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1. Introduction

Disparities in child health by race and ethnicity, socioeconomic status, and immigration status are a major concern for policymakers and the public. The reduction of these disparities is a key goal of U.S. public health policy, as outlined in *Healthy People 2010.* Family background and behaviors, and the characteristics of neighborhoods in which children live, are likely to play the central role in creating and maintaining disparities in child health. Social epidemiologists have argued that persistent residential segregation by race/ethnicity and social class is likely to be a key cause of social disparities in health (Diez Roux, 2001; Acevedo-Garcia, 2000; Robert, 1999). Residential segregation concentrates social problems and health risk factors in poor, minority, and immigrant neighborhoods. Residents in poor neighborhoods may, therefore, be exposed to greater health risks than they would be purely because of their own socioeconomic status.

Robert (1999) suggests that poor neighborhoods can have detrimental effects on individual health status through three types of pathways. First, concentration of poverty and related characteristics may create more detrimental social environments (e.g., violence, stress and anxiety, exposure to drugs, limited social control). Second, poorer communities are less likely to have access to adequate health care and social services. Third, the physical environment (e.g., air pollutants, hazardous conditions leading to accidents, poorer sanitation) in poor communities may be worse than in more affluent communities.

This paper examines the effects of family and neighborhood factors on child health in one of the largest urban areas in the United States, Los Angeles County. We use data from a new representative survey of neighborhoods and households in L.A.—the Los Angeles Family and Neighborhood Survey, or L.A.FANS—to examine the effects of family and neighborhood characteristics on child health status. A particular focus is on differences between Latinos and other race/ethnic groups as well as differences by duration of family residence in the U.S. and other key factors. We seek to answer two questions. First, how are family background factors such immigrant status, ethnicity, and social class related to child health outcomes? Second, are there differences in health outcomes by neighborhood-level socioeconomic status, once individual and family differences are held constant? Among the child health outcomes we examine are the mother's report of the child's overall health status, reports of physician diagnoses of key chronic diseases (such as anemia and asthma), and, among children aged 12-17 years, body mass index adjusted for age as well as indicators of being overweight or at risk of overweight.

The paper is organized as follows. In the next section, we describe Los Angeles, the data used in the analysis, the specific child health outcomes that we examine, and our modeling approach. In Section 3, we present descriptive and multivariate results. In the final section we discuss the results and highlight some policy implications and directions for future research.

2. Study Setting, Data, and Methods

The setting for this study is Los Angeles County, California. The total 2000 county population of about 9.5 million was 45% Latino, 31% white, 13% Asian-Pacific Islander, and 10% African American. Los Angeles is a major destination for immigrants: in 2000, about 30% of the population was foreign born. These figures, however, underestimate the size of migration streams because Los Angeles is an initial point of entry into California for both immigrants and for migrants from other states who subsequently move on to other counties (Frey, 1995). Recent immigration has dramatically changed many neighborhoods, as immigrants replace African Americans and native-born Latinos in inner city areas, and the displaced former inner-city dwellers move into increasingly multi-ethnic communities elsewhere in the County (Frey and Farley, 1996; Clark, 1996). Residential segregation by ethnicity is not as extreme as in many mid-west and northeastern cities, but is, nonetheless, a major force in the social and political life of Los Angeles. Residential segregation by race and ethnicity declined only slightly in Los Angeles between 1990 and 2000 (Logan, 2002; Mare and Cort, 2003). Los Angeles County shares many health problems with other major metropolitan areas in the United States, including violence-related injury and death and the difficulty of providing health services to a very large and diverse low-income population (Finucane, 1998).

Data: The Los Angeles Family and Neighborhood Survey

This study is based on data from the first wave of the Los Angeles Family and Neighborhood Survey (L.A.FANS) which was fielded in a sample of 65 census tracts throughout Los Angeles County. L.A.FANS is a longitudinal survey, designed to answer research questions about the effects of neighborhood social environments on outcomes for adults and children in Los Angeles. Wave 1 of the L.A.FANS survey began in April 2000 and was completed at the end of 2001.

L.A.FANS is based on a multistage clustered sampling design. First, census tracts in Los Angeles County were divided into three strata based on the percent of the tract's population in poverty in 1997. The three strata are: very poor (those in the top 10 percent of the poverty distribution), poor (tracts in the 60-89th percentiles), and non-poor (tracts in the bottom 60 percent of the distribution). To achieve an oversample of poor and very poor tracts, 20 tracts were sampled in the poor and very poor strata. An additional 25 tracts were sampled in the non-poor stratum, for a total of 65 tracts (see Sastry et al., 2000, for more information). In the second stage, census blocks were sampled within each tract and all dwelling units were listed in sampled blocks. In the third stage, households were sampled within each block and screened. Approximately 40-50 households were interviewed in each census tract, for a total sample size of 3,000 households.

In households with children, one child was chosen at random from all household members age 17 and younger. If the child had one or more siblings, one of these was chosen at random as a second sampled child. Interviews were conducted with sampled children's mothers and sampled children over age nine. L.A.FANS collected extensive information on the household socioeconomic status, family life, neighborhood life, residential mobility, program participation, health status, health insurance, health care utilization, and many other topics. To permit comparisons with national-level survey data, the L.A.FANS employed standard, well-tested batteries of questions from the Panel Study of Income Dynamics, the National Longitudinal Survey, the National Survey of Families and Households, and other national surveys. Questions on health status in L.A.FANS came primarily from the National Health Interview Survey.

The analysis in this paper is based on the L.A.FANS child and sibling samples. There are a total of 3,140 children in these two samples, which together provide a representative sample of children age 17 and younger in L.A. County. For all sampled children, mothers provided information on their health status and use of health care. Children aged 12-17 completed a self-administered questionnaire in which they reported their weight and height.

We examine four sets of child health measures. The first is the mother's report of the child's overall health status, which indicates whether the child was in excellent, very good, good, fair, or poor health. The second is the mother's reports of medical diagnoses of common chronic conditions of childhood. Following the National Health Interview Survey (NHIS) questions, L.A.FANS asked mothers whether they had ever been told by a health care provider that their child had each of a series of chronic conditions.[1] We examine a count of these chronic conditions and whether a child had any chronic condition. We also analyze the most common chronic conditions: asthma, an asthma attack in the past year, chronic ear infections, and anemia. Some caution is necessary in interpreting the reports of chronic conditions because they may reflect, in part, differences in access to and use of health care. The third child health measure is a report of whether the child was ever hospitalized. The final set of measures comprises of indicators of weight and overweight for adolescents. These indicators use adolescents' self-reported height and weight, together with their age, to calculate their body mass index (weight divided by height squared). We use the newly revised CDC growth charts (Kuczmarski et al., 2002) to calculate z-scores and percentiles for BMI by the child's age and sex. Children are classified as being at risk for overweight if they fall between the 85^{th} and 95^{th} percentiles of the CDC standard population (for their age and sex) and as overweight if they are at or above the 95^{th} percentile.

A central focus of this paper is on health disparities between Latinos and other ethnic groups in Los Angeles County. L.A.FANS collected extensive information on race and ethnic identity. The race/ethnicity questions were based on the 2000 U.S. Census questions and allowed respondents to choose multiple categories of ethnic identity. Results from the L.A.FANS pretest showed that the 2000 Census questions on ethnicity were not consistent with local classification of ethnicity in Los Angeles. Specifically, Latinos were perplexed about how to classify themselves on the "race" question from the census which is limited to categories for black, white, Native American, and several Asian-origin groups. As a result, the L.A.FANS question on race included a separate category for "Latino."

Methods

Our analysis of child health in Los Angeles is based on a set of multivariate models appropriate matched to the particular child health outcome. For the five-category general health status measure we use an ordered logit model, but also dichotomize this variable and compare children in excellent or very good health to children in good, fair, or poor health using logistic regression. All other binary indicators are also analyzed using logistic regression. Finally, for BMI-for-age z-scores we fit ordinary least squares regression models to the mean, but also estimate quantile regression models that jointly fit models to the median (i.e., the 50^{th} percentile) as well as the 75^{th}, 90^{th}, and 95^{th} percentiles of the distribution. The results from the quantile regression models are interpreted the same as those from an ordinary least squares regression

[1] The chronic conditions include: asthma; epileptic fit or convulsion; diabetes; 4+ ear infections per year; speech impairment or delay; serious hearing difficulty or deafness; serious difficulty seeing or blindness; mental retardation; serious emotional disturbance; anemia; elevated lead in blood; orthopedic impairment; developmental delay; learning disability; autism; and ADD/ADHD.

model—the difference is that the quantile regression estimates show the effects of covariates at different points of the distribution rather then just at the mean.

With the exception of the quantile regression models, all models control for correlation among siblings in the sample by either including a family-level random effect or, for the ordered logit model, by using robust standard error estimates. These approaches provide corrected standard error estimates that account for the presence of up to two children from the same family. The distribution of the random effects provides useful information about the size of family-level variation due to unobserved variables (i.e., variables not included in the model). By estimating a family random effect, we can examine the effects of neighborhood-level variables net of both observed and unobserved family-level variation.

3. Results

We present our results in two subsections. We begin by providing a descriptive analysis of child health differences by race and ethnicity and, for Latinos in the sample, by national origin. We also provide summary results regarding the overall importance of family and neighborhood effects on child health. In the second subsection we present the full set of results from the multivariate analysis.

Descriptive Analysis of Child Health in Los Angeles

In Table 1, we present summary statistics for the various child health measures separately by the four main race/ethnic groups and for the entire sample. We show estimates for Latinos, whites, African Americans, and Asians; results for the other ethnic groups—primarily Native Americans and Pacific Islanders—are not shown separately because of small sample sizes although they are included in the totals.

The first panel of Table 1 shows that mothers of white and Asian children are much more likely to say that their children are in excellent health and much less likely to say that they are in good or fair health. Very few children were reported to be in poor health. Latino mothers report their children as having the poorest overall health: 37 percent of children are reported to be in good, fair, or poor health, which is 50 percent higher than for African Americans and three times higher than for whites and Asians. This negative assessment of children's overall health status is at odds with reported levels of chronic disease (discussed below), which suggests that perhaps chronic diseases are under-diagnosed or under-reported among Latinos or that there are language or cultural factors that influence mother's reports of their children's health status.

The second panel in Table 1 shows race and ethnic differences in medically diagnosed chronic conditions. African American children were substantially more likely to have been diagnosed with asthma than any other group: African American children were twice as likely to have asthma compared with white or Asian children, and almost three times as likely to have had an asthma attack in the past year. Latino children are least likely to have been diagnosed with asthma and to have had an asthma attack. White and Asian children are slightly more likely to have chronic ear infections, although this may be the result of better access to health care. Although anemia is a relatively uncommon condition affecting only six percent of children in the sample, it is more common among Latino and African American children and rare among white children. The total number of diagnosed chronic conditions is highest among African American children, primarily because of the higher rates of asthma, which is the most common chronic condition in the list. Roughly one-in-three children have at least one chronic condition, with the rate for African Americans again the highest at 43 percent. Only four percent of children have ever been hospitalized and there is relatively little variation by ethnicity.

The results for weight and obesity among adolescents aged 12 to 17 years differ strikingly by ethnicity. The first row in the bottom panel of Table 1 shows z-scores for the body mass index (BMI). The z-scores are substantially higher for Latino and African American children than for whites and Asians. White teens have the lowest z-scores. The differences in z-scores translate into large differences in the percent overweight or at risk of overweight. A total of 14 percent of adolescents in the sample are overweight based on the standard criterion which is that BMI-for-age exceeds the 95th percentile of the reference population. An additional 17 percent are at risk of overweight, for a combined overweight or at risk total of 31 percent, which represents almost one-third of the sample. Overweight or at risk is considerably higher among Latino and African American adolescents than among whites and Asians. One in five African Americans in the sample are overweight, which is roughly twice as high as the rate for whites or Asians and one-third higher than for Latinos. However, Latinos have higher rates of being at risk for overweight, that is, falling in the 85th to 95th percentile of the BMI-for age distribution. Over 20 percent of Latinos are at risk of overweight, compared to 13 percent of whites, 10 percent of African Americans, and 15 percent of Asians.

In Table 2, we present these health outcome measures for the Latino sample by national origin, defined as the country in which the mother was born. The majority of Latino children in the sample (58 percent) have Mexican-born mothers; 22 percent of Latino children have native-born mothers, while the remaining 20 percent of children were born to mothers from Central or South America (mostly El Salvador and Guatemala). Latino children of native-born mothers are much more likely to report their children as being in excellent health. These children are also more likely to have been diagnosed with asthma and chronic ear infections, but less likely to have anemia. Children of Mexican-origin mothers have the fewest diagnosed chronic conditions and are the least likely to have any diagnosed chronic condition.

Overweight rates for adolescents of U.S.- and Mexican-born mothers are very high. About one in six children in these two groups have an age-standardized BMI above the 95th percentile. Far fewer children of mothers from Central and South America are overweight. Adolescents born to Mexican-origin mothers have exceptionally high rates of risk for overweight: 25 percent of these children have age-standardized BMI between the 85th and 95th percentiles, compared to 18 percent for adolescents born to mothers from Central or South America and 12 percent among children of native-born mothers.

Multivariate Analysis of Child Health in Los Angeles

We now turn to examining race and ethnic disparities in child health while controlling for other child, family, and neighborhood characteristics. In a preliminary analysis that examined child health differences by mother's country of origin for Latinos, we found no significant differences after accounting for other factors. As a consequence, we dropped these indicators from our analysis. The child health disparities by Latino sub-group presented above are thus entirely accounted for by the covariates in our models.

A list of independent variables included in our models is shown in Table 3, which also includes the means and standard deviations for continuous variables or percentage distributions by category for categorical variables. Independent variables in our models include characteristics of each child such as age in years, sex, birthweight, whether or not the child was born prematurely (i.e., preterm birth), and the child's race/ethnicity. Family-level characteristics include the mother's immigration status, her level of educational attainment, whether she was interviewed in Spanish, and family earnings. Maternal educational attainment is classified in three categories: less than high school, high school graduate or some college, and college graduate.

The analysis also includes three neighborhood-level characteristics that reflect neighborhood compositional characteristics shown by previous research to be related to children's outcomes: tract level median family income, immigrant concentration, and residential stability (Duncan and Aber, 1997; Sampson, Raudenbush, and Earls, 1997; Sampson, Morenoff, and Earls, 1999). The latter two measures are indices, constructed on the basis of results from a factor analysis of a set of tract measures from the 2000 U.S. Census that were highly correlated with each other. The immigrant concentration index included measures from the census on tract-level population percentages of the foreign-born, non-citizens, Spanish-speakers, and Latinos. The residential stability index incorporated the following measures: percent of dwellings in multiple-unit structures, percent of households that were owner-occupied, percent of households that were non-family, and the percent of households that did not move between 1995 and 2000. The average of the tract median family income was $43,600. The two indices each have a zero mean and a standard deviation of one.

In Table 4, we present a summary of results that show the overall effects of family and neighborhood characteristics on the various child health outcomes before and after controlling for the independent variables described above. All of the child health outcomes in Table 4 are binary variables. The first column is general health status, divided into whether or not each child was reported to be in excellent or very good health. The other health variables are: whether the child has any diagnosed chronic health condition; whether he/she has chronic ear infections, anemia, or asthma; whether he/she has had an asthma attack in the past year; whether he/she has ever been hospitalized, and whether he/she is overweight or at risk of overweight. The first row in the table shows the mean for each child health outcome. The second row shows the intra-neighborhood correlation coefficient, which represents the fraction of total variation in each health outcome that is accounted for by neighborhood factors through neighborhood-level random effects.[2] This estimate is based on a model that includes tract-level random effects but no other variables. Because no controls are included for child or family characteristics (which are likely to be correlated among children in the same neighborhood), this represents an upper bound of the influence of neighborhoods on children's health outcomes in Los Angeles. Our results indicate that neighborhood effects are statistically significant for all child health outcomes except the indicator of whether the child was ever hospitalized. However, the magnitude of these effects is generally modest. It is highest for the mother's report of the child's overall health status, which reflects the fact that mothers in the same neighborhood are likely to have similar perceptions of child health standards (against which they rate their own child's health). Ten percent of the total variation in overweight status is accounted for by neighborhood factors, which is relatively high. For all other variables, neighborhood effects are small in magnitude,

[2] These estimates are based on a parallel multilevel linear model with an unobserved latent variable representing child health as the outcome of interest and an individual level error term that follows the standard logistic distribution. The intra-group correlation coefficient is $r_g = s_g^2/(s_g^2 + p^2/3)$, where s_g^2 is the variance of the group-level random effect.

although they are statistically significant. They generally account for between five and seven percent of the total variation in each child health outcome.

The next row in the table shows the intra-family correlation coefficient for each child health outcome. The total family effects are in many cases an order of magnitude larger than the total neighborhood effects. Only for the indicator of whether the child was ever hospitalized is the family effect statistically insignificant. The largest family effects are for the child's overall health status and overweight among adolescents. For both of the outcomes, family factors account for approximately two-thirds of the total variation. The remaining one-third is accounted for idiosyncratic factors that are unique to each child. For the other child health outcomes, family effects account, on average, for about 45 percent of the total variation. The following line in the table shows the net effects of family factors after we control for the independent variables identified above and also a set of tract-level dummy variables that capture the total effect of all neighborhood-level characteristics separately for each tract. Family effects are diminished substantially only for the measures describing adolescents' overweight status and whether the child was ever hospitalized. For the remaining child health outcomes, the combined effects of all measured family characteristics—and all measured and unmeasured neighborhood factors—account for between 17 and 33 percent of the total family effect (as shown in the second to last row of the table). Clearly there are other important family factors that affect children's health beyond those that are measured in our data. Finally, the last row in Table 4 shows the results of a joint test of the neighborhood level fixed-effects in models that control for all the independent variables and incorporate family-level random effects. In no case was the joint test of neighborhood fixed-effects statistically significant. This indicates that after controlling for observed and unobserved family characteristics as well as a number of child characteristics, there is no systematic effect of neighborhood of residence. Although we may yet find certain significant effects of neighborhood variables on child health outcomes, based on these results our expectations for doing so are modest.

Tables 5, 6, and 7 present the results for child health models that include child, family, and neighborhood variables and family random effects. In Table 5, we show the results for four variables measuring overall health. Columns 1 and 2 show two different forms of the general health status variable. The first column is based on an ordered logit model in which the outcome is the five responses to the general health status question (this model does not include a family-level random effect). The second column is based on a logit model in which the outcome is whether or not the child was classified in excellent or very good health. In both cases the coefficients are presented as odds-ratios. The third and fourth columns examine whether the child has diagnosed chronic conditions. Results in the third column are the coefficients of an OLS regression with the number of chronic conditions the child has as the dependent variable. The fourth column is based on a logit model with whether or not the child had any conditions as the dependent variable. The figures in the fourth column are odds ratios.

The results are quite different for the two sets of variables. For example, none of the coefficients on the child's race/ethnicity variables is statistically significant in either chronic condition equation. However, African American children are significantly less likely to be reported to be in excellent or very good health compared with Latinos. White children have better mother-reported overall health than Latino children (Column 1), although this effect is statistically significant only at the .10 level. Mothers who were interviewed in Spanish—which is a proxy for poor English language skills and may also reflect cultural and family background factors—reported that their children were in significantly poorer health than those interviewed in English. The results for maternal educational attainment also differ. Mother's education has a very large and highly significant effect on general health status, but is not significantly associated with the number of chronic health conditions a child has. Better-educated mothers are considerably more likely to report that their children are in excellent or very good health compared with mothers who have less than a high school education.

Two variables that have effects on each of these overall measures of health status are sex and immigrant status. Boys are less likely to be reported in excellent or very good health, have a larger number of chronic conditions, and are more likely to have any conditions than girls. Compared with natives, immigrants are reported to be in poorer health (although the difference is significant only for recent immigrants) but have fewer diagnosed chronic conditions and a lower likelihood of having any chronic condition. As noted above, part of the reason for the effects of immigrant status on diagnosed chronic conditions may be poorer access to health care for immigrants compared to natives. Low birthweight and premature birth are consistently associated with poorer child health, although the effects are statistically significant only for the two summary chronic disease measures.

Results in this table also show that neighborhood characteristics have little effect on these health outcomes. The only exception is that higher levels of immigrant concentration and residential stability are weakly associated with a lower likelihood of a mother reporting her child to be in excellent or very good health. These results reinforce our conclusions based on Table 4 that, once the observed and unobserved family-level effects are taken into account, neighborhood characteristics have little effect on child health outcomes. The fraction of variance due to unobserved family effects is large and significant, indicating that the family-level variables included in the models capture only part of the effects of family characteristics.

In Table 6, we consider the results for specific chronic conditions, including chronic ear infections, anemia, asthma, and an asthma attack in the past year. In each case the results are based on logit models and we present the coefficients as odds ratios. The prevalence of chronic ear infections and anemia decrease significantly with age, while the likelihood of having asthma and an asthma attack increase significantly with age. Boys are significantly more likely to have asthma and an asthma attack compared to girls. Chronic ear infections and anemia are both more common among children born prematurely and higher birthweight is associated with a significantly lower risk of anemia.

Both race/ethnicity and immigration status have significant effects on all four outcomes. White and Asian children are significantly more likely to have medically-diagnosed chronic ear infections. This effect is likely the result of better access to health care for these two groups. On the other hand, black children are twice as likely to have been diagnosed with anemia, although this effect is statistically significant only at the .10 level. African American children are significantly more likely to be diagnosed with asthma and to have had an asthma attack. Other ethnic groups are not statistically significantly different from Latinos. Compared with native-born children, immigrants are less likely to be diagnosed with chronic ear infections but more likely to have been diagnosed with anemia. A clear effect of length of residence in the U.S. (and, probably, in the Los Angeles area) is apparent for asthma and the likelihood of an asthma attack in the past year. While both immigrant groups have significantly lower prevalence of asthma compared to the native-born, those who have been in the U.S. for the shortest period have the lowest rates.

Interestingly, there appears to be no variation in asthma rates within Los Angeles, at least according to neighborhoods as characterized by tract median family income, immigrant concentration, and residential stability. Anemia is higher in neighborhoods with a greater concentration of immigrants and with higher levels of residential stability. Although researchers have hypothesized that residential stability should have beneficial effects on children's outcomes by promoting a positive neighborhood social environment for children, empirical results have shown that low rates of mobility may be indicative of neighborhood problems (Duncan and Aber, 1997; Corbin and Coulton, 1997). Maternal education is also associated with children's anemia, although the relationship is weak. As in Table 5, the fraction of variance due to unobserved family effects in Table 6 is large and statistically significant, indicating that unobserved family-level factors account for much of the variation in chronic conditions.

Table 7 shows results for four regression models. The first three columns show results for logistic regression models of hospitalization and two measure of overweight; odds ratios are presented in the table for these model results. In the last column of Table 7, we present the results for an ordinary least squares regression model of the BMI-for-age z-score. Note that although there are several significant covariate effects, the model for overweight status does not fit the data.

Hospitalization is significantly associated only with idiosyncratic characteristics of the child, including the child's age, sex, and birthweight. The risk of hospitalization increases significantly with the age of the child. This effect may be due to the fact that older children simply have more years at risk of being hospitalized than younger children. Boys and children who were smaller at birth are significantly more likely to have been hospitalized. No other family or neighborhood level variables are significantly related to hospitalization. Furthermore, there are no effects of unobserved family-level factors.

For adolescents, being overweight or at risk of overweight (Column 2) is significantly associated with sex, maternal education, neighborhood immigrant concentration, mother's height, and especially with the mother's own BMI. Boys are significantly more likely to be overweight or at risk than girls. There appear to be substantially higher rates of overweight or risk of overweight for Asians, although small sample sizes mean that this effect is not estimated with much precision. Thus there are no statistically significant differences in being overweight or at risk of overweight by race/ethnic group. Without controls for other variables, Latinos and African Americans are most likely to be overweight or at risk (see Table 1). However, once family socioeconomic status and maternal BMI is held constant, Asian children are in fact the most likely to be overweight or at risk of being overweight. These results suggest that the higher likelihood of Latino and African American children being overweight or at risk is due to family socioeconomic status and especially maternal weight.

The last column of Table 7 shows that immigrants have lower z-scores compared to natives, although only the coefficient for recent immigrants is significant. Children of college graduates have significantly lower z-scores. Maternal BMI has large and significant effects on children's obesity status. Overweight and at risk mothers are significantly more likely to have overweight and at risk children.

Children living in neighborhoods with higher concentrations of immigrants are considerably more likely to be overweight. There is evidence too that higher levels of residential stability are associated with a higher likelihood of adolescents being overweight. The fraction of variance due to unobserved family effects is again large and significant for both overweight variables and for BMI.

In Table 8, we examine the determinants of children's BMI-for-age z-score using a different type of statistical model known as quantile regression. Quantile regression allows us to fit a model to the median of the distribution (i.e., the 50th percentile), as well as other fixed percentiles (i.e., quantiles) of the distribution. In particular, it is potentially valuable for modeling how the effects of covariates vary across the BMI distribution and for focusing on the determinants of BMI at the upper end of the BMI distribution, such as the 85th or 95th percentile, but without the large loss of information that comes with transforming a continuous variable to a dichotomous one. It is straightforward to jointly estimate an entire family of models to examine covariate effects at various quantiles of the BMI distribution. We estimate quantile regression models for the median as well as the 75th, 90th, and 95th percentiles because our primary concern is with the upper end of the weight distribution, i.e., obesity. The estimated parameters are interpreted in essentially the same way as the results from an ordinary least squares regression. For example, the significant coefficient on child sex in the model for the 95th percentile indicates that male adolescents have BMI-for-age z-scores that are 0.28 points higher than girls at the 95th percentile of the BMI-for-age distribution. Note that child sex does not have a significant effect in any of the other models. In other words, the differences by sex are only present at the top end of the BMI distribution.

The use of quantile regression produces several interesting results that are quite different from the logit and OLS regression results in Table 7. For example, Asians have an increasingly large gap in BMI-for-age z-scores compared to Latinos as we move from the 50th percentile up through the 75th, 90th, and 95th percentiles, although the effects for the first model are not significant and for the last three models the effects are statistically significant only at the .10 level. In contrast to earlier results, immigration status is not significantly related to children's weight in this model. Significant effects of maternal education (at the .10 level) appear only for the 75th, 90th, and 95th quantiles, although the magnitude of the effects is similar across the four different models. The effects of mother's BMI diminish as we move up the distribution for children's BMI, with the effects twice as strong at the median and the 75th percentile than at the 90th and 95th percentiles. This suggests that the intergenerational transmission of excess weight diminishes as the child's weight increases.

Two of the neighborhood characteristics are significantly related to adolescent BMI-for-age z-scores for the quantiles we examine. As in previous models, tract level income is not associated with children's weight. The effects of immigrant concentration are present across the upper half of the BMI distribution, and there is little variation in the magnitude of the effect as we move up the BMI distribution. For all four models, higher concentration of immigrants in a neighborhood is associated with higher body weight for adolescents. Neighborhood residential stability is significantly and positively associated with children's body weight at the 90th and 95th quantiles. Models that focus on the center of the distribution alone, such as OLS regression model or a median regression model would miss these effects, which show that children living in neighborhoods with higher stability rates are likely to weigh more than other children.

4. Discussion

In this paper we have examined the effects of child, family, and neighborhood characteristics on a broad range of children's health outcomes including general health status, chronic conditions, hospitalization, and overweight. Results from this analysis lead us to the following conclusions:

- Despite the emphasis in the social epidemiology literature on the effects of poor neighborhoods on health, our results show that neighborhood effects on health outcomes are generally small once measured and unmeasured family characteristics are taken into account. However, our analysis included only a very limited set of neighborhood characteristics and focused on self-reported or parent-reported health outcomes which may be subject to a number of biases. Moreover, our analysis examined only the effects of a child's *current* neighborhood of residence on health outcomes, as is common in the public health literature on neighborhood effects. However, in a highly geographically mobile society such as the United States, it is likely to be important to consider the cumulative effects of all neighborhoods that the child has lived in throughout his or her life.

- The concentration of immigrants in a neighborhood is associated with higher rates of overweight and obesity among adolescents. This result is robust to a variety of different model specifications. In particular, it emerges when BMI-for-age is modeled as a continuous variable using either quantile regression or ordinary least squares regression or when BMI-for-age is used to construct a binary indicator of overweight or at risk. There is also some evidence that neighborhood residential stability is associated with higher rates of obesity, though only at the upper-end of the BMI-for-age distribution. Greater residential stability is also associated with higher rates of anemia and is weakly associated with lower levels of mother-reported overall health status. Further work is required to uncover the reasons behind the negative effects of neighborhood residential stability on child health.

- As many previous studies have shown, ethnicity is an important determinant for many of the health outcomes we investigated. In simple cross-tabulations (Table 1) African American children are in poorest health on most measures and Latino children have the next poorest health on most indicators. However, in multivariate models with other child, family and neighborhood variables held constant, more complex patterns began to emerge. For example, African American children are significantly less likely to be reported in excellent or very good general health when other variables are held constant. Latino children, however, are not significantly less likely to be in excellent or very good health than other children. Nonetheless, in general, African American children appear to be the most disadvantaged in term of most health measures. Particularly alarming are the large differences between African American and other children in the likelihood of having asthma and an asthma attack within the previous year.

- Immigrant status is also an important factor for many of the health outcomes examined. Recent immigrants have a significantly lower general health status than other children, but are also significantly less likely to have been diagnosed with chronic ear infections or asthma. They also have a significantly lower BMI-for-age than other children. We speculate that part of the explanation for poorer reported general health status may be a cultural or language issue for Latino immigrants. Evidence in favor of this hypothesis comes from the odds ratio for Spanish language speakers in the equations for general health status. These odds ratios show that mothers who were interviewed in Spanish are significantly less likely to say that their children are in good health than mothers interviewed in English, ceteris paribus.

- The results for overweight indicate that maternal BMI is, not surprisingly, a very important determinant of children's weight status. Although there are substantial weight differences by ethnicity (Table 1), most of the coefficients for race/ethnicity and immigrant status are not significant in the multivariate models including maternal BMI. This result suggests that the higher frequency of obesity among African American and Latino teens is strongly related to family eating and exercise habits and, perhaps, ethnic variation in genetic predisposition to obesity.

  One interesting result for weight is that when other factors (including maternal BMI) are held constant, Asian teens are significantly more likely to be overweight. This result implies that maternal weight has less effect on weight gain by Asian teens than on teens of other ethnic groups.

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Table 1. Distribution of Child Health Measures by Child's Race/Ethnicity

	Race/Ethnicity				Total
	Latino	White	Black	Asian	Sample
Overall health status					
Excellent	40%	66%	46%	63%	47%
Very good	23	24	29	24	24
Good	31	9	20	11	24
Fair	6	1	5	1	5
Poor	0	0	0	0	0
Medically-diagnosed chronic conditions					
Asthma	9%	11%	22%	13%	11%
Asthma attack in past year	3%	5%	14%	4%	5%
Chronic ear infections	9%	15%	12%	12%	11%
Anemia	8%	2%	6%	4%	6%
Total conditions[a]	0.53	0.64	0.79	0.59	0.59
Any condition[a]	34%	40%	43%	33%	36%
Hospitalized ever	4%	2%	4%	4%	4%
Number of Cases	1,882	541	274	211	2,975
Weight and obesity[b]					
BMI z-score (std. dev.)	0.58 (1.03)	0.14 (1.06)	0.44 (1.07)	0.26 (1.11)	0.43 (1.06)
Overweight or at risk[c]	36%	23%	29%	24%	31%
Overweight[b]	15%	10%	19%	9%	14%
Number of Cases	384	164	69	58	692

Notes: [a] Chronic conditions include: asthma; epileptic fit or convulsion; diabetes; 4+ ear infections per year; speech impairment or delay; serious hearing difficulty or deafness; serious difficulty seeing or blindness; mental retardation; serious emotional disturbance; anemia; elevated lead in blood; orthopedic impairment; developmental delay; learning disability; autism; and ADD/ADHD.

[b] Weight and height information was only collected for children aged 12-17 years.

[c] Overweight or at risk of overweight corresponds to BMI-for-age above the 85th percentile.

[d] Overweight is defined as BMI-for-age above the 95th percentile.

Table 2. Distribution of Child Health Measures for Latinos by National Origin

	National origin			Total Latino
	U.S.	Mexico	Central or Latin America	
Overall health status				
Excellent	54%	35%	42%	41%
Very good	25	21	26	23
Good	18	36	25	30
Fair	3	8	6	6
Poor	0	0	1	0
Medically-diagnosed chronic conditions				
Asthma	14%	8%	11%	10%
Asthma attack in past year	6%	3%	2%	3%
Chronic ear infections	13%	8%	10%	10%
Anemia	5%	8%	8%	8%
Total conditions[a]	0.63	0.50	0.63	0.55
Any condition[a]	39%	31%	38%	34%
Hospitalized ever	3%	5%	5%	4%
Number of cases	419	1,139	378	1,936
Weight and obesity[b]				
BMI z-score (std. dev.)	0.57 (0.91)	0.63 (1.07)	0.43 (0.99)	0.58 (1.02)
Overweight or at risk[a]	28%	42%	27%	36%
Overweight	16%	17%	9%	15%
Number of cases	92	239	64	395

Notes: [a] Chronic conditions include: asthma; epileptic fit or convulsion; diabetes; 4+ ear infections per year; speech impairment or delay; serious hearing difficulty or deafness; serious difficulty seeing or blindness; mental retardation; serious emotional disturbance; anemia; elevated lead in blood; orthopedic impairment; developmental delay; learning disability; autism; and ADD/ADHD.
[b] Weight and height information was only collected for children aged 12-17 years.
[c] Overweight or at risk of overweight corresponds to BMI-for-age above the 85th percentile.
[d] Overweight is defined as BMI-for-age above the 95th percentile.

Table 3. Distribution of Child, Family, and Neighborhood Variables

Variable	Mean (std. dev.) or percent by category	
Child age (years)	8.2	(5.0)
Child sex		
Male	51%	
Female	49	
Birthweight (kilograms)	3.4	(0.6)
Premature		
Yes	17%	
No	83	
Race		
Latino	65%	
Black	10	
White	24	
Asian	8	
Other	2	
Immigration status		
Native	38%	
Pre-1990 immigrant	38	
Post-1990 immigrant	24	
Mother's education		
Less than high school	39%	
High school/some college	45	
College graduate	16	
Interviewed in Spanish		
Yes	44%	
No	56	
Family earnings (dollars)	38,251	(68,739)
Tract median family inc.	43,599	(26,031)
Immigrant concentration index	0.02	(0.97)
Residential stability index	-0.01	(0.97)
Number of cases	2,975	

Table 4. Child Health Outcomes and Family and Neighborhood Effects

	General health status[a]	Any chronic condition	Chronic ear infections	Anemia	Asthma	Asthma attack in past year	Ever hospitalized	Overweight or at risk	Overweight
Mean	71%	36%	11%	6%	11%	5%	4%	32%	14%
Total effect of neighborhood	0.13***	0.02***	0.07***	0.07***	0.05***	0.06***	0.02	0.05***	0.10***
Total effect of family	0.63***	0.35***	0.45***	0.44***	0.43***	0.48***	0.19	0.37***	0.63***
Net effect of family	0.52***	0.29***	0.32***	0.35***	0.34***	0.32**	0.00	0.00	0.37*
Family effect explained	17%	17%	29%	25%	21%	33%	100%	100%	41%
Significant net neighborhood effects?	No	No	No	No	No	No	No	No	No

Note: See text for details regarding summary indicators of family and neighborhood effects.
[a] General health status of excellent or very good.

Table 5. Regression results for child health outcomes

	General health status		GHS excellent or very good		Number of chronic conditions		Any chronic condition	
Child age (years)	0.97***	(0.01)	0.95***	(0.01)	0.02***	(0.01)	1.04***	(0.01)
Child sex								
Female[a]	.	.	.	.	.	.	.	.
Male	0.89*	(0.07)	0.79*	(0.10)	0.17***	(0.04)	1.52***	(0.15)
Birthweight (kilograms)	1.10	(0.07)	1.18	(0.13)	-0.12***	(0.03)	0.86*	(0.07)
Premature								
No[a]	.	.	.	.	.	.	.	.
Yes	0.90	(0.09)	0.78	(0.14)	0.17***	(0.05)	1.38**	(0.19)
Child Race								
Black	0.63***	(0.10)	0.46***	(0.14)	0.10	(0.08)	1.22	(0.26)
White	1.27*	(0.17)	1.45	(0.39)	0.03	(0.07)	1.16	(0.21)
Latino[a]	.	.	.	.	.	.	.	.
Asian	1.33	(0.24)	1.27	(0.46)	0.04	(0.09)	0.90	(0.20)
Other	1.36	(0.37)	1.62	(0.97)	0.08	(0.14)	1.23	(0.45)
Immigration status								
Native[a]	.	.	.	.	.	.	.	.
Pre-1990 immigrant	0.81*	(0.10)	0.72	(0.19)	-0.13**	(0.06)	0.71**	(0.12)
Post-1990 immigrant	0.59***	(0.08)	0.48***	(0.14)	-0.18***	(0.07)	0.52***	(0.10)
Language of interview								
English[a]	.	.	.	.	.	.	.	.
Spanish	0.58***	(0.08)	0.36***	(0.09)	.	.	.	.
Mother's education								
Less than high school[a]	.	.	.	.	.	.	.	.
High school/college grad	1.33***	(0.13)	1.92***	(0.35)	0.07	(0.05)	1.02	(0.14)
College graduate	1.82***	(0.29)	4.01***	(1.33)	0.03	(0.08)	1.01	(0.22)
Mother's height (inches)	1.01	(0.00)	1.01	(0.01)	-0.00	(0.00)	0.99	(0.01)
Family earnings ($10,000)	1.01	(0.01)	1.00	(0.02)	0.00	(0.00)	1.01	(0.01)
Tract median family inc.	1.04	(0.03)	1.07	(0.07)	0.04	(0.04)	1.02	(0.04)
Immigrant concentration	0.97	(0.07)	0.78*	(0.11)	0.03	(0.03)	1.10	(0.11)
Residential stability	0.94	(0.05)	0.85*	(0.08)	0.03	(0.03)	1.11	(0.08)
Constant	.	.	.	.	0.95**	(0.38)	.	.
Fraction of variance due to unobserved family effects	-		0.52***		0.31***		0.35***	
Model Chi-squared (df)	307.42*** (18)		183.31*** (18)		88.20*** (17)		70.34*** (17)	
Observations	2,975		2,975		2,977		3,302	

Odds ratios shown; standard errors in parentheses; *p<.10; **p<.05; ***p<.01.
Source: Authors' calculations using data from the 2000-01 L.A.FANS Wave 1.
Notes: [a] Reference category.

Table 6. Regression results of child health outcomes

	Chronic ear infections		Anemia		Asthma		Asthma attack in past year	
Child age (years)	0.96***	(0.01)	0.91***	(0.02)	1.09***	(0.02)	1.06***	(0.02)
Child sex								
Female[a]	.	.	.	.	.	.	.	.
Male	1.04	(0.15)	1.09	(0.20)	1.78***	(0.27)	1.71**	(0.36)
Birthweight (kilograms)	1.11	(0.14)	0.73**	(0.12)	1.14	(0.14)	1.26	(0.23)
Premature								
No[a]	.	.	.	.	.	.	.	.
Yes	1.67***	(0.31)	1.77**	(0.43)	1.31	(0.26)	1.33	(0.35)
Child Race								
Black	1.18	(0.34)	2.19*	(0.81)	1.72**	(0.46)	2.25***	(0.72)
White	1.70**	(0.41)	1.27	(0.44)	0.73	(0.18)	0.65	(0.21)
Latino[a]	.	.	.	.	.	.	.	.
Asian	1.73*	(0.51)	1.18	(0.52)	1.42	(0.44)	0.99	(0.43)
Other	2.15	(0.95)	1.66	(1.14)	1.09	(0.52)	2.05	(1.07)
Immigration status								
Native[a]	.	.	.	.	.	.	.	.
Pre-1990 immigrant	0.70	(0.16)	1.91**	(0.60)	0.50***	(0.11)	0.37***	(0.12)
Post-1990 immigrant	0.58**	(0.15)	1.51	(0.50)	0.27***	(0.08)	0.24***	(0.10)
Mother's education								
Less than high school[a]	.	.	.	.	.	.	.	.
High school/college grad	0.93	(0.19)	0.66*	(0.15)	1.24	(0.25)	1.62	(0.48)
College graduate	0.91	(0.27)	0.49*	(0.21)	0.96	(0.30)	1.46	(0.62)
Mother's height (inches)	0.99	(0.01)	0.99	(0.01)	1.01	(0.01)	1.01	(0.01)
Family earnings ($10,000)	1.02	(0.01)	1.02	(0.02)	0.99	(0.01)	1.01	(0.02)
Tract median family inc.	0.96	(0.05)	0.90	(0.08)	1.02	(0.06)	0.93	(0.07)
Immigrant concentration	0.97	(0.14)	1.43*	(0.28)	1.05	(0.15)	0.83	(0.16)
Residential stability	1.14	(0.11)	1.31**	(0.17)	1.00	(0.10)	1.09	(0.15)
Fraction of variance due to unobserved family effects	0.39***		0.41***		0.40***		0.36***	
Model Chi-squared (df)	51.84*** (17)		54.61*** (17)		83.32*** (17)		66.34*** (17)	
Observations	2,972		2,970		2,972		2,972	

Odds ratios shown; standard errors in parentheses; **p*<.10; ***p*<.05; ****p*<.01.
Source: Authors' calculations using data from the 2000-01 L.A.FANS Wave 1.
Notes: [a] Reference category.

Table 7. Regression results of child health outcomes

	Any hospitalization		Overweight or at risk		Overweight		BMI-for-age z-score	
Child age (years)	0.92***	(0.02)	0.92	(0.05)	0.88	(0.10)	-0.01	(0.02)
Child sex								
Female[a]	.	.	.	.	.	.	.	.
Male	1.40**	(0.27)	1.59**	(0.32)	1.77	(0.70)	0.09	(0.08)
Birthweight (kilograms)	0.71**	(0.11)	0.93	(0.14)	1.02	(0.29)	0.02	(0.06)
Premature								
No[a]	.	.	.	.	.	.	.	.
Yes	1.33	(0.34)	1.18	(0.32)	2.22	(1.08)	0.02	(0.11)
Child Race								
Black	1.14	(0.42)	0.76	(0.29)	1.87	(1.29)	-0.18	(0.15)
White	0.95	(0.32)	1.17	(0.36)	2.34	(1.41)	-0.06	(0.12)
Latino[a]	.	.	.	.	.	.	.	.
Asian	1.55	(0.56)	1.94	(0.80)	3.29	(2.64)	0.26*	(0.16)
Other	1.44	(0.89)	1.10	(0.69)	0.73	(0.97)	0.11	(0.26)
Immigration status								
Native[a]	.	.	.	.	.	.	.	.
Pre-1990 immigrant	1.30	(0.38)	1.32	(0.39)	1.32	(0.78)	-0.13	(0.12)
Post-1990 immigrant	1.18	(0.36)	0.56	(0.22)	0.54	(0.41)	-0.40***	(0.15)
Mother's education								
Less than high school[a]	.	.	.	.	.	.	.	.
High school/college grad	1.04	(0.23)	0.93	(0.23)	0.88	(0.40)	-0.07	(0.10)
College graduate	0.93	(0.37)	0.41**	(0.16)	0.67	(0.49)	-0.34**	(0.15)
Mother's height (inches)	1.01	(0.01)	1.02**	(0.01)	1.03	(0.02)	-0.01	(0.00)
Mother's BMI	.	.	1.07***	(0.02)	1.11***	(0.04)	0.03***	(0.01)
Family earnings ($10,000)	0.97	(0.03)	0.98	(0.07)	0.95	(0.06)	-0.01	(0.01)
Tract median family inc.	0.90	(0.08)	0.99	(0.07)	0.84	(0.14)	-0.02	(0.03)
Immigrant concentration	0.95	(0.17)	1.64***	(0.32)	2.71**	(1.12)	0.18**	(0.07)
Residential stability	0.85	(0.10)	1.23	(0.16)	1.92**	(0.53)	0.07	(0.05)
Constant	.	.	.	.	.	.	-0.99	(0.84)
Fraction of variance due to unobserved family effects	0.00		0.14***		0.56***		0.30***	
Model Chi-squared (df)	41.52*** (17)		35.94*** (18)		18.13 (18)		93.42*** (18)	
Observations	2,696		692		692		692	

Table 8. Quantile regression models for BMI-for-age z-score

	Quantile							
	50		75		90		95	
Child age (years)	-0.03	(0.04)	-0.05	(0.04)	-0.01	(0.03)	0.00	(0.03)
Child sex								
Female[a]	.	.	.	.	.	.	.	.
Male	0.03	(0.13)	0.19	(0.12)	0.13	(0.12)	0.28**	(0.12)
Birthweight (kilograms)	-0.01	(0.09)	0.08	(0.09)	-0.02	(0.10)	-0.05	(0.11)
Premature								
No**[a]**	.	.	.	.	.	.	.	.
Yes	-0.03	(0.12)	0.12	(0.17)	0.13	(0.16)	0.10	(0.15)
Child Race								
Black	-0.22	(0.20)	-0.23	(0.26)	0.03	(0.25)	0.21	(0.23)
White	-0.08	(0.16)	0.11	(0.19)	0.17	(0.17)	0.14	(0.15)
Latino[a]	.	.	.	.	.	.	.	.
Asian	0.19	(0.21)	0.35*	(0.19)	0.42*	(0.22)	0.47*	(0.27)
Other	-0.09	(0.41)	0.22	(0.38)	-0.11	(0.30)	-0.31	(0.22)
Immigration status								
Native[a]	.	.	.	.	.	.	.	.
Pre-1990 immigrant	0.03	(0.12)	-0.01	(0.19)	0.07	(0.18)	0.11	(0.18)
Post-1990 immigrant	-0.37*	(0.19)	-0.25	(0.20)	-0.18	(0.24)	-0.26	(0.25)
Mother's education								
Less than high school[a]	.	.	.	.	.	.	.	.
High school/college grad	-0.11	(0.14)	-0.04	(0.13)	-0.00	(0.17)	0.05	(0.17)
College graduate	-0.24	(0.21)	-0.36*	(0.21)	-0.32*	(0.17)	-0.31*	(0.17)
Mother's height (inches)	0.01	(0.01)	0.01***	(0.00)	0.01	(0.01)	0.00	(0.01)
Mother's BMI	0.04***	(0.01)	0.04***	(0.01)	0.02***	(0.01)	0.02**	(0.01)
Family earnings ($10,000)	0.00	(0.01)	-0.01	(0.01)	-0.02	(0.01)	-0.01	(0.02)
Tract median family inc.	-0.01	(0.04)	0.02	(0.04)	-0.02	(0.05)	-0.03	(0.05)
Immigrant concentration	0.20***	(0.13)	0.33**	(0.13)	0.25**	(0.13)	0.27*	(0.14)
Residential stability	0.00	(0.07)	0.10	(0.09)	0.15**	(0.08)	0.16***	(0.04)
Constant	-1.88*	(1.07)	-1.14	(0.90)	0.21	(1.01)	1.50	(1.05)
Pseudo R-squared	0.09		0.10		0.10		0.11	
Observations	784		784		784		784	

Odds ratios shown; standard errors in parentheses; **p*<.10; ***p*<.05; ****p*<.01.
Source: Authors' calculations using data from the 2000-01 L.A.FANS Wave 1.
Notes: [a] Reference category.