared relative income levels (represented as a percentage of the Federal Poverty Level based on the size of the household of the survey respondent) and reported race/ethnicity between CTS respondents and the 2000 Census, designating regions as shown in Figure 1. We included adult and child respondents to the Round Three CTS household survey, to most closely match the format of aggregated Census data, and used the survey weights so that the responses represent the CTS sampled communities. Income categories used for this comparison were those available on aggregated census data, while the race/ethnicity categories used for this comparison were those available on the CTS survey data. As Table 1 shows, the CTS appears to have slightly over sampled communities with low income residents, particularly in the Southern region. The population weighted distribution of survey respondents by race/ethnicity matches the Census data for the regions fairly well.

The CTS survey includes a field calculated from survey respondents that represents household income in the format used by the U.S. Census. The survey also includes the dollar amount of income that would meet the standard Federal poverty level guideline for the size of the respondent household. Thus, household income of survey respondents can be expressed as a percentage of

the Federal Poverty Level (FPL). However, there are many well documented weaknesses of the FPL as a measure of poverty, including lack of adjustment for geographic variations in the cost of living, lack of consideration of non-cash income (e.g., government benefits) as it contributes to a household's means of livelihood, and outdated consideration of the expenditures necessary to meet a household's basic needs (Brady 2003). The lack of adjustment for geographic variations in cost of living is the most serious weakness of the FPL measure for the purposes of this study, since we are focusing on regional variation in the correlation between income and health measures. Therefore we apply a cost of living adjustment to the incomes reported by survey respondents before calculating the percentage of the FPL that the income represents. The Association of Chambers of Commerce Researchers (ACCRA) conducts surveys quarterly on relative prices for a market basket of goods (food, clothing, housing, etc) and provides a cost of living index for the responding communities relative to the nation as a whole. Forty two of the 60 CTS sites were included in the ACCRA cost of living survey conducted in the fourth quarter of 2000 (the middle of the survey period). We used the cost of living index for these communities and for close geographic substitutes for the other 18 CTS communities (see Appendix Table 2) to adjust the reported incomes of survey respondents. Table 2 shows the portion of adult survey respondents in each region that were categorized in four FPL categories, with and without cost of living adjustment of their reported incomes. As can be seen, sites included in the Northeast region had the highest and most variable cost of living indices. As a result, more

households in the Northeast region shifted to lower poverty level categories with cost of living adjustments.

Much recent literature on community level health status explores the relationship between income inequality and health. Findings are mixed (Lynch et al, 2004a and 2004b) and studies that include both individual incomes and income inequality generally find that the individual income measures dominate the effect. Other studies have shown that income inequality has weak direct effects on mortality rates once social capital is also included as an independent predictor of mortality (Kawachi et al, 1997). However, because variation in income inequality across regions is one possible explanation for regional variation in health measures, we control for county level income inequality in the survey sample, using a gini index of inequality calculated by the U.S. Census Bureau using 2000 census data. The gini index ranges from 0 to 1 and is a measure of the relative equality or inequality in shares of the total income earned in a community across income earners (Jones and Weinberg 2000).

The final source of data used for this study is the designation of U.S. counties along a nine stage urban to rural continuum. This categorization is based on the 2000 Census data and compiled by the Economic Research Service of the U.S. Department of Agriculture. The designation combines the reported population of each county with an indicator of whether it is within, adjacent to or separate from a Metropolitan Statistical Area.

Variable Definitions

Health is a complex construct and can be assessed in many dimensions. When health measures are gathered from a survey, as opposed to direct examination, the responses always represent an individual's personal perception and evaluation of their health status. The CTS includes four different measures of perceived health, each relatively commonly used in the health research literature. The first health measure provides a list of conditions to the respondents and asks whether a doctor or health professional ever told them that they had any of these conditions. We selected eight chronic conditions from this list and scored respondents from 0 to 8 based on whether they reported a history of the condition. The eight conditions are diabetes, arthritis, asthma, hypertension, coronary heart disease, chronic obstructive pulmonary disease, and depression.

The other health measures are drawn from standard survey questions included in the SF36, a widely used health status measure with extensive validation and norms in healthy and chronically ill populations (McDowel and Newell 1996). We include a global assessment of whether the respondents rate their health as excellent, very good, good, fair or poor, and the physical and mental components of the SF12, a subset of the SF36 that is also widely used as a generic measure of health status (Ware, Kosinski, and Keller, 1995). Both

summary components score respondents from 1 to 100 for physical and for mental health functioning, with a population standard mean score for adults of 50 points with a standard deviation of 10 points.

Needless to say, many unique individual factors affect respondents' assessments of their health status, as measured above, and a survey-based study can only control for a small fraction of these factors. In this study, using CTS data, we control for income, expressed as a cost of living adjusted percentage of the FPL and categorized as below 100% of the FPL, 100-200% of the FPL, 200-300% of the FPL and above 300% of the FPL. We also control for sex and age, as females consistently report more health problems and health status tends to decline over the life span. The relationship between age and health is not linear, and we account for the non-linear relationship by including splines in age. The choice of nodes is arrived at by a process of finding means of the health measures by age, and choosing those nodes which revealed a sizable discontinuity in health. Based on this identification, we categorize age of these respondents as 19 – 30, 31 – 50, 51-70 and above age 70. Higher education also tends to correlate to better health, so we use the highest grade completed from the survey responses to categorize respondents as having less than a high school education, having completed high school and having some education after high school. We control for the racial/ethnic background of the respondents using the most detailed level available on the survey, which is a mutually

exclusive categorization of individuals as White, Black or African American, Hispanic, or Asian, Native American or “Other”.

Studies indicate that married individuals report better health status than unmarried individuals (Waite, 1995); we include this and a separate measure of whether the adult’s household includes children as additional control variables. Health behaviors also have a major impact on health status, but measurement of these is limited in the Community Tracking Survey. We include a measure of whether the respondent ever smoked cigarettes and whether he or she currently smokes as indicators of health behaviors.

Three community level measures used in this study are the designation of the county by degree of urbanization, the gini coefficient for income inequality calculated at the county level, and region as described above. The effect of region on health is thus a summary of various unmeasured differences across regions that have a consistent impact on the health of individual residents.

Analytic Approach

The first analysis in this study is a bivariate comparison of risk factors and outcome measures across the four regions. These weighted frequencies, with

significance testing, are calculated using SUDAAN software, to account for the stratified sampling scheme.

The second set of analyses apply multivariate models for each of the four health status measures, testing whether region of residence is associated with the health measures, once other individual factors are taken into account. We use a Poisson regression model for the count data of the number of chronic conditions, an ordered probit model for the five stage model of general health status, and ordinary least squares models for the physical and mental component scores of the SF12. Analyses are conducted using STATA, with standard errors of parameter estimates corrected to adjust for the stratified sampling scheme. The models for general health status and for the physical and mental components of the SF-12 include the count of number of chronic conditions as a control factor, so that they represent perceived health and functional status, taking the number of chronic conditions that the respondent reported into account.

The third set of analyses repeat the multivariate models, but interact the region with the four categorical income levels. This tests whether the association between region and income is consistent across all income levels.

Finally, we use simulation modeling to explore whether the extent of the disparities in health measures across income levels is consistent across regions.

Because individuals with differing risk factors for poor health are unequally distributed across income levels, direct comparisons of health measures at high and low income levels may overstate the extent of the income associated disparities. For the simulation we estimate for each region the predicted health measures for an individual with average risk factors for the lowest income level group, using the coefficients from regressions conducted on that sub-sample in that region. The variable measuring relative degree of urbanization is not included in this regression, since some levels of this variable are not represented in all regions. In addition, the simulation models exclude the gini coefficients for communities. We then use those same average risk factors, but apply the coefficients from the regressions for the highest income group, and again predict the health measures. The scores on these health measures thus represent the average scores that a person with the average demographic characteristics of the population below the poverty level would have if they were part of the income group above 300% of the poverty level. The percentage difference in these two sets of health measures represent the income-related difference in health measures within the region. Comparing these differences across regions will allow us to identify which regions have greater or lesser disparities in health measures across the income gradient.

Findings

Table 3 shows regional differences in the risk factors associated with the health measures, and Table 4 shows differences in the health measures. There are regional differences in the distribution of all of the risk factors except for marital status. Individuals with cost of living adjusted incomes near and below the poverty level are more likely to live in the Northeast, past and current cigarette smokers are more likely to live in the Midwest, and those living in communities in the Northeast and the South have equivalent and significantly higher levels of average income inequality in their residential counties than those living in communities in the Midwest and West. The other negative risk factors, including older age, female sex, lower education levels, identifying as Black or African American and living in more rural areas, are more frequent for residents of the South. Residents of the South also are more likely to report being in fair or poor health and to have more functional restrictions related to physical health (i.e., lower average physical component SF12 scores).

Table 5 shows the results of the four multivariate analyses assessing the relationship between region of residence and health measures, once other risk factors are taken into account. With other factors taken into account, residents of the Northeast have fewer chronic conditions and, taking the number of chronic conditions into account, better perceived global health status as well as better perceived physical health status than residents of the South. Residents of the Midwest also reported fewer restrictions due either to physical or to mental health status than residents of the South.

Lower income levels are strongly negatively associated with all four health measures, with associations most negative at the lowest income levels. Compared to female respondents, male respondents had fewer chronic conditions, better reports of global health status and fewer physical and mental health related restrictions. Compared to respondents who identified themselves as White, those identifying as Black or African American reported more chronic conditions, worse general health status and worse physical functioning. Other non-white individuals also reported worse global health status and worse physical health status, while those identifying as Hispanic reported worse global health status and worse mental health related functioning. For the most part, older age was negatively associated with the health measures, except that mental health related functioning was better for older individuals within the age 30-50 gradient and the age 50-70 gradient, and physical functioning was better for older individuals within the age 50-70 gradient. Compared to respondents with some education after high school, those with high school and less than high school education reported worse assessments on all four health measures. Where the relatively urban or rural nature of the respondent's residential county was significantly associated with health measures, rural residents reported more chronic conditions, poorer general health status and poorer physical health status than urban residents, although residents of rural communities adjacent to metropolitan areas were much less likely to report limitations related to mental health status. Higher levels of income inequality in residential counties was

associated with fewer reports of chronic conditions, but not associated with other health measures. Individuals who were married reported fewer chronic health conditions and better mental health related functioning, but worse physical health status than those who were not married. Those with children reported fewer chronic health conditions and better physical functioning, but were more likely to report lower general health status. Respondents who had ever smoked reported more chronic conditions and worse general health status, while those who were currently smoking reported worse general health status and lower scores on the measures of physical and mental health status.

Table 6 shows the multivariate analyses with tests for the difference in the impact of income across regions. The main effects shown in the table represent the extent, direction and statistical significance of the measures for the reference group – residents of the South with incomes above 300% of the FPL. All income groups for Southern residents have lower scores on all four health measures than the highest income group (the income main effect in Table 6). Within this highest income group, residents of the Northeast reported fewer chronic conditions, better general health status, better physical functioning but worse mental health functioning than residents of the South. Residents of the West also reported worse mental health functioning than residents of the South in this income group (the region main effect in Table 6).

For three of the four health measures, the association between region and health in the lowest income group is the same as in the highest income group. Lowest income residents of the Northeast have fewer chronic conditions, better general health status and better physical functioning than lowest income residents of the South. However, in this lowest income group, residents of the Northeast, Midwest and West all have better mental health function scores than lowest income residents in the South, in contrast to the findings at the highest income level, where residents of the South had higher scores. Differences in health measures across regions is more pronounced in the 100% FPL to 200% FPL income group: residents of the Northeast have fewer chronic conditions than residents of the South to a greater extent than in the higher income group, while residents of the Northeast, Midwest and West report better physical function and those in the Northeast report better mental health function. At the next highest income level, 200%-300% FPL, residents of the Northeast report even better physical function than residents of the South than in the highest income group.

In sum, the regional differences observed in the number of chronic conditions, general health status and physical functioning persist across the income gradient, and are actually more pronounced for those individuals who are slightly above the poverty level, compared to the lowest or highest income groups. However, mental health functioning is clearly worse for the lowest income residents of the South, compared to other regions, but better for the highest income residents of the South compared to the other regions. The other

risk factor associations are the same as those described above in Table 5: more education, male sex, white race/ethnicity and for the most part younger age are all associated with better performance on the health measures. Current and past smokers report poorer health status. Respondents who are married report fewer chronic conditions and better mental health functioning, but poorer physical functioning. Those in more rural areas generally have poorer health status, and higher levels of income inequality are associated with reports of fewer diagnosed chronic conditions.

The third aspect of this analysis of regional variation in health measures compares the extent of the gap in health measures between the lowest and highest income groups across regions. For this simulation analysis, we estimated the predicted health scores for the "average" lowest income individual in each region, and then estimated what the predicted health scores would be for someone with the same risk characteristics in the highest income level. Table 7 compares the means of the risk characteristics for the lowest and highest income levels in each region. Table 8 shows the percent difference in each predicted health score in each region between the lowest and highest income categories for individuals with the average characteristics of the lowest income category.

Table 7 shows that higher income groups in each region have fewer of the non-income characteristics associated with poorer health status: there are fewer females, fewer who are not white, fewer individuals with a high school or lower

education, fewer unmarried adults, and fewer previous or current smokers. Table 8 shows that the biggest income gap in health measures occurs for the general health status question, taking the number of chronic conditions reported into account. Residents of the Northeast have the least difference in this health measure, while residents of the other regions all have double the portion of highest to lowest income residents rating their health as excellent, taking other risk factors into account. The next largest gap in health measures across income groups is in the count of the number of chronic conditions. For this measure, there is less difference across income groups in the South compared to other regions. For measures of functional restrictions related to physical symptoms, taking the number of chronic conditions into account, residents of the Northeast and West have less difference across the income groups than residents of the Midwest and South. Finally, for functional restrictions related to mental health symptoms, the greatest gap across the income range is in the South, while the smallest gap across income ranges is in the Western region.

Discussion

It is clear from this study, as well as from much of the other research literature, that lower income has a direct negative effect on perceived health status, and also that individuals in lower income groups have more of the other risk factors associated with poor health. Lower incomes, less education and

smoking history and status have a consistent negative effect across the four measures of health status examined here. Controlling for other factors, individuals identifying as Black or African American have a slightly higher count of chronic conditions, report poorer health status and report more restricted physical functioning than those identifying as White, but report no difference in restrictions related to mental health status. Individuals identifying as Asian, Native American or "other" report poorer general health status and more restricted physical functioning, while those identifying as Hispanic report poorer general health status and more restricted mental health functioning than those identifying as White. Family structural features have a somewhat mixed effect on the health measures used in this study: both married individuals and those with children report fewer chronic conditions. Those with children also report better general health status and fewer limitations due to physical health status. Those who are married report more restrictions on physical function but fewer restrictions related to mental health status. Higher levels of income inequality in the community are associated only with fewer reports of diagnosed chronic diseases, once the direct effect of income is controlled in the multivariate analysis. This finding may indicate lower levels of access to sources of care that would diagnose chronic conditions in communities where income is concentrated within a smaller segment of the population, but this hypothesis would need to be tested with further research.

When all of these factors, along with the relative urban or rural nature of the county of residence are taken into account, residents of the U.S. South report more chronic conditions, poorer general health status, and more restrictions due to physical health status than residents of the Northeast, as well as more functional restrictions related to physical and mental health status than residents of the Midwest. The income interaction analysis indicates that the disadvantage for residents of the South on chronic conditions, general health status and functional restrictions related to physical health status exists across the income gradient, and is actually most marked for individuals with cost of living adjusted incomes between 100% and 200% of the Federal Poverty Level. For functional restrictions related to mental health status, however, lower income residents of the South are at a disadvantage relative to other regions, while higher income residents of the South are advantaged relative to residents of other regions.

There are some regional differences in the extent of the gap between the lowest and highest income groups on health measures, but they are not dramatic. The gap is similar across regions on the count of chronic conditions, and similar for the Midwest, South and West in the comparison of reports of general health status. The Midwest and South both have about an 11% difference in the extent of restrictions related to physical health status between the lowest and highest income groups, higher than the 7% difference in the Northeast and Midwest. Regional variation is most noticeable in the income gap

related to mental health status. The gap is much lower for residents of the West and much higher for residents of the South.

An important limitation of this study is associated with the limitations on the measure of income used – cost of living adjusted income expressed as a percentage of the federal poverty level. Because some communities in the Northeast (particularly in the New York metropolitan area) had very high cost of living indices relative to the rest of the country, residents with relatively higher cash incomes have been classified in lower income categories (see Table 2). In addition the income based poverty level measure does not take into account the value of welfare related benefits such as health insurance and income support, which may be greater at higher income levels in some regions compared to others. To the extent that residents of the Northeast classified in the lower income groups in this study have higher cash incomes and possibly more welfare related benefits than residents of the South in the same income groups, region may be serving as a proxy, to some extent for actual differences in material resources. However, since regional variation was observed across income levels, this limitation is not the only explanation for the observed regional variations in health measures.

The observation that regional differences in three of the four health measures are consistent suggests that the differences are related to perceived health status, and are not an artifact of regional variations in interpretation of the

survey questions. The observation that variations persist across the income gradient suggests that the underlying features that cause these variations are affecting the entire population in the region, not only the low income segment of the population. In contrast, however, regional variations in measures of mental health function clearly differ across income groups. These findings suggest that a wide variety of community level factors influence health status across the income gradient, while a separate set of community level factors may interact with income in communities to increase particularly mental health risks for a subset of the population. A fruitful area for further research would be the identification of the specific community level characteristics, accruing at the regional level in the U.S., that have a negative impact on mental health status for low income groups.

References

Brady, D. (2003) Re-thinking the sociological measurement of poverty. Social Forces 81:715-752.

Cutler, S. and Coward, RT (1988) Residence difference in the health status of elders. Journal of Rural Health 4, 11-26.

Hillemeier, M. M., Lynch, J., Harper, S., Casper, M. (2003) Measuring contextual characteristics for community health. Health Services Research 38(6 Part 2), 1645-1717.

Holtzman, D. , Powell-Griner E., Bolen, J.C., Rhodes, L. (2000) State- and sex-specific prevalence of selected characteristics- Behavioral Risk Factor Surveilance System, 1996 and 1997. MMWR 49(SS06);1-39, 7/7/2000.

Kaplan, G.A., Pamuk, E.R., Lynch, J.W., Cohen, R.D. and Balfour, J.L. (1996) Inequality in income and mortality in the United States: Analysis of mortality and potential pathways. BMJ 31297037):999-1003.

Kawachi I, Kennedy BP, Lochner K, Prothrow-Stith D. Social capital, income inequality, and mortality. American Journal of Public Health 1997;87:1491-1498.

Kemper, P., Blumenthal, D., Corrigan, J.M., Cunningham, P.J., Felt, S.M., Grossman, J.M., Kohn, L.T., Metcalf, C.E., St. Peter, R.F., Strouse, R.C. and Ginsburg, P.B. (1996). The design of the Community Tracking Study: A longitudinal study of health system change and its effects on people. Inquiry 33, 195-206.

Waite, L.J. (1995) Does Marriage Matter? Demography 32, 483-508.

Lin, G. (2000) Regional assessment of elderly disability in the U.S. Social Science and Medicine 50, 1015-1024.

Lynch, J., Smith, G.D., Harper, S., Hillemeier, M., Ross, N., Kaplan, G.A., and Wolfson, M. (2004a) Is Income inequality a determinant of population health? Part I. A systematic review. The Millbank Quarterly 82,5-100.

Lynch, J., Smith, G.D., Harper, S., Hillemeier, (2004b) Is Income inequality a determinant of population health? Part 2. U.S. National and Regional Trends in Income Inequality and age and cause-Specific mortality The Millbank Quarterly 82,355-400.

Matthews, T.J., Marian, M.S., MacDorman, M.F., and Menacker, F. (2002) Infant mortality statistics from the 1999 period linked birth/infant death data set. National Vital Statistics Report 50(4), Centers for Disease Control, 1/30/2002

McDowel, I, Newell, C. (1996) Measuring Health: A guide to rating scales and questionnaires 2nd Ed. New York; Oxford University Press

Porrell, F.W.and Miltiades H.B., (2002) Regional differences in functional status among the aged. Social Science and Medicine 54,1181-1198.

Rowland D and Lyons B. (1989) Triple jeopardy: Rural, poor and uninsured. Health Services Research 23,975-1004.

Ware, JE, Kosinski, M, and Keller, SD. (1995) SF-12: How to Score the SF-12 Physical and Mental Health Summary Scales. 2nd ed. Boston, MA: The Health Institute, New England Medical Center

Williams, D.E., Collins, C. (1995) US Socioeconomic and racial differences in health: Patterns and explanations. Annual Review of Sociology 21, 349-386.

Wing, S., Barnett, E., Casper, M., Tyroler, H.A., (1992) Geographic and socioeconomic variation in the onset of decline of coronary heart disease mortality in White women. American Journal of Public Health 82, 204-209.

Zopf, P.E. (1992) Mortality Patterns and Trends in the United States. Greenwood Press, Westport CT.

Figure 1. Division of U.S. States with CTS Sample Sites into Regions

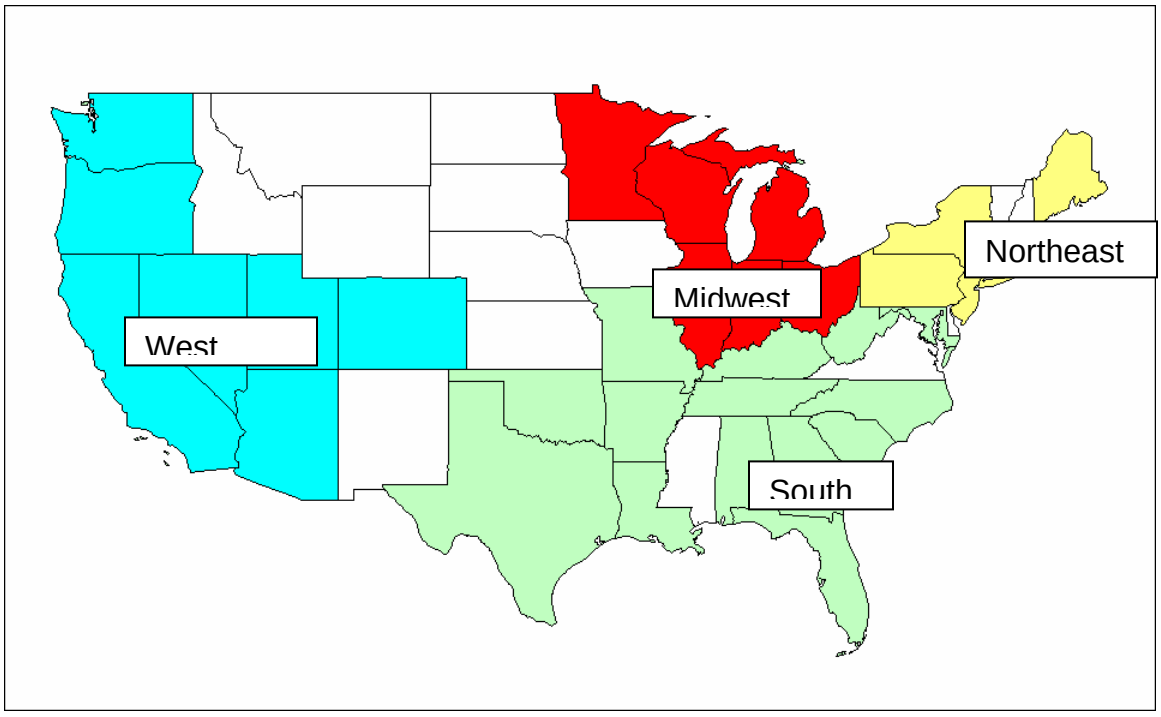

Table 1 Comparison of CTS Sample and Census Data

	% < 100% FPL	% 100-200% FPL	% 200 + FPL	% White non-Hispanic	% Black non-Hispanic	% Asian, native, other, non-Hispanic	% Hispanic
Northeast							
Census	8.99	15.09	75.92	72.89	11.32	4.43	9.69
CTS	10.88	14.86	74.26	74.07	11.48	4.16	10.29
Midwest							
Census	7.61	15.60	76.80	80.62	10.44	2.49	5.08
CTS	9.76	16.87	73.37	82.93	9.67	2.67	4.73
South							
Census	10.46	19.58	69.96	67.09	17.39	2.64	11.48
CTS	15.60	19.81	64.59	66.19	18.79	2.85	12.17
West							
Census	9.88	18.93	71.19	60.64	4.53	9.37	22.66
CTS	12.89	18.01	69.10	67.00	3.64	6.79	22.57

Table 2. Income comparisons Across CTS Sites within Regions

	Northeast N= 10,013	Midwest N = 9,382	South N = 15,437	West N = 10,027
Mean [se] of Median income in counties in region	$48,451[ttt] [2491]	$44,277[ttt] [622]	$37,614 [981]	$47,931[ttt] [1771]
% < 100% FPL	10.15	8.48	13.96	11.00**
% 100-200% FPL	14.10	15.45	18.49	16.86**
%200-300% FPL	15.73	18.85	18.11	18.20**
% 300%+ FPL	60.01	57.23	49.44	53.93**
Mean [se] ACCRA Cost of Living Index for sites in survey sample	147.04[ttt] [13.80]	100.71[ttt] [0.63]	97.23 [0.49]	114.62[ttt] [3.77]
% < 100% FPL COL adjusted	16.38	8.63	13.37	13.41***
% 100-200% FPL COL adjusted	21.13	16.01	18.09	18.42***
% 200-300% FPL COL adjusted	18.30	18.49	17.29	19.96***
% 300%+ FPL COL adjusted	50.19	56.87	51.25	48.20***

* chi square p < .05 ** chi square p < .01 *** chi square p < .001
[t] t-test comparing each mean to mean of South p < .05
[tt] t-test comparing each mean to mean of South p < .01
[ttt] t-test comparing each mean to mean of South p < .001

Table 3 Individual Risk Factor Comparisons Across Regions

	Northeast N= 10,013	Midwest N = 9,382	South N = 15,437	West N = 10,027
% < 100% FPL COL adjusted	16.38	8.63	13.37	13.41***
% 100-200% FPL COL adjusted	21.13	16.01	18.09	18.42***
% 200-300% FPL COL adjusted	18.30	18.49	17.29	19.96***
% 300%+ FPL COL adjusted	50.19	56.87	51.25	48.20***
% male	47.90	48.10	47.10	49.14***
% White	75.57	84.15	68.15	69.79***
% Black	10.84	8.87	17.45	3.53***
% Other	3.92	2.48	2.84	6.88***
% Hispanic	9.67	4.50	11.55	19.80***
% Age < 40	42.01	41.62	40.72	46.57***
% Age 40-64	41.56	42.61	41.07	39.18***
65+	16.44	15.77	18.21	14.25***
% < 12 grade	12.22	12.94	18.60	15.39***
% 12 grade	35.08	39.18	35.80	31.09***
> 12 grade	52.70	47.89	45.60	53.52***
Reside Metro over 1 million	62.76	56.35	29.58	68.90***
Reside Metro 250,000 – 1 million	23.37	14.57	37.29	9.83***
Reside Metro < 250,000	0	10.49	10.54	6.14***
Reside Non Metro 20,000 + adjacent to metro	5.18	9.04	5.09	5.15***
Reside Non Metro 20,000 + Not adjacent to metro	0	0	2.25	1.88***
Reside Non Metro 2500 – 20,000 adjacent to metro	4.45	7.38	5.33	3.74***
Reside Non Metro 2500-20,000 not adjacent to metro	3.65	2.00	3.27	3.47***
Reside Rural adjacent to metro	0.59	0.16	2.84	0.24***
Reside Rural not adjacent to metro	0	0	3.80	0.64***

	Northeast N= 10,013	Midwest N = 9,382	South N = 15,437	West N = 10,027
Mean gini coefficient for income inequality in community	0.46	0.42[ttt]	0.46	0.44[tt]
% Married	60.07	61.52	62.14	61.73
% Have children	38.67	40.19	37.72	40.88*
% Ever smoked	49.77	53.15	49.44	45.70*
% Smoke now	21.34	26.76	24.40	19.39***

* chi square $p < .05$ ** chi square $p < .01$ *** chi square $p < .001$
[tt] t-test comparing each mean to mean of South $p < .01$
[ttt] t-test comparing each mean to mean of South $p < .001$

Table 4 Health Measure Comparisons Across Regions

	Northeast N= 10,013	Midwest N = 9,382	South N = 15,437	West N = 10,027
% Any chronic conditions	44.91	46.09	48.65	41.94***
Mean [se] number of chronic conditions, those with any	1.67 [0.02]^{ttt}	1.71 [0.01]^{ttt}	1.77 [0.02]	1.64 [0.02]^{ttt}
General Health Excellent	22.48	19.82	19.42	22.93***
Very Good	37.27	38.82	33.76	34.95***
Good	25.95	26.67	28.24	26.01***
Fair	11.35	11.42	13.21	12.43***
Poor	4.04	3.27	5.36	3.66***
Mean [se] Physical Component Score of SF12	49.23^{ttt} [0.20]	48.66^{ttt} [0.17]	47.39 [0.26]	48.92^{ttt} [0.24]
Mean [se] Mental Component Score of SF12	52.21 [0.23]	52.60^{tt} [0.15]	52.01 [0.15]	51.95 [0.11]

* chi square p < .05 ** chi square p < .01 *** chi square p < .001
^{t} t-test comparing each mean to mean of South p < .05
^{tt} t-test comparing each mean to mean of South p < .01
^{ttt} t-test comparing each mean to mean of South p < .001

Table 5. Multivariate analysis of factors affecting health scores

	Number of chronic conditions (low is better)	Global health status (low is better)	Physical Component Score (high is better)	Mental Component Score (high is better)
	Coeff [t]	Coeff [t]	Coeff [t]	Coeff [t]
< 100% fpl	0.323 [10.26]***	0.353 [12.96]***	-3.380 [-14.57]***	-2.947 [-9.92]***
100-200% fpl	0.179 [6.69]***	0.249 [10.33]***	-2.199 [-13.03] ****	-1.530 [-6.58]***
200-300% fpl	0.137 [5.65]***	0.136 [5.97]***	-1.147 [-7.15]***	-0.300 [-1.99]*
300%+ fpl	Reference	Reference	Reference	Reference
Northeast	-0.100 [-3.92]***	-0.086 [-3.77] ***	1.101 [5.91]***	-0.053 [-0.31]
Midwest	-0.032 [-1.19]	-0.030 [-1.03]	0.491 [2.23]*	0.266 [1.67]
South	Reference	Reference	Reference	Reference
West	-0.082 [-2.52]*	-0.027 [-1.01]	0.280 [1.44]	-0.341 [-2.06]*
Male	-0.187 [-14.30]***	-0.061 [-3.74]***	1.016 [-10.02]***	1.506 [12.57]***
White	Reference	Reference	Reference	Reference
Black	0.093 [2.73]**	0.145 [8.17]***	-0.676 [-3.40] **	0.159 [0.69]
Other	0.036 [0.87]	0.196 [5.03]***	-1.342 [-6.11]***	-0.318 [-1.24]
Hispanic	-0.049 [-1.19]	0.301 [5.99]***	-0.096 [-0.37]	-0.546 [-2.69]**
< 30	0.010 [2.31]*	0.008 [2.09]*	-0.064 [-3.02]**	-0.077 [-3.21]**
30-50	0.050 [24.47]***	0.006 [4.99]***	-0.090 [-8.82]***	0.085 [5.64]***
50-70	0.024 [14.44]***	-0.007 [-4.61]***	0.011 [0.68]	0.271 [16.87]***
70+	-.005 [-2.70]**	0.013 [4.03]***	-0.276 [-8.41]***	-0.065 [-2.77]**
< 12 grade ed	0.132 [4.80]***	0.457 [13.02]***	-2.433 [-10.16]***	-1.327 [-4.79]***
12 grade ed	0.033 [1.96]	0.170 [13.77]***	-0.905 [-5.78]***	0.150 [1.54]
> 12 grade ed	Reference	Reference	Reference	Reference
Metro 1,000 k+	Reference	Reference	Reference	Reference
Metro 250 k – 1,000 k	0.057 [2.30]*	0.022 [1.18]	-0.376 [-2.35]*	-0.048 [-0.34]
Metro < 250 k	0.115 [4.32]***	0.061 [1.95]*	-0.871 [-3.94]***	-0.045 [-0.23]
Non Metro 20 k + Adjacent	0.040 [1.08]	0.078 [2.45]*	-0.363 [-0.76]	0.681 [3.21]**
Non Metro 20 k + Not Adjacent	0.174 [2.79]**	0.077 [2.26]*	-0.501 [-1.96]	0.178 [0.76]
Non Metro 2500 – 20 K adjacent	0.030 [0.80]	0.085 [2.98]**	-1.133 [-4.14]***	0.423 [1.57]
Non Metro 2500- 20K not adjacent	-.002 [-0.03]	0.100 [2.49]*	-.491 [-1.84]	0.544 [1.76]

	Number of chronic conditions (low is better)	Global health status (low is better)	Physical Component Score (high is better)	Mental Component Score (high is better)
Rural adjacent	0.122 [2.03]*	-0.019 [-0.29]	-1.417 [-2.10]*	-0.012 [-0.03]
Rural not adjacent	-0.045 [-0.92]	0.141 [1.45]	-0.939 [-2.09]*	-0.674 [-1.57]
Gini index	-0.767 [-3.94]***	-.211 [-0.83]	1.801 [1.14]	-2.495 [-1.45]
Married	-0.048 [-2.85]**	0.020 [1.25]	-0.304 [-2.27]*	0.955 [7.18]***
Has children	-0.176 [-6.97]***	-0.051 [-2.59]*	1.144 [9.26]***	-0.228 [-1.91]
Ever smoked	0.183 [10.54]***	0.055 [2.84]**	-0.284 [-1.86]	-0.199 [-1.33]
Smokes now	-0.025 [-1.07]	0.218 [11.40]***	-0.708 [-4.91]***	-1.901 [-9.85]***
Number of Chronic conditions	----------	0.445 [41.60]***	-4.00 [-51.82]***	-2.648 [-32.70]***

Table 6. Multivariate analysis of factors affecting health scores, interacting region and income

	Number of chronic conditions (low is better)	Global health status (low is better)	Physical Component Score (high is better)	Mental Component Score (high is better)
	Coeff [t]	Coeff [t]	Coeff [t]	Coeff [t]
Main Effects				
< 100% fpl	0.273 [5.68]***	0.330 [7.24]***	-3.655 [-8.13]***	-4.10 [-10.71]***
100-200% fpl	0.195 [4.79]***	0.277 [7.53]***	-3.053 [-13.13]***	-2.14 [-6.36]***
200-300% fpl	0.158 [3.47]**	0.156 [3.17]**	-1.531 [-5.24]***	-0.120 [-0.43]
300%+ fpl	Reference	Reference	Reference	Reference
Northeast	-0.100 [-3.92]***	-0.058 [-2.45]*	0.607 [2.91]**	-0.507 [-2.59]*
Midwest	-0.041 [-1.36]	-0.031 [-1.51]	0.283 [1.66]	0.008 [0.04]
South	Reference	Reference	Reference	Reference
West	-0.068 [-1.85]	-0.027 [-1.22]	-0.197 [-0.95]	-0.694 [-3.83]***
Interactions with < 100% fpl				
Northeast	0.096 [1.52]	0.014 [0.24]	0.276 [0.47]	1.730 [3.88]***
Midwest	0.105 [1.67]	-0.012 [-0.23]	-0.059 [-0.10]	1.481 [2.08]*
South	Reference	Reference	Reference	Reference
West	0.059 [0.81]	0.078 [0.89]	0.915 [1.36]	2.116 [3.37]**
Interactions with 100% - 200% fpl				
Northeast	0.011 [0.22]	-0.124 [-2.47]*	1.520 [4.04]***	1.380 [3.31]**
Midwest	0.009 [0.15]	0.025 [0.41]	0.994 [2.42]**	0.600 [1.00]
South	Reference	Reference	Reference	Reference
West	-0.096 [-1.81]	-0.019 [-0.33]	1.396 [3.65]***	0.784 [1.54]
Interactions with 200%-300% fpl				
Northeast	-0.019 [-0.35]	-0.025 [-0.43]	0.939 [2.60]**	-0.341 [-0.87]
Midwest	-0.037 [-0.60]	-0.020 [-0.38]	0.214 [0.53]	-0.084 [-0.19]
South	Reference	Reference	Reference	Reference
West	-0.038 [-0.61]	-0.041 [-0.74]	0.643 [1.73]	-0.307 [-0.80]
Male	-0.188 [-14.33]***	-0.061 [-3.76]***	1.015 [10.01]***	1.503 [12.46]***
White	Reference	Reference	Reference	Reference
Black	0.094 [2.73]**	0.148 [8.26]***	-0.602 [-2.87]**	0.195 [0.83]
Other	0.034 [0.82]	0.197 [5.04]***	-1.329 [-5.98]***	-0.327 [-1.30]
Hispanic	-0.47 [-1.13]	0.299 [5.92]***	-0.107 [-0.36]	-0.612 [-2.91]**
Age < 30	0.102 [2.31]*	0.008 [2.11]*	-0.063 [-2.99]**	-0.772 [-3.21]**
Age 30-50	0.050 [24.33]***	0.006 [4.97]***	-0.089 [-8.96]***	0.086 [5.85]***
Age 50-70	0.024 [14.63]***	-0.007 [-4.64]***	0.012 [0.70]	0.272 [16.88]***
Age 70+	-0.006 [-2.76]**	0.013 [4.06]***	-0.275 [-8.41]***	-0.063 [-2.70]**
< 12 grade ed	0.132 [4.76]***	0.455 [12.97]***	-2.415 [-10.10]***	-1.290 [-4.66]***
12 grade ed	0.032 [1.88]	0.171 [13.86]***	-0.918 [-5.72]***	0.137 [1.32]

	Number of chronic conditions (low is better)	Global health status (low is better)	Physical Component Score (high is better)	Mental Component Score (high is better)
> 12 grade ed	Reference	Reference	Reference	Reference
Metro 1,000 k+	Reference	Reference	Reference	Reference
Metro 250 k – 1,000 k	0.059 [2.38]*	0.208 [1.13]	-0.375 [-2.36]**	-0.049 [-0.35]
Metro < 250 k	0.115 [4.36]***	0.059 [1.95]	-0.856 [-3.83]***	-0.034 [-0.18]
Non Metro 20 k + Adjacent	0.042 [1.15]	0.075 [2.35]*	-0.362 [-0.76]	0.703 [3.19]***
Non Metro 20 k + Not Adjacent	0.177 [2.80]**	0.077 [2.23]*	-0.546 [-2.17]*	0.167 [0.30]
Non Metro 2500 – 20 K adjacent	0.031 [0.84]	0.083 [2.91]**	-1.094 [-4.03]***	0.470 [1.76]*
Non Metro 2500- 20K not adjacent	0.001 [0.01]	0.102 [2.61]**	-0.492 [-1.72]	0.557 [1.86]*
Rural adjacent	0.131 [2.13]*	-0.021 [-0.31]	-1.383 [-2.01]*	0.126 [0.28]
Rural not adjacent	-0.045 [-0.89]	0.136 [1.43]	-0.813 [-1.79]	-0.580 [-1.47]
Gini	-0.783 [-4.09]***	-.211 [-.81]	2.005 [1.23]	-2.48 [-1.50]
Married	-0.047 [-2.78]**	0.021 [1.27]	-0.316 [-2.39]*	0.955 [7.28]***
Has children	-0.175 [-6.92]***	-0.052 [-2.66]**	1.146 [9.21]***	-0.214 [-1.78]
Ever smoked	0.182 [10.62]***	0.055 [2.82]**	-0.291 [-1.90]	-0.210 [-1.43]
Smokes now	-0.026 [-1.11]	0.218 [11.43]***	-0.705 [-4.87]***	-1.906 [-10.04]***
Number of Chronic conditions	----------	0.445 [41.72]***	-3.996 [-52.11]***	-2.649 [-33.12]***

Table 7. Mean Risk Characteristics of Lowest and Highest Income Groups in Each Region

	Northeast		Midwest		South		West	
	Lowest Income	Highest Income	Lowest Income	Highest Income	Lowest Income	Highest Income	Lowest Income	Highest Income
# Chronic conditions (including none)	1.03	0.66	1.21	0.70	1.19	0.76	0.87	0.66
Male	0.37	0.49	0.36	0.48	0.35	0.47	0.41	0.49
Black	0.25	0.05	0.26	0.06	0.34	0.13	0.06	0.03
Other	0.05	0.03	0.04	0.02	0.03	0.03	0.07	0.07
Hispanic	0.19	0.03	0.08	0.03	0.20	0.08	0.43	0.09
< High school	0.31	0.03	0.37	0.04	0.42	0.06	0.37	0.05
High school	0.42	0.27	0.39	0.34	0.37	0.32	0.35	0.26
Age < 30	28.37	28.90	28.43	28.79	28.51	28.51	28.05	28.85
Age 30-50	11.48	12.69	11.14	12.28	12.02	12.54	9.49	12.31
Age 50-70	5.44	3.93	5.37	3.75	6.18	4.25	3.80	4.07
Married	0.36	0.73	0.33	0.72	0.37	0.71	0.44	0.69
Has Children	0.34	0.42	0.34	0.40	0.34	0.38	0.42	0.37
Ever Smoked	0.52	0.48	0.58	0.50	0.49	0.46	0.47	0.44
Smokes Now	0.30	0.16	0.38	0.21	0.29	0.19	0.26	0.16

Table 8. Percentage Difference in Health Measures Holding Risk Factors Constant

	Northeast	Midwest	South	West
Number of Chronic conditions				
Lowest income group predicted number	0.85	0.99	0.91	0.77
Highest income group predicted number	0.61	0.71	0.67	0.55
% difference	28.2	28.2	26.3	28.5
General Health Status				
Lowest income group predicted probability of excellent health	0.12	0.06	0.05	0.05
Highest income group predicted probability of excellent health	0.18	0.12	0.10	0.10
% difference	50.0	100.0	100.0	100.0
Physical Component Score				
Lowest income group predicted score	45.16	44.31	43.15	45.81
Highest income group predicted score	48.13	48.33	46.77	48.76
% difference	6.6	10.92	10.74	6.4
Mental Component Score				
Lowest income group predicted score	49.09	48.18	47.71	49.14
Highest income group predicted score	51.47	51.42	51.64	50.97
% difference	4.84	6.70	8.23	3.72

Appendix Table 1. Sites included in the Community Tracking Study Survey

Northeast	Midwest	South	West
Boston, MA	Cleveland OH	Greenville SC	Orange County CA
Newark NJ	Indianapolis IN	Little Rock AR	Phoenix AZ
Syracuse NY	Lansing MI	Miami FL	Seattle WA
Bridgeport CT	Chicago IL	Atlanta, GA	Denver CO
Middlesex NJ	Columbus OH	Augusta GA/SC	Las Vegas NV/AZ
Nassau NY	Detroit MI	Baltimore MD	Los Angeles CA
New York City NY	Milwaukee WI	Greensboro NC	Modesto CA
Philadelphia PA/NJ	Minneapolis MN/WI	Houston TX	Portland OR/WA
Pittsburgh PA	Terre Haute IN	Knoxville TN	Riverside CA
Rochester NY	Northeastern IL	Huntington WV/KY/OH	San Francisco CA
Worcester MA	Northeastern IN	Killeen TX	Santa Rosa CA
Eastern Maine		San Antonio TX	Northern UT
		Shreveport LA	Northwestern WA
		St. Louis MO/IL	
		Tampa FL	
		Tulsa OK	

Northeast	Midwest	South	West
		Washington DC/MD	
		West Palm Beach FL	
		Dothan AL	
		Wilmington NC	
		West Central AL	
		Central AR	
		Northern GA	
		Eastern NC	

Appendix Table 2. Substitutions for CTS sites with no ACCRA cost of living data

CTS site	Substitute site used as source of cost of living data	CTS site	Substitute site used as source of cost of living data
Modesto CA	Fresno CA	Middlesex NJ	Nassau NY
Orange County CA	San Diego CA	Newark NJ	New York City NY
Santa Rosa CA	San Francisco CA	Rochester NY	Buffalo NY
Bridgeport CT	New Haven CT	Syracuse NY	Binghamton NY
Miami FL	Orlando FL	Northeast ME	Plattsburgh NY
Terre Haute IN	Bloomington IN	Columbus OH	Dayton OH
Baltimore MD	Washington DC	Greenville SC	Columbia SC
Worcester MA	Natick MA	Seattle WA	Tacoma WA
Detroit MI	Toledo OH	Milwaukee WI	Sheboygan WI