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*Research Article*

**Health and development among Mexican, black  
and white preschool children: An integrative  
approach using latent class analysis**

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## **Health and development among Mexican, black and white preschool children: An integrative approach using latent class analysis**

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### **Abstract**

#### **BACKGROUND**

Building on an emerging scientific consensus that the concept of child health should encompass chronic conditions, functional abilities, and developmental domains, we delineate the multidimensional health statuses of Mexican, non-Hispanic black, and non-Hispanic white preschool children in the United States. This integrative approach provides the foundation for an in-depth analysis of health disparities.

#### **OBJECTIVE**

The research objectives are: (1) to demonstrate a new methodological approach to identifying the major child health statuses; (2) to document differences in the prevalence of those health statuses among children in the largest ethnoracial groups in the U.S.; and (3) to assess whether key sources of disadvantage account for ethnoracial disparities in children's health.

#### **METHODS**

With data from a nationally representative sample, we use latent class analysis to estimate a set of latent health statuses that capture the nature of health at age four. The latent class membership of children is predicted using multinomial logistic regression.

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## **RESULTS**

Mexican and non-Hispanic black children are more likely than non-Hispanic white children to fall into health statuses distinguished by low cognitive achievement and multiple developmental problems. Mexican children are the most likely to be classified into these problematic health statuses. This pattern persists in multivariate models that incorporate potential explanatory factors, including health at birth, socio-demographic characteristics, home environment, well-child care and center-based child care.

## **CONCLUSIONS**

Latent class analysis is a useful method for incorporating measures of physical conditions, functional problems, and development into a single analysis in order to identify key dimensions of childhood health and locate ethnoracial health disparities.

## **1. Introduction**

In recent years there has been an explosion of interest in the early origins of adult health. A growing body of evidence shows that maternal health before conception, prenatal and perinatal exposures, and health in early childhood play critical roles in health trajectories across the life course (Barker 1992; Case, Fertig, and Paxson 2005; Haas 2007). In addition, childhood health is a potentially important explanatory factor for the intergenerational transmission of inequality (Case and Paxson 2010; Currie 2009; Palloni 2006). As the long-term consequences of early health become clear, the need to understand the health disparities that appear in the preschool years is increasingly pressing.

This issue is especially important given the changing composition of the child population of the United States. One of the most noteworthy demographic trends of the last several decades is the rapid growth of the Hispanic population, which has increased 43% since 2000 (Mather, Pollard, and Jacobsen 2011). The Mexican-origin population accounted for three-fourths of that increase and currently comprises 63% of the Hispanic population (Ennis, Rios-Vargas, and Albert 2011). Because births now contribute more to Hispanic population growth than does immigration, the composition of the child population is shifting very rapidly at the youngest ages (Pew Hispanic

Center 2011). Today, about 18% of U.S. children ages 0-5 are of Mexican origin, 15% are non-Hispanic black, and 53% make up the non-Hispanic white majority.<sup>5</sup>

Economic inequality among families with children has likewise grown, due in part to the intersection of trends in immigration, human capital attainment, and family formation (Western, Bloome, and Percheski 2008). The convergence of these trends is evident in ethnoracial variation in education and family structure.<sup>6</sup> Mexican men and women average 10 years of education, compared to 13 for non-Hispanic blacks and 14 for non-Hispanic whites (Duncan, Hotz, and Trejo 2006). Foreign-born Mexicans have even lower educational attainment, often coupled with limited English proficiency and undocumented status. Given that most Mexican-origin children have foreign-born parents, it is not surprising that their poverty rate substantially exceeds that of non-Hispanic white children (34% vs. 13%) and is roughly comparable to that of non-Hispanic black children (38%; see footnote 5). In addition, although Mexican children are more likely to live with two parents (67%) than non-Hispanic black children (37%), their two-parent family structure is eroding (Landale, Oropesa, and Bradatan 2006). Currently, about half of Mexican-origin mothers are unmarried at the time they give birth, compared to 35% of non-Hispanic whites and 71% of non-Hispanic blacks (National Center for Health Statistics 2010). In sum, the growing size and vulnerability of the Mexican child population underscore the need to understand their early health and well-being.

The present study introduces a new approach to assessing ethnoracial variation in children's health. A limitation of research on children's health is that studies have examined specific conditions in a piecemeal fashion. Relatively low risks of some problems and high risks of others have been documented (Martin et al. 2012; Escarce, Morales, and Rumbaut 2006), but little attention has been paid to identifying the major dimensions of childhood health and addressing their intersections with ethnicity and race in a holistic fashion. Following National Research Council (NRC) and Institute of Medicine (IOM) (2004) recommendations, child health is treated here as a multidimensional construct that subsumes specific conditions, functional problems, and domains of development. Using data from a nationally representative sample of

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<sup>5</sup> These figures are based on the authors' calculations from the 2009-2011 American Community Survey conducted by the U.S. Census Bureau.

<sup>6</sup> We use the term "ethnoracial" throughout this article to refer to group identity categories based on ethnicity and race. Race is now widely recognized as a social category that is not clearly separable from ethnicity (Hirschman 2004). Furthermore, race and ethnicity are clearly conflated in the minds of Hispanics (Landale and Oropesa 2002). Here, the terms "Mexican" and "Mexican-origin" are used interchangeably to refer to the heritage or ancestry of an individual, regardless of his or her designated race or birthplace.

children born in the United States in 2001, we pursue three objectives: (1) to demonstrate a new methodological approach to identifying the major health statuses of children; (2) to document differences between Mexican, non-Hispanic black, and non-Hispanic white preschool children in the prevalence of those health statuses, with special attention to Mexican-origin children; and (3) to assess whether key sources of disadvantage account for ethnoracial disparities in children's health.<sup>7</sup>

## **2. Conceptualizing and measuring children's health**

Current conceptualizations of children's health extend traditional definitions which focus narrowly on the absence of disease. Building on the NRC's (2001) earlier call for an integrative approach, the Committee on the Evaluation of Children's Health (NRC and IOM 2004: 33) defined children's health as "the extent to which individual children or groups of children are able or enabled to (a) develop and realize their potential, (b) satisfy their needs, and (c) develop the capacities that allow them to interact successfully with their biological, physical, and social environments." This definition is consistent with an emerging scientific consensus that the concept of child health should incorporate a wide spectrum of chronic conditions, overall levels of functioning, and developmental domains, including the potential for future well-being (IOM 2011). In short, children's health is both multidimensional and emergent. New approaches are needed to delineate the major health profiles that characterize young children and to identify children with specific constellations of health and developmental problems.

Some efforts to measure children's health broadly use summary indexes of chronic conditions, functional problems, activity limitations, and elevated service use (Kohen et al. 2007). Chronic conditions are biophysical or psycho-cognitive conditions that can be expected to recur over a period of a year or more (van der Lee et al. 2007). They range from asthma and allergies to cardiac and neurological problems. Functional problems involve the senses, fine and gross motor skills, cognition, and emotions (Horsman et al. 2003; Kohen et al. 2007). These conditions are also indicated by activity limitations, or restricted participation in normal activities for a child of a specific age (Wells and

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<sup>7</sup> We restrict the analysis to Mexican, non-Hispanic black, and non-Hispanic white children because they are the three largest ethnoracial groups in the U.S. child population and because comparisons of Mexican and non-Hispanic black children are of theoretical importance. We exclude other Hispanic children and Asian children because these are heterogeneous groups that would have to be disaggregated to be analyzed in a meaningful way. Sample sizes of specific Asian and other Hispanic groups are insufficient for such analyses.

Hogan 2003). Lastly, elevated service use identifies children with challenging health conditions that require regular professional attention by considering: daily medication use; greater use of medical, mental health, and educational services than is typical for a child of a particular age; special therapies; and counseling for emotional, developmental, or behavioral problems.

Several challenges complicate the assessment of children's health using such summary indexes. The stand-alone usage of single indexes may poorly characterize the severity of health conditions or provide insufficient insights into their consequences. Moreover, single indexes may miss complex comorbidities that span broad classes of conditions. This is why conclusions about prevalence rates and the composition of populations with health problems are sensitive to whether single or multiple indexes are used. Kohen et al. (2007) examined four indexes corresponding to the abovementioned health domains using a nationally representative survey of Canadian children. They showed that more than one-half of children have a health problem using a liberal definition that requires only an elevated score on one index. This is problematic because it does not differentiate between various dimensions of health or between children with more and less severe manifestations of health problems. Examining health problems using multiple indicators and recognizing constellations of conditions may identify children with complex and serious health problems more accurately.

Another key dimension of children's health that is recognized by the NRC and IOM (2004) is "health potential," or cognitive, emotional, and social capacities. As preschool children develop the intellectual abilities necessary to reason effectively, they begin to be able to interpret the emotional states of others and to experience similar emotions (empathy). They also acquire social skills, including the ability to make friends, engage in play, and become connected to others. Even though these aspects of health potential are framed conceptually in positive terms, they are usually operationalized as problems with cognitive functioning (Hillemeier et al. 2009), attention span, self-regulation (Morgan, Farkas, and Hillemeier 2009), externalizing behavior, and internalizing behavior (Holmbeck et al. 2008).

Despite recognition of the interconnections between children's physical health, their functioning, and these aspects of development, the measurement of children's health has not kept pace with calls for integrative approaches (but see Hillemeier et al. 2012). A major goal of this study is to investigate health and health disparities among Mexican, non-Hispanic black and non-Hispanic white children within a broad, integrative framework that builds upon the premise that the totality of child health cannot be understood from studies that focus on single health conditions in isolation (Magnusson 2003).

### **3. Vulnerabilities and resources: Diverse profiles**

One of the most enduring empirical findings on childhood health is that poverty has pervasive negative effects on a wide range of childhood health conditions and developmental outcomes (Bradley and Corwyn 2002; Case, Lubotsky, and Paxson 2002; Currie and Lin 2007). Poverty may influence children's health because it constrains access to health-promoting resources, such as nutritious diets, health care, and safe environments (Case, Lubotsky, and Paxson 2002). There is also evidence that poor children are more likely than non-poor children to experience adverse psychosocial environments, including lower quality parent-child communication, family stress, and less access to nurturing environments outside the home (Kroenke 2008; National Scientific Council on the Developing Child 2007).

At the same time, poverty is intertwined with other aspects of children's lives in multifaceted ways. In particular, the constellation of advantages and disadvantages that occur alongside poverty may vary across ethnoracial groups. Thus, while differences in poverty rates are often considered a primary explanation for health disparities by race-ethnicity, there are irregularities in patterns that challenge the view that poverty is a master status that overrides other risk and protective factors. A well-established finding that has received attention in this regard is that Mexican-origin children – who have a much higher poverty rate than non-Hispanic white children – have comparable health at birth. This stands in contrast to non-Hispanic black children, who have birth outcomes consistent with their high poverty rate. In 2010, 6.5% of Mexican-origin infants were born with low birth weight, compared to 7.1% for non-Hispanic whites and 13.5% for non-Hispanic blacks (Martin et al. 2012). The favorable birth outcomes of Mexican children in the face of socioeconomic disadvantage have been characterized as an “epidemiological paradox” or “Hispanic health paradox” (Markides and Coreil 1986).

One conclusion that has been drawn from studies of the epidemiological paradox is that impoverished minority groups have divergent histories and circumstances that may lead to different health outcomes. Moreover, similar health outcomes may result from distinct combinations of vulnerabilities and advantages. Mexican and non-Hispanic black children provide a key comparison for understanding such divergent pathways to health outcomes among disadvantaged children. Although the poverty rate is similar for Mexican and non-Hispanic black children, there are important differences between the groups in family structure, parental education, parental nativity and citizenship, language spoken in the home, and culture (García Coll and Magnuson 2000; Landale, Thomas, and Van Hook 2011).

Because of the rapid growth of the Mexican-origin child population, the puzzle of their favorable health at birth, and evidence linking birth weight to health conditions later in childhood, there is widespread interest in the health of Mexican children.

However, the extent to which their healthy beginning is maintained throughout childhood appears to depend on the health indicator examined. The National Health Interview Survey (Bloom, Cohen, and Freeman 2011) indicates that Mexican-origin children under the age of 18 are less likely than their non-Hispanic white counterparts to have been diagnosed with asthma, hay fever or allergies. They are also less likely to use prescription medication regularly. A similar pattern is reported for learning disabilities and attention deficit hyperactivity disorder (ADHD) among children ages 3-17. In contrast, non-Hispanic black children are more likely than non-Hispanic white children to have been diagnosed with asthma, a learning disability, or ADHD. They are less likely to have hay fever, they show a mixed portrait for various types of allergies, and they are equally likely to use prescription medication regularly. These ethnoracial differences may be partially attributable to variations in access to medical care that can provide timely diagnoses of health problems (Bloom, Cohen, and Freeman 2011). Access to health care is relatively low for Mexican-origin children (Perez et al. 2009).

On other health outcomes, the relative status of Mexican youth is more consistent with their SES. Mexican children, especially boys, have higher rates of obesity than non-Hispanic white children (Fryar, Ogden, and Carroll 2012). Non-Hispanic black children also have higher rates of obesity than non-Hispanic whites, but the difference is larger for girls than boys. Mexican children also have a relatively high risk of early cognitive delay (Fuller et al. 2009; Padilla et al. 2002) and are less likely (74.9%) than non-Hispanic white children (87.3%) to be described by their parents as being in very good or excellent health (Bloom, Cohen, and Freeman 2011). About 71.8% of non-Hispanic black children are reported to be in very good or excellent health. The patterns for parent-reported health may be complicated by cultural differences in perceptions of health and translation problems (Bzostek, Goldman, and Pebley 2007).

One limitation of the aforementioned studies is that they examine health conditions individually. As noted by Palloni (2006: 590), “Child health status is a multidimensional concept that often is translated into and confused with very narrow, one-dimensional indicators.” This perspective is consistent with what has been called the person approach as opposed to the variables approach (Magnusson 2003). A key idea is that the multiple aspects of health in the developing child must be understood as integrated rather than as independent components.

Focusing on children in the largest U.S. ethnoracial groups, we provide an integrative portrait of four-year-old children’s health using latent class analysis (LCA) to identify the health statuses that best represent health conditions, functional problems, and development. After describing differences in the prevalence of these statuses among Mexican, non-Hispanic black, and non-Hispanic white children, we turn to multivariate models that incorporate potential explanatory factors, including health at

birth, family socio-demographic characteristics, the home environment, and utilization of well-child health care and center-based child care.

## **4. Methods**

### **4.1 Data**

We use data from the Early Childhood Longitudinal Study, Birth Cohort (ECLS-B), which is based on a sample of 14,000 children born in the United States in 2001. The sample was drawn from birth certificates, with oversamples of various subpopulations. Parent interviews were obtained for 10,700 (74%) of the children in the original birth certificate sample when they were about nine months of age. Additional parent interviews were conducted when the children were two years old (2003-04), four years old (2005-06) and starting kindergarten (2006 or 2007), with direct developmental assessments at each time point. The ECLS-B data are the only nationally-representative data on U.S. children that include all of the health domains central to the concept of child health, as explicated by the NRC and IOM.

Our analytic sample consists of 6,400 Mexican, non-Hispanic black and non-Hispanic white children who were followed to age four and had parent interviews and preschool child assessments.<sup>8</sup> As noted, these are the three largest ethnoracial groups in the United States. All analyses are based on weighted data to generate nationally-representative estimates. Reported sample sizes have been rounded to the nearest 50, as was required by the ECLS-B confidentiality agreement.

### **4.2 Measures**

#### **4.2.1 Child health**

Table 1 describes the variables used in the comprehensive model of child health. At the preschool wave, height and weight were measured. Parents indicated whether their child had been diagnosed with specific chronic conditions, such as asthma, autism, diabetes, epilepsy, a heart defect, or mental retardation. Because preschool children

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<sup>8</sup> To simplify the presentation of results, non-Hispanic whites and non-Hispanic blacks will be referred to as whites and blacks in both the tables and the remainder of this article.

have few chronic health conditions, the prevalence of most conditions is too low to include them as separate measures. Indicators of the two most common physical health problems for young children – being overweight and asthma – are included, as is a summary measure of other chronic health conditions. Parents also were asked about diagnoses of specific disabilities, including problems with attention, activity, limbs, hearing, vision, and communication. These items are used in an indicator of whether the child had functional problems. In addition, parents reported the child's daily use of prescription medications.

**Table 1: Variables used in latent class analysis**

Health Domain	Variable Description	Values
Asthma	Parent told child has asthma by doctor, nurse, or other health professional	Asthma=2; otherwise=1
Overweight/ Obese	Body Mass Index (BMI) calculated from measured height and weight. The formula for BMI is: weight (kg) / [height (m)] <sup>2</sup> . BMI percentiles indicate the relative position of the child's BMI number among children of the same sex and age, as calculated by the Centers for Disease Control.	BMI ≥ 85th percentile for age and gender=2; otherwise=1
Other Chronic Conditions	Chronic health condition diagnosed by a doctor: autism, diabetes, epilepsy, heart defect, ADHD, ODD, mental retardation, mobility problem, other developmental delay, special equipment used	One or more conditions=2; otherwise=1
Functional Problems	Diagnosed by a professional with specific functional disability: attention, activity, limbs, hearing, vision, communication	One or more diagnoses=2; otherwise=1
Daily Prescription Use	Takes prescription medication daily	Daily medicine=2; otherwise=1
High Externalizing Behavior	Score on additive index of externalizing behavior ( $\alpha = .77$ ): how often child is physically aggressive, angry, has temper tantrums, acts impulsively, is overly active, annoys other children, destroys others' things	Total externalizing behavior score > 19 (highest quartile)=2; otherwise=1 <sup>b</sup>
Low Social Skills	Score on additive index of social skills ( $\alpha = .66$ ): how often child makes friends easily, is accepted by other children, is invited to play	Total social skills score < 12 (lowest quartile)=2; otherwise=1 <sup>b</sup>

**Table 1: (continued)**

Health Domain	Variable Description	Values
Low Empathy	Score on additive index of empathy ( $\alpha = .78$ ): how often child volunteers to help others, comforts others, uses words to describe feelings, invites children to play, stands up for others' rights, tries to understand others	Total empathy score < 20 (lowest quartile)=2; otherwise=1 <sup>b</sup>
Approaches to Learning Difficulties	Score on additive index of approaches to learning ( $\alpha = .70$ ): how often child is eager to learn new things, able to pay attention well, works independently, keeps working on tasks until finished, has difficulty concentrating or staying on task (reverse coded for consistency)	Total approaches to learning score < 17 (lowest quartile)=2; otherwise=1 <sup>b</sup>
Poor Fine Motor Skills	Scale scores calculated by ECLS-B based on standardized fine motor tasks, including building with blocks and copying forms	Total fine motor scale score < 3 (lowest quartile)=2; otherwise=1 <sup>b</sup>
Low Early Reading Skills	Scale scores calculated by ECLS-B based on standardized assessment of early reading skills	Total early reading skills scale score < 17.6 (lowest quartile)=2; otherwise=1 <sup>b</sup>
Low Early Math Skills	Scale scores calculated by ECLS-B based on standardized assessment of early math skills	Total early math skills scale score < 22.2 (lowest quartile)=2; otherwise=1 <sup>b</sup>

<sup>a</sup> Indicators coded as '2' and '1' for LCA software.

<sup>b</sup> Quartiles are based on the full population of U.S. children. They are approximate due to the empirical distributions of the scales.

Child development is assessed with the parent questionnaire and direct assessments. Measures of externalizing behavior, social skills, and empathy are derived from the Preschool and Kindergarten Behavior Scales (PKBS-2), and the Social Skills Rating System (SSRS). Items that measure approaches to learning, a well-established dimension of school readiness, are taken from the Early Childhood Longitudinal Study-Kindergarten Class of 1998-99 (ECLS-K). All items used to measure these constructs are based on parent reports of the frequency with which the child showed specific traits over the three months preceding the interview. Factor analysis was used to identify the specific sets of items included in the scales for externalizing behavior, social skills, empathy, and approaches to learning (see Table 1). To be consistent with the health

condition measures, scores on the development scales were dichotomized into indicators of risk based on the empirical distributions. Children in highest risk quartile based on the full ECLS-B sample (weighted to represent the population of U.S. children) are contrasted with others.

Children's fine motor skills and cognitive development are based on direct assessments. Cognitive development is evaluated with early reading and math test batteries designed specifically for the ECLS-B. The early reading skills battery includes a core set of items and second-stage sets for children who found the core items too challenging or too easy. The early math skills battery consists of an initial test that channeled children into one of three second-stage tests. Item Response Theory (IRT) modeling was used to estimate early reading and math scale scores using the sets of items that were administered to the child. It should be noted that the cognitive assessments were administered in English unless the child was unable to answer any of the screening items. In those cases, children were routed into a Spanish cognitive battery if their home language was Spanish and out of the cognitive testing altogether if their home language was not English or Spanish.<sup>9</sup>

#### 4.2.2 Child characteristics

Ethnoracial origins are categorized as Mexican, black and white. Children who are classified as Mexican or have a father or mother who is classified as Mexican are considered to be of Mexican origin. Because parents' race and ethnicity is available from both the child's birth certificate and the survey, missing data on ethnoracial origin are minimized. Birth certificate information is used when survey data are missing.

All multivariate models control for the children's age in months at the preschool wave, gender, and birth weight. Children's birth weight was obtained from the birth certificate and classified into three categories: very low (less than 1500 grams), moderately low (1500-2499 grams), and normal (2500+ grams).

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<sup>9</sup> About 250 children in the full ECLS-B sample were unable to pass the English language screening test. Of those, about 100 children took the test in Spanish. Scores are not provided for the Spanish tests because a larger sample is required to generate reliable test scores and statistics. It is not surprising that few children were Spanish monolingual, since all of the ECLS-B children were born in the United States and the assessments were conducted at about four years of age.

### 4.2.3 Socio-demographic variables

Parental nativity is frequently a central focus in studies of Mexican-origin children because it signals various aspects of assimilation that may influence children's environments and outcomes. We include an indicator of maternal nativity, or whether the mother was foreign versus native born. Maternal nativity is fixed, but other socio-demographic variables may change over time. Because children's health at age four reflects conditions experienced throughout the first years of life, mother's English proficiency, family poverty, maternal education, and family structure are based on data collected in wave 1, when the children were nine months old.

Preliminary analyses of both the home language and the mother's English proficiency showed that the latter variable is more strongly associated with child health than the former. Therefore, we constructed an indicator of poor maternal English from separate measures of her self-reported ability to speak, read, write, and understand English. After coding the responses so that higher values reflected better ability, these four-point scales were summed to create an additive index ranging from 4 to 16. Mothers scoring less than 12 are classified as having poor English language ability. About 39% of Mexican mothers are in this category. A non-English language was the primary home language for about 98% of children whose mothers had poor English proficiency.

Family poverty is measured according to the Census Bureau's poverty thresholds. A family is coded as poor if its total income fell below the threshold for a family of its size and age composition. Mother's completed education is classified as: less than high school, high school, some college, and college graduate. Family structure is measured with two variables. The first is whether both biological parents live in the home. The second is extended family structure: no extension, vertical extension (grandparents) only, horizontal extension (aunts, uncles, cousins) only, and both types of extension.

### 4.2.4 Home, health care, and child care exposures

Parents provide the major inputs to the home environment and make health care and child care decisions. To measure critical features of the home environment, the ECLS-B gathered information on parenting practices and the availability of stimulating materials and experiences in the home. These items were derived from the short form of the Home Observation Measurement of the Environment scale (Caldwell and Bradley 1984). Some home characteristics were obtained via interviewer observation. Examples include whether the parent responded to the child's speech, caressed the child, provided toys, and kept the child in view. Parent reports were used to construct other indicators,

such as the frequency of reading or telling stories to the child and the number of children's books, soft toys for role playing, or push-pull toys in the home. Factor analyses of these items indicated relatively low internal consistency (Andreassen, Fletcher, and Park 2007), leading the National Center for Education Statistics to advise ECLS-B users to consider methods other than scaling to measure the home environment. Therefore, we used a count of 16 dichotomized items to indicate the quality of the home environment. The items were taken from wave 2 because the measures available were more extensive than at wave 1. The resulting variable was standardized to facilitate interpretation.

Young children's health problems are diagnosed and treated through contact with the health care system, especially well-child visits during the first years of life. In the wave 3 interview, mothers were asked how many times the child had been taken for a well-child visit since the wave 2 interview (about two years earlier). Since the recommended schedule calls for one visit per year in this age group, this variable was dichotomized to indicate adequate well-child care (2 or more visits) and inadequate well-child care (< 2 visits).

Another institutional setting that provides health screening as well as stimuli and instruction that promote child development is center-based child care. The ECLS-B asked about the child's primary child care arrangement at each wave. Our measure of center-based care contrasts those whose primary child care arrangement was a child care center at *any* of the waves with others.<sup>10</sup>

### 4.3 Analysis

The first two goals of our analysis are to delineate the multidimensional health statuses that characterize preschool children's health and to examine ethnoracial variation in their prevalence. We use LCA to estimate a set of latent health statuses that capture the nature of children's health at 48 months of age. LCA resembles cluster analysis conceptually but is based on a measurement model that is akin to factor analysis. This person-centered approach postulates that there are underlying subgroups of individuals

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<sup>10</sup> The benefits of center-based child care depend upon its quality. The ECLS-B evaluated the quality of center-based care, but the assessment was conducted for only 26% of the children in such care. Thus, it is not possible to differentiate center-based care by its quality in this analysis. Among those who were assessed, child care quality was similar for Mexican-origin children and white children, but significantly lower for black children (authors' calculations).

who have similar characteristics, but that true subgroup membership is unknown and can only be inferred through a set of measured characteristics. Thus, in using the LCA model to examine child health, we posit that: (1) a set of underlying latent classes, or health statuses, exists in the population such that each health status is unique from the others; (2) the set consists of mutually exclusive and exhaustive health statuses; and (3) children belonging to a particular latent health status are homogeneous.

While LCA can accommodate health indicators of different scales (e.g., binary, ordinal), including a mix of such indicators is rarely done because model identification and interpretation become very difficult. In order to accommodate a wide range of health indicators, our LCA analysis uses 12 binary indicators of health and developmental problems to infer children's latent class membership. Each child's true latent health status is not known with certainty; rather, each child has a probability of membership in each latent health status. An important advantage of LCA and the reason that it is innovative and appealing for our purposes is that each latent class reflects higher-order interactions among all 12 health indicators. With 12 binary responses, there are 4,096 (i.e.,  $2^{12}$ ) possible patterns of unique responses to the health indicators. LCA reduces this complex information to a set of latent classes reflecting dominant health profiles in the population. It is therefore a particularly appropriate methodology for providing evidence-based content in response to calls for broad conceptualizations of health that encompass multiple domains.

Two sets of parameters are estimated. The first set contains the latent class membership probabilities (often denoted as  $\gamma$  parameters), reflecting the relative proportion of individuals in each latent class. These parameters represent a vector of probabilities that sum to 1. The second set of parameters contains item-response probabilities (often denoted as  $\rho$  parameters) representing the probability of a particular response to each indicator given latent class membership. These item-response probabilities express the relationship between observed and latent variables. In so doing, they provide a basis for interpreting the latent classes. The latent class model assumes conditional independence. In the context of this study, for example, individuals' membership in a latent health status is assumed to account for any relation among their responses to the various health indicators.

Based on the LCA parameter estimates and an individual's observed responses, each individual's posterior probability of membership in each latent class can be calculated using Bayes' theorem. Because there is no closed-form solution to estimate the LCA parameters, iterative procedures – typically the expectation-maximization algorithm – are used. This procedure requires that starting values be specified. For well-identified models, the choice of starting values has no impact on the solution. However, under-identification is common in LCA, particularly for models with more latent classes. To the extent that different sets of starting values lead to different solutions, a

model is not well identified. Well-identified models with different numbers of latent classes can be compared using information criteria such as AIC and BIC, although interpretation of the latent classes can play a substantial role in model selection. We rely on the AIC and BIC to determine the range of the competing models (i.e., number of latent classes) to consider; we then rely on our ability to meaningfully interpret the resultant latent classes when selecting a final model. Details about the LCA mathematical model, posterior probabilities, model identification, and model selection can be found in Collins and Lanza (2010).

All latent class models are estimated using PROC LCA (Lanza et al. 2011). In subsequent analyses we predict latent class membership using multinomial logistic regression. For these models, children are classified into the latent health status that best represents their health profile according to their individual maximum posterior probability. This class assignment is treated as a fully-observed dependent variable in the regression analyses.

We use a hybrid approach to handling missing data. The software we employ to perform LCA uses a full-information maximum-likelihood approach to handle missing values on the 12 indicators of latent health status. This routine adjusts for data that are missing at random (MAR). After children are assigned to a latent health status, we employ multiple imputation to handle incomplete data on the independent variables (Rubin 1987; Schafer 1997). We include class assignment in the imputation model. In contrast to other methods of dealing with missing data, multiple imputation maintains the original relationships among variables as well as the overall variability. Twenty-five data sets were imputed to take the uncertainty of imputed values into account. Multinomial logistic regression models are fit in each data set, and the results are combined across imputations to generate the parameter estimates and standard errors.

## **5. Results**

### **5.1 Latent class analysis**

As with any latent variable model, group comparisons in the structural part of the LCA model (here, class membership probabilities) are typically of greatest interest. However, such comparisons assume that the underlying latent construct is measured similarly across groups. We therefore conducted model selection using the following procedure. First, we created separate data sets for Mexican-origin children, black children, and white children. Model selection was conducted for each subsample in order to understand the health statuses that characterized each population. Well-identified models with different numbers of latent classes were compared on the basis of the AIC,

BIC, and the ability to meaningfully interpret the parameter estimates. We selected either five or six latent classes as optimal in each group-specific analysis. As expected, a high level of overlap in the meaning of latent classes emerged across groups. For example, a latent class characterized by low cognitive ability but no other health deficits emerged in all three groups.

Second, model selection was conducted with the pooled sample of Mexican, black, and white children. Models with one through seven latent classes were compared, again using the AIC, BIC, and substantive meaning of the latent classes, to determine the optimal number of latent health statuses. A six-class model was selected. By including a grouping variable for ethnoracial group, we were able to compare the resultant classes with those derived from the group-specific analyses described above. All of the latent classes identified above emerged in the final model, indicating that our final six-class model describes latent health statuses in each group well. We then assessed whether measurement invariance held across the three groups. Although this very sensitive test was significant, providing evidence for different item-response probabilities across groups, the BIC indicated that the model that imposed invariance across measurement was optimal. Given this support, and so that we could make meaningful comparisons across groups in subsequent analyses, we specified a final six-class model with measurement held equal across the three groups.

Parameter estimates from the model with six latent health statuses are summarized in Table 2. The 12 health indicators are listed in the first column, and the remaining columns present parameters reflecting the probability of reporting each health problem conditional on latent health status membership (i.e., item-response probabilities). Labels for each latent health status were created on the basis of the item-response probabilities. The panel at the top of the table indicates the percentage of children in each ethnoracial group who fall into each latent health status. The prevalence of latent health statuses within each ethnoracial group is also illustrated in Figure 1, where the bar representing each group is subdivided to indicate the distribution of children across the latent health statuses.

The **Healthy** status is distinguished by very low probabilities (0.15 or lower, with the exception of overweight/obese) of any reported health/developmental problem. Only 29% of Mexican children and 34% of black children are classified as Healthy, compared to 57% of white children. Children in the **Asthma** status have a relatively high probability of diagnosed asthma and daily prescription use (0.65 and 0.66, respectively). Mexican-origin children stand out as being highly unlikely to fall into this health status (2%), compared to black (9%) and white children (7%). The **Low Cognitive Achievement** status comprises children with a high probability of exhibiting poor early reading skills and poor early math skills (0.77 and 0.63, respectively) without highly elevated probabilities of other health/developmental problems. This is

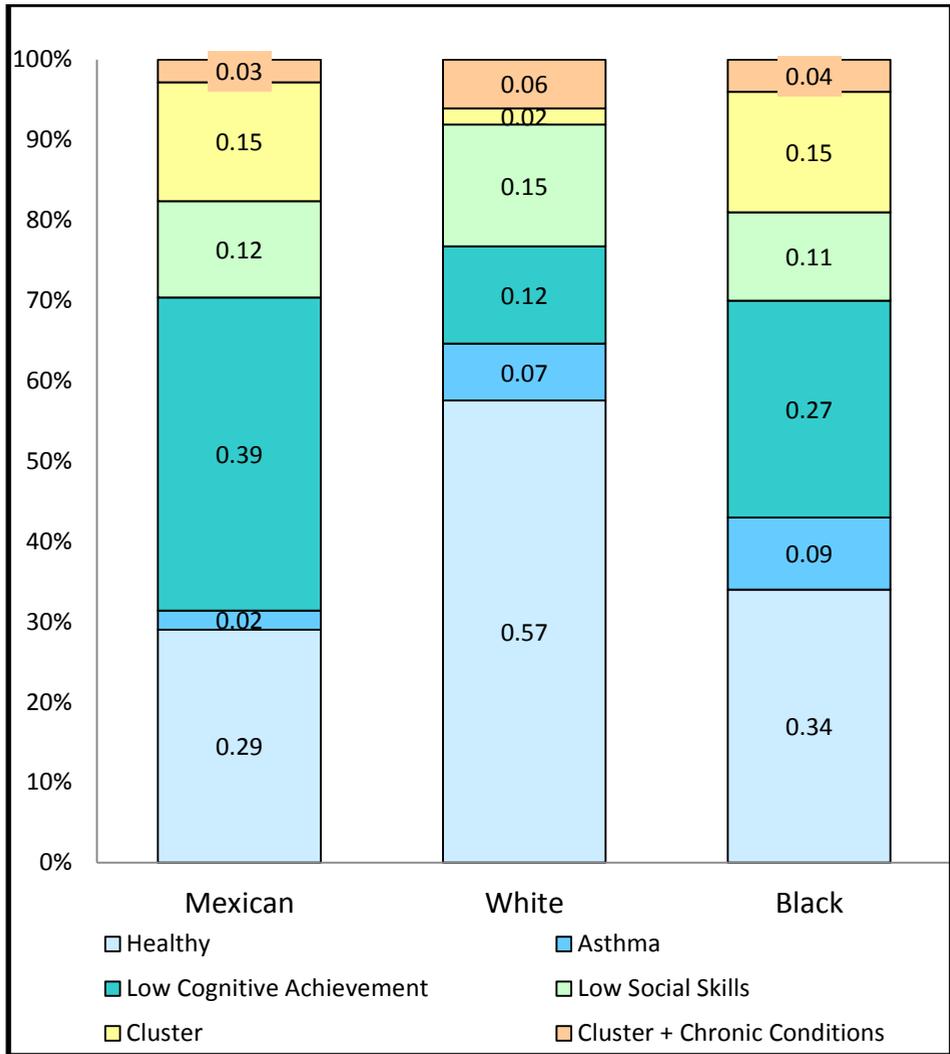
the modal health status for Mexican children. Fully 39% of Mexican children are categorized into the Low Cognitive Achievement health status, a much higher percentage than that for black children (27%) or white children (12%). The **Low Social Skills** status is characterized by relatively high probabilities of scoring in the lowest quartile on indexes of social skills and empathy (0.60 and 0.52, respectively). About 12% of Mexican children, 11% of black children, and 15% of white children fall into this health status.

**Table 2: Probability of reporting each health problem conditional on membership in latent health status (N=6400)**

	Healthy	Asthma	Low Cognitive Achievement	Low Social Skills	Cluster	Cluster + Chronic
<b>Percentage in latent health status</b>						
Mexican	29.10	2.50	38.51	12.44	14.71	2.75
White	56.89	7.43	12.06	15.29	2.47	5.86
Black	33.85	9.32	26.67	10.89	15.27	3.99
<b>Health Indicator</b>						
Asthma	0.05	<b>0.65</b>	0.09	0.03	0.17	0.20
Overweight/Obese	0.34	0.42	0.39	0.31	0.40	0.36
Other Chronic Conditions	0.04	0.12	0.03	0.00	0.04	<b>0.82</b>
Functional Problems	0.11	0.30	0.11	0.14	0.10	<b>0.90</b>
Daily Prescription Use	0.04	<b>0.66</b>	0.05	0.07	0.06	0.32
High Externalizing Behavior	0.10	0.23	0.18	0.37	<b>0.59</b>	<b>0.55</b>
Low Social Skills	0.08	0.14	0.14	<b>0.60</b>	<b>0.63</b>	<b>0.62</b>
Low Empathy	0.03	0.07	0.10	<b>0.52</b>	<b>0.60</b>	<b>0.67</b>
Approaches to Learning Difficulties	0.03	0.11	0.04	0.37	<b>0.67</b>	<b>0.69</b>
Poor Fine Motor Skills	0.15	0.29	0.45	0.30	<b>0.58</b>	<b>0.63</b>
Low Early Reading Skills	0.02	0.10	<b>0.77</b>	0.07	<b>0.90</b>	<b>0.51</b>
Low Early Math Skills	0.05	0.14	<b>0.63</b>	0.12	<b>0.79</b>	<b>0.56</b>

Note: Probabilities greater than 0.50 are bolded to facilitate interpretation.

**Figure 1: Prevalence of latent health statuses by ethnoracial group**



The last two health statuses reflect the *joint occurrence* of poor early reading and math skills, approaches to learning difficulties, low social skills, low empathy, high externalizing, and poor fine motor skills. *The intersection of these multiple*

*developmental problems is referred to as a “cluster.”* The **Cluster** status includes children who are unlikely to report any other physical health problem, whereas the **Cluster + Chronic** status includes children who are likely to also have a chronic health condition (other than asthma) and functional problems. The emergence of these two health statuses is consistent with recent neurobiological studies that conclude that cognitive, emotional, and social capabilities are deeply interconnected in early childhood (National Scientific Council on the Developing Child 2007).

The Cluster status comprises 15% of Mexican and black children, compared to 2% of white children. In contrast, white children are more likely (6%) to fall into the Cluster + Chronic health status than Mexican (3%) or black (4%) children. The children who fall into the Cluster and Cluster + Chronic health statuses are of particular concern, given their multiple health and developmental problems. Importantly, they would not have been identified with the typical analytic strategy of examining health problems individually.

One striking finding is that overweight/obesity is present in every health status at about the same rate. The item-response probabilities for overweight/obesity range from 0.31 for Low Social Skills to 0.42 for Asthma. This suggests independence between overweight/obesity and health status as defined by this comprehensive set of indicators.

## 5.2 Models of health status

The third goal of our analysis is to assess the extent to which major sources of social and economic disadvantage account for ethnoracial disparities in children’s health. The descriptive statistics presented in Table 3 provide insight into group differences in children’s circumstances. Values that differ significantly from those for whites are marked with asterisks. Additional notation (<sup>a</sup>) indicates whether differences between Mexican and black children are statistically significant.

Differences in birth weight are consistent with other studies: Mexican children have a birth-weight profile that is comparable to that of white children, despite their socioeconomic disadvantage. Black children are considerably more likely than both white and Mexican children to have had a moderately low or very low birth weight.

**Table 3: Descriptive statistics by race-ethnicity (weighted)**

	<b>Mexican</b>	<b>White</b>	<b>Black</b>
<b>Child Characteristics</b>			
Mean Age in months, 48 month wave	53.1***	52.1	52.2 <sup>a</sup>
% Male	52.7	51.4	51.2
Birth Weight			
% normal	93.5	93.6	87.9*** <sup>a</sup>
% moderately low (1500-2499 grams)	5.4	5.4	9.7*** <sup>a</sup>
% very low (< 1500 grams)	1.1	1.0	2.4*** <sup>a</sup>
Socio-demographic Variables			
% Mother Foreign Born	54.4***	4.2	9.7*** <sup>a</sup>
% Mother's English Poor	39.4***	0.8	1.5 <sup>a</sup>
% Poverty	39.2***	13.2	47.4*** <sup>a</sup>
Mother's Education			
% less than high school	41.7***	9.9	25.4*** <sup>a</sup>
% high school	34.0**	29.9	39.5*** <sup>a</sup>
% some college	17.0***	26.6	26.0 <sup>a</sup>
% college graduate	7.2***	34.5	9.1***
% Two Biological Parents in Home	80.4***	88.4	40.7*** <sup>a</sup>
<b>Extended Family Structure</b>			
% none	67.5***	88.2	67.9***
% vertical only	8.3*	6.1	10.2***
% horizontal only	13.0***	1.6	6.7*** <sup>a</sup>
% vertical and horizontal	11.2***	4.1	15.2*** <sup>a</sup>
<b>Home Environment</b>			
Mean HOME Environment Score	95.8***	104.2	90.9*** <sup>a</sup>

**Table 3: (continued)**

	Mexican	White	Black
<b>Health Care and Child Care</b>			
% Well-child Care	80.3	79.6	84.4** <sup>a</sup>
% Ever in Center-based Care	46.9***	65.6	71.4** <sup>a</sup>
Unweighted N	1300	3800	1300

Note: Significant differences between white children (the reference group) and Mexican and black children are identified as follows:

\*  $p < .05$  \*\*  $p < .01$  \*\*\*  $p < .001$ .

Significant differences between Mexican and black children are identified with the superscript <sup>a</sup>.

The socio-demographic variables reveal that Mexican children have potentially favorable risk profiles on some measures and unfavorable risk profiles on others. Over half (54%) of Mexican preschool children have foreign-born mothers. This may offer some protections, but it is also associated with risk factors such as low English language proficiency and low education. About 39% of Mexican mothers of preschool children have poor English skills and about 42% did not complete high school. These estimates are considerably higher than those for whites and blacks. As expected, Mexican preschool children are more likely to live in poverty (39%) than white children (13%). However, they are significantly less likely to be poor than black preschool children (47%), a pattern at least partially attributable to their higher likelihood of living with two parents (80% for Mexican children compared to 41% for black children). As for family extension, a substantial majority of children live in nuclear families. Still, about a third of Mexican and black children live in extended families at nine months of age, compared to about 12% of white children.

Socio-demographic characteristics shape additional resources that parents can bring to bear on their children's health. Subject to socioeconomic constraints, parents make lifestyle decisions that affect their children's access to various domestic and non-domestic resources. The home environment measure indicates the extent to which parents provide age-appropriate stimulation and nurturing. A comparison of means suggests that white parents are more able to provide an enriched home environment than are Mexican and black parents. Furthermore, the home environment score is significantly higher for Mexican children than for black children. In contrast, black children are the most likely to have received adequate well-child care (84% vs. 80% for both whites and Mexicans) and to have been enrolled in center-based child care (71% vs. 66% for white children and 47% of Mexican children). Mexican children stand out for their relatively low exposure to center-based child care.

In summary, Mexican-origin children and black children experience distinct profiles of disadvantage. A relatively large share of Mexican children have mothers with low education and English ability, and they are relatively unlikely to be exposed to formal child care. They also have a higher poverty rate and less enriched home environments than do white children. In contrast, among all three ethnoracial groups, black children have the highest poverty rate, the lowest likelihood of living with two parents, and the least enriched home environments.

**Table 4** presents odds ratios from multinomial logistic regression models predicting latent health status. Latent health statuses are coded with Healthy as the reference category. The baseline model (Model 1, top panel) includes ethnoracial group and three control variables: the child’s age, gender, and birth weight. Model 2 (middle panel) adds socio-demographic variables, including maternal nativity, English language proficiency, and education – as well as poverty and family structure. Model 3 (bottom panel) adds the home environment score, well-child care and center-based child care.

**Table 4: Odds ratios from multinomial logistic regression models predicting latent child health status (N=6400)**

Predictors	Asthma	Low Cognitive Achievement	Low Social Skills	Cluster	Cluster + Chronic
<b>Model 1</b>					
Race-ethnicity					
White	---	---	---	---	---
Mexican	0.74 <sup>a</sup>	8.85 <sup>***a</sup>	2.01 <sup>***a</sup>	21.33 <sup>***a</sup>	1.00
Black	2.21 <sup>***</sup>	3.94 <sup>***</sup>	1.16	14.73 <sup>***</sup>	1.18
Age in months	0.96 <sup>*</sup>	0.86 <sup>***</sup>	0.95 <sup>***</sup>	0.86 <sup>***</sup>	0.93 <sup>***</sup>
Male	1.55 <sup>**</sup>	1.64 <sup>***</sup>	1.85 <sup>***</sup>	3.26 <sup>***</sup>	3.74 <sup>***</sup>
Birth Weight					
normal	---	---	---	---	---
moderately low	2.07 <sup>***</sup>	1.87 <sup>***</sup>	1.25	1.88 <sup>***</sup>	3.25 <sup>***</sup>
very low	2.86 <sup>***</sup>	1.60 <sup>***</sup>	1.38 <sup>*</sup>	3.10 <sup>***</sup>	10.72 <sup>***</sup>

**Table 4: (continued)**

Predictors	Asthma	Low Cognitive Achievement	Low Social Skills	Cluster	Cluster + Chronic
<b>Model 2</b>					
Race-ethnicity					
White	---	---	---	---	---
Mexican	0.66 <sup>a</sup>	5.49 <sup>****a</sup>	1.68 <sup>***</sup>	9.97 <sup>***</sup>	0.66
Black	1.94 <sup>***</sup>	2.49 <sup>***</sup>	1.49	7.58 <sup>***</sup>	0.77
Age in months	0.96 <sup>*</sup>	0.84 <sup>***</sup>	0.94 <sup>***</sup>	0.83 <sup>***</sup>	0.91 <sup>***</sup>
Male	1.58 <sup>**</sup>	1.75 <sup>***</sup>	1.89 <sup>***</sup>	3.55 <sup>***</sup>	4.04 <sup>***</sup>
Birth Weight					
normal	---	---	---	---	---
moderately low	2.01 <sup>***</sup>	1.78 <sup>***</sup>	1.21	1.82 <sup>***</sup>	3.05 <sup>***</sup>
very low	2.87 <sup>***</sup>	1.67 <sup>***</sup>	1.41 <sup>*</sup>	3.47 <sup>***</sup>	11.22 <sup>***</sup>
Mother Foreign Born	0.86	1.39 <sup>*</sup>	1.10	1.21	1.00
Mother's English Poor	0.56	1.00	1.43	1.00	1.07
Poverty	1.36	1.81 <sup>***</sup>	1.29 <sup>*</sup>	2.05 <sup>***</sup>	1.95 <sup>***</sup>
Mother's Education					
less than high school	1.10	1.50 <sup>**</sup>	1.14	2.33 <sup>***</sup>	1.29
high school	---	---	---	---	---
some college	1.00	0.75 <sup>*</sup>	0.74 <sup>*</sup>	0.63 <sup>*</sup>	0.66 <sup>*</sup>
college graduate	0.84	0.31 <sup>***</sup>	0.71 <sup>*</sup>	0.15 <sup>***</sup>	0.50 <sup>**</sup>
Two Biological Parents	0.88	0.92	1.09	0.67 <sup>*</sup>	0.63 <sup>*</sup>
Extended Family Structure					
None	---	---	---	---	---
vertical	0.90	0.76	0.95	0.63	1.01
horizontal	0.88	1.21	0.98	1.46	1.57
vertical and horizontal	0.75	1.61 <sup>**</sup>	0.81	1.02	1.06

**Table 4: (continued)**

Predictors	Asthma	Low Cognitive Achievement	Low Social Skills	Cluster	Cluster + Chronic
<b>Model 3</b>					
Race-ethnicity					
White	---	---	---	---	---
Mexican	0.81 <sup>a</sup>	4.76 <sup>****a</sup>	1.40	9.61 <sup>****a</sup>	0.65
Black	1.95 <sup>***</sup>	2.46 <sup>***</sup>	1.01	5.34 <sup>***</sup>	0.77
Age in months	0.95 <sup>*</sup>	0.85 <sup>***</sup>	0.94 <sup>***</sup>	0.84 <sup>***</sup>	0.90 <sup>***</sup>
Male	1.58 <sup>**</sup>	1.74 <sup>***</sup>	1.86 <sup>***</sup>	3.53 <sup>***</sup>	3.91 <sup>***</sup>
Birth Weight					
normal	---	---	---	---	---
moderately low	2.01 <sup>***</sup>	1.78 <sup>***</sup>	1.21	1.86 <sup>***</sup>	3.06 <sup>***</sup>
very low	2.86 <sup>***</sup>	1.66 <sup>***</sup>	1.39 <sup>*</sup>	3.57 <sup>***</sup>	11.03 <sup>***</sup>
Mother Foreign Born	0.86	1.36	1.06	1.23	0.92
Mother's English Poor	0.55	0.95	1.38	0.89	1.07
Poverty	1.38	1.73 <sup>***</sup>	1.24	1.90 <sup>***</sup>	1.87 <sup>***</sup>
Mother's Education					
less than high school	1.11	1.45 <sup>**</sup>	1.12	2.18 <sup>***</sup>	1.27
high school	---	---	---	---	---
some college	0.99	0.78	0.77	0.70	0.71
college graduate	0.83	0.35 <sup>***</sup>	0.80	0.19 <sup>***</sup>	0.56 <sup>*</sup>
Two Biological Parents	0.89	0.90	1.10	0.65 <sup>*</sup>	0.66
Extended Family Structure					
none	---	---	---	---	---
vertical	1.53	0.92	0.74	0.95	0.61
horizontal	0.89	1.16	0.96	1.32	1.53
vertical and horizontal	0.76	1.55 <sup>*</sup>	0.78	0.93	1.02
Home Environment Score	1.00	0.98 <sup>***</sup>	0.98 <sup>***</sup>	0.96 <sup>***</sup>	0.97 <sup>***</sup>
Well-child Care	1.35	0.99	0.99	0.61 <sup>**</sup>	1.08
Ever in Center-based Care	1.06	0.71 <sup>***</sup>	0.93	0.61 <sup>**</sup>	1.28

Note: Significant differences between white children (the reference group) and Mexican and black children are identified as follows: \* p < .05 \*\* p < .01 \*\*\* p < .001.  
 Significant differences between Mexican and black children are identified with the superscript a.

Model 1 shows that compared to white children, Mexican children have elevated odds of falling into three health statuses relative to the Healthy status: Low Cognitive Achievement, Low Social Skills, and Cluster. The odds ratios are especially high for Low Cognitive Achievement (OR=8.85) and the Cluster (OR=21.33), which includes low cognitive achievement along with multiple developmental problems. Black children also have higher odds than white children of being classified into the Low Cognitive Achievement (OR=3.94) and Cluster (OR=14.73) statuses, but they are significantly less likely than Mexican children to fall into these groups. In addition, black children are significantly more likely than white and Mexican children to be in the Asthma category and significantly less likely than Mexican children to be in the Low Social Skills category.

As for the control variables, boys are significantly more likely than girls to be in all five problematic health statuses. Children with moderately low or very low birth weights are also more likely than others to fall into the problematic health groups, though the elevated odds ratio for the Low Social Skills health status is not significant for moderately low-birth-weight children. Very low-birth-weight children have an especially high likelihood of falling into the Cluster + Chronic health status relative to normal-birth-weight children (OR=10.72).

Model 2 adds controls for socio-demographic variables. Mexican children remain significantly more likely than white children to fall into the Low Cognitive Achievement, Low Social Skills, and Cluster statuses, despite a reduction in the odds ratios relative to the first model (5.49 for Low Cognitive Achievement, 1.68 for Low Social Skills, and 9.97 for the Cluster). Patterns for Asthma, Low Cognitive Achievement, and the Cluster also mirror Model 1 for black children, and are similarly attenuated. Once socio-demographic variables are controlled for, Mexican children differ from black children in their relatively low odds of being in the Asthma health status and relatively high odds of being in the Low Cognitive Achievement health status.

In general, the socio-demographic variables are related to health in the expected manner. Poor children have higher odds than non-poor children of falling into health statuses characterized by low cognitive achievement, low social skills, and clustered developmental problems (with and without chronic conditions). Low maternal education is associated with elevated odds of being in the Low Cognitive Achievement and Cluster health statuses. Net of other socio-demographic variables, living with both biological parents is protective primarily with respect to the Cluster and Cluster + Chronic health statuses. Having two parents in the home may allow for greater time and attention to be devoted to activities and interactions that promote child development. Extended family members potentially play a similar role. However, health status does not vary significantly by family extension except that living in a family that is extended

both vertically and horizontally is associated with relatively high odds of falling into the Low Cognitive Achievement health status.

Although some prior studies have shown that children's outcomes vary significantly by maternal nativity (e.g., Hamilton et al. 2011), Model 2 shows that after other socio-demographic variables are controlled for, having a foreign-born mother is related only to the odds of being classified into the Low Cognitive Achievement health status (OR = 1.39).<sup>11</sup> However, these results do not support the conclusion that low exposure to English in the home is responsible for Mexican children's low cognitive achievement on tests administered in English. Mother's English proficiency is unrelated to the odds of membership in the Low Cognitive Achievement or Cluster health statuses.

Model 3 includes measures of three potential mechanisms through which ethnoracial group and socio-demographic characteristics may influence health status: the quality of the home environment, receipt of well-child care, and participation in center-based child care. Even though they are related to child health, these potential mechanisms do not fully explain ethnoracial or socio-demographic differences in health statuses. Their inclusion in the model attenuates the odds ratios for race/ethnicity only slightly and does little to change the odds ratios for socio-demographic variables.

Nonetheless, the home environment is a strong predictor of child health status, with children in relatively enriched home environments less likely to fall into each of the problematic health statuses except Asthma. Well-child care provides opportunities for intervention to reduce child health problems. Children who receive adequate well-child care have lower chances of falling into the Cluster health status than children who do not. Another factor that may hinder Mexican children's cognitive achievement is their low participation in center-based child care. Model 3 shows that children who have been enrolled in center-based care are less likely than others to fall into the Low Cognitive Achievement and Cluster statuses.<sup>12</sup>

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<sup>11</sup> In additional analyses (not shown), we added maternal nativity to a model that included only ethnoracial group and also to Model 1. In both models, maternal nativity was associated only with the odds of low cognitive achievement. Using Models 2 and 3 as the baseline, we also tested for an interaction between ethnoracial group and maternal nativity. These tests indicated that the interaction was not significant in either model.

<sup>12</sup> Center-based child care potentially has a greater impact on child development for children who are not regularly exposed to English at home. Thus, we tested for an interaction between poor maternal English ability and participation in center-based child care. This interaction was not statistically significant.

## **6. Discussion**

Drawing on a life course framework, a growing body of research emphasizes the long-term effects of health in early childhood on adult health and achievement (Case, Fertig, and Paxson 2005; Palloni 2006). It is clear that health disparities begin early in life and widen across the life course. Moreover, health at one time point affects health at later points in both childhood and adulthood (NRC and IOM 2004). Palloni (2006) argues that childhood health – broadly defined as a multidimensional concept that includes cognitive ability and personality traits – plays an important explanatory role in the transmission of inequality across generations.

Measurement strategies have not kept pace with emerging conceptualizations of child health as comprising a wide spectrum of chronic conditions, overall levels of functioning, and well-being. Health is typically measured by treating specific conditions, such as asthma or being overweight, as individual outcomes. In response to the call for more integrative approaches, this study measured health holistically by using LCA to characterize the higher-order interactions among 12 unique aspects of health. The study's aims were to delineate the multidimensional health statuses that characterize preschool children's health, to document ethnoracial differences in the prevalence of those health statuses with special attention to Mexican-origin children, and to assess whether key sources of disadvantage account for ethnoracial health disparities. By incorporating multiple measures of physical conditions, functional problems, and areas of development into a single latent class analysis, we identified the major dimensions of health during the preschool years and the relative standing of Mexican, black and white children.

Mexican-origin children begin life with a health advantage: They have a birth weight distribution that is comparable to that of white children despite having a much higher level of socioeconomic adversity. This health advantage carries over to later physical health conditions, including asthma and other chronic conditions that co-occur with functional and developmental problems. Only 5% of Mexican-origin children fall into the two latent health statuses that are characterized by problems in these areas, compared to 13% of whites and 14% of blacks. Still, Mexican children are more likely than white and black children to fall into a latent health status characterized by developmental problems without physical health conditions, including Low Cognitive Achievement, Low Social Skills, or Cluster. About two thirds of Mexican-origin children fall into one of these health statuses, compared to 30% of white children and 53% of black children. The difference between Mexican and black preschool children in this regard stands in sharp contrast to their relative health at birth.

Among Mexican children, the modal health status is Low Cognitive Achievement (38%). An additional 15% fall into the Cluster health status, which is defined by low

cognitive achievement in combination with other developmental problems. Two explanations of Mexican children's low cognitive achievement are their limited exposure to English (and consequent disadvantage on tests administered in English) and their lack of exposure to cognitively stimulating home or preschool environments. Even though all children in the ECLS-B are U.S. born, the majority of the Mexican-origin children have one or more foreign-born parents. Their experiences are shaped by their parents' position as an economically disadvantaged U.S. minority group that faces special challenges due to immigrant adaptation to life in the United States. The analyses show that 39% of U.S.-born Mexican preschool children have mothers with poor English language ability, and almost all of those children speak a non-English language at home. Still, very few ECLS-B children (250 in total; 100 Spanish speakers) failed to pass the English screening test that was a prerequisite for taking the tests in English.

It is likely that the Mexican children's comprehension of instructions and content in English was lower than that of white and black children. Nonetheless, findings from one recent study indicate that it is doubtful that these children would have performed better if they had taken the test in Spanish. Using data from a test language randomization experiment conducted as part of the New Immigrant Survey (NIS), Akresh and Akresh (2011) showed that U.S.-born Hispanic children with immigrant parents scored better on Woodcock Johnson achievement tests administered in English than on comparable tests administered in Spanish. They concluded that Hispanic children born in the United States quickly become English-dominant, even if their proficiency is somewhat limited. Although the children tested were generally older (ages 3 to 12) than those considered in this study (age 4), the NIS results suggest that the Mexican-origin children in the ECLS-B may not have performed better on the early reading and early math tests if they had been given in Spanish. Still, the challenges involved in learning two languages simultaneously may play a role in Mexican children's low cognitive achievement.

Sub-optimal cognitive stimulation at home or in child care environments could also play a role. For example, the quantity and quality of the vocabularies mothers use when conversing with their offspring are critical to the children's cognitive development. Maternal vocabulary varies by education level (Hillemeier et al. 2010), which is generally quite low among Mexican-origin mothers. Other aspects of parenting that contribute to cognitive development, such as having books in the home and reading to children, also vary by parental education (Farkas and Hibbel 2007). Nonetheless, in multivariate models that controlled for maternal English language proficiency, maternal education, the quality of the home environment, and exposure to center-based child care, Mexican-origin children remained considerably more likely than white children to fall into the Low Cognitive Achievement health status and the Cluster health status. They were also more likely to fall into those health statuses than were black children.

Our analyses are consistent with prior research showing a disproportionate burden of health problems among ethnoracial minority children (for a recent review, see Flores and The Committee on Pediatric Research 2010), but extend the literature by quantifying disadvantages with respect to a comprehensive set of multidimensional health statuses. By comparing Mexican and black children, we also showed that children in various impoverished ethnoracial groups face different constellations of risk and protective factors that contribute to distinct health profiles. In addition, our analytic strategy allowed us to expand upon a prominent paradigm in child health research that calls attention to a group termed “children with special health care needs” (CSHCN). These are children who “have or are at increased risk for a chronic physical, developmental, behavioral, or emotional condition and who also require health and related services of a type or amount beyond that required by children generally” (McPherson et al. 1998: 138). The intentionally broad CSHCN definition has been critiqued for being non-specific with regard to criteria for being “at risk” and for failing to differentiate subgroups that differ with regard to medical complexity and particular combinations of health conditions and functional problems (Cohen et al. 2011; IOM 2011; Lollar, Hartzell, and Evans 2012). Our analysis addressed these concerns by providing specificity about prominent patterns of co-occurring health conditions and by showing that Mexican and black children have relatively high risks of concurrent developmental problems.

Although our comprehensive approach to measuring health status represents an advance that is consistent with the recommendations of the National Research Council and Institute of Medicine (2004), some possible limitations should be acknowledged to provide direction for future research. First, as with any analysis, conclusions may be sensitive to the measurement scale of the constructs under study. Many of our health status indicators were binary in nature (e.g., diagnosis of asthma, functional problems, daily prescription use), whereas others were created by recoding continuous scales (e.g., low early reading skills). An LCA with indicators of mixed scales is technically possible, but can lead to models that are challenging to interpret and difficult to compute, particularly with models involving many indicators. Thus, we chose to consider only binary health indicators in this model so that the maximum number of health dimensions could be included simultaneously. While we selected cut-points that were intuitive and facilitated clear interpretation, we recognize that selection of different cut-points could lead to slightly different interpretations of the latent classes. Second, the latent class model relies on an assumption of conditional independence, i.e. that the health indicators are independent given latent health status. This assumption could be violated, for example, due to shared method variance among parent-reported health items. Many of the latent health statuses identified here, though, were characterized by health issues that cut across different methods of assessment,

indicating that shared method variance was not a primary determinant of the latent class structure.

In summary, latent class analysis is a useful method for incorporating measures of physical conditions, functional problems, and development into a single analysis in order to identify key dimensions of childhood health and locate ethnoracial health disparities. Future studies should build on this research by further analyzing the roles of family, child care, and community environments in the health disparities we have documented. The consequences of the intersection of specific sets of health problems for later health and achievement also warrant further study. Finally, despite the educational progress of Mexicans between the first and subsequent generations, it is imperative that the cognitive disadvantage of young Mexican children be addressed in order to reduce the future impact of current inequalities. Although Mexican-origin preschool children are a heterogeneous group, they have an overall health profile that places them at a high risk of falling behind.

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