



Parental Numeracy and Asthma Exacerbations in Puerto Rican Children

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Background: Puerto Ricans share a disproportionate burden of childhood asthma in the United States. Little is known about the impact of low parental numeracy (a health literacy skill) on asthma morbidity in Puerto Rican children. Our objective was to examine whether low parental numeracy is associated with increased asthma morbidity in Puerto Rican children.

Methods: This was a cross-sectional study of 351 children with asthma, aged 6 to 14 years, living in San Juan, Puerto Rico. Parents of study participants completed a modified version of the Asthma Numeracy Questionnaire. Multivariate linear or logistic regression was used to examine the relation between low parental numeracy (defined as no correct answers in the modified Asthma Numeracy Questionnaire) and indicators of asthma morbidity (severe asthma exacerbations, core measures of asthma exacerbations, and lung function measures). All multivariate models were adjusted for age, sex, household income, reported use of inhaled corticosteroids in the previous 6 months, and exposure to secondhand tobacco smoke.

Results: Low parental numeracy was associated with increased odds of visits to the ED or urgent care for asthma (adjusted OR [aOR] = 1.7, 95% CI = 1.03-2.7, $P = .04$). The association between low parental numeracy and hospitalizations for asthma was significant only among children not using inhaled corticosteroids (aOR = 2.8, 95% CI = 1.4-5.6, $P = .004$). There was no association between low parental numeracy and use of systemic steroids or lung function measures.

Conclusions: Low parental numeracy is associated with increased asthma morbidity in Puerto Rican children. *CHEST* 2013; 144(1):92-98

Abbreviations: ANQ = Asthma Numeracy Questionnaire; ICS = inhaled corticosteroid

Both Puerto Ricans living in the island of Puerto Rico and those living in the mainland United States bear a disproportionate burden of childhood asthma in this country.¹⁻⁴ The prevalence of childhood asthma is

higher in Puerto Ricans (18.4%) than in non-Hispanic blacks (14.6%) or in non-Hispanic whites (8.2%).⁵ Compared with non-Hispanic blacks or non-Hispanic whites, Puerto Rican children with asthma also have an increased use of health-care services.⁶ Little is known about the risk factors that lead to worse asthma outcomes in this population.^{1,2}

Health literacy can be defined as an individual's capacity to obtain and understand basic information required to make appropriate health decisions.⁷ Health literacy includes not only reading and writing but also

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other skills, such as numeracy, the mathematical knowledge required to understand and act upon instructions given by health-care providers (eg, knowing that a prescribed dose of 40 mg of prednisone is the same as taking four 10-mg tablets of prednisone, understanding that a 1% chance is equivalent to a one in 100 chance, and so forth).^{8,9} The 2003 National Assessment of Adult Literacy found that 44% of adults in the United States have basic or below basic health literacy and that 22% possess no more than the most simple and concrete quantitative skills.^{10,11} Findings from this national survey also indicate that members of Hispanic subgroups have, on average, the lowest health literacy level of all ethnic groups in this country.¹¹ An increasing body of research suggests that low health literacy may partially explain health disparities for some diseases.¹²

Parents are largely responsible for following health-care instructions related to asthma management in their children. Among children aged 3 to 12 years, low parental health literacy (assessed primarily by reading skills) has been associated with increased lifetime risk of asthma exacerbations in some studies¹³ but not others.¹⁴ Numeracy appears to be specifically related to asthma outcomes, and higher numeracy has been associated with lower asthma morbidity and higher asthma-related quality of life in adults.^{15,16} To date, there has been no study of parental numeracy and asthma morbidity in childhood.

We hypothesized that low parental numeracy is associated with increased asthma morbidity in Puerto Rican children, independent of indicators of socioeconomic status and access to health care. To test this hypothesis, we examined the relation between parental numeracy and indicators of asthma morbidity in a cohort of children with asthma living in San Juan, Puerto Rico.

MATERIALS AND METHODS

Study Population

From March 2009 to June 2010, children in San Juan (Puerto Rico) were chosen from randomly selected households using a scheme similar to that of a prior study.¹⁷ In brief, households in the metropolitan area of San Juan were selected by a multistage probability sample design. Primary sampling units were randomly selected neighborhood clusters based on the 2000 United States census, and secondary sampling units were randomly selected households within each individual primary sampling unit. A household was eligible if one or more residents was a child aged 6 to 14 years old. In households with more than one eligible child, one child was randomly selected for screening by using Kish tables.¹⁷ On the basis of the sampling design, 7,073 households were selected, and 6,401 (90.5%) were contacted. Of these 6,401 households, 1,111 had one or more children within the age range of the study who met other inclusion criteria (see later description). In an effort to reach a target sample size of approximately 700 children, we attempted to enroll a random sample ($n = 783$) of these

1,111 children. Parents of 105 of these 783 eligible households refused to participate or could not be reached. There were no significant differences in age, sex, or area of residence between eligible children who did ($n = 678$ [86.6%]) and did not ($n = 105$ [13.4%]) agree to participate. We selected as cases children who had parental report of physician-diagnosed asthma and wheeze in the previous year ($n = 351$). All study participants had to have four Puerto Rican grandparents to ensure that they were of Puerto Rican descent.³ Because we focused on indicators of asthma morbidity, only cases were included in this analysis.

Study Procedures

Study participants completed a protocol that included administration of questionnaires, spirometry, and collection of blood samples (for measurement of serum IgE to common allergens). The child's parents completed a questionnaire used in the Genetics of Asthma in Costa Rica Study, which was slightly modified from one used in the Collaborative Study of the Genetics of Asthma.¹⁸ This questionnaire was used to obtain information about the child's general and respiratory health, sociodemographic characteristics, family history, (current) exposure to secondhand tobacco smoke, in utero smoking, use of inhaled corticosteroids (ICSs) in the previous 6 months, and asthma outcomes (including information about severe asthma exacerbations¹⁹ and core measures of asthma exacerbations²⁰ [see later description]). Parental numeracy was measured in one of the parents using a slightly modified version of the Asthma Numeracy Questionnaire (ANQ), a four-item validated test that uses arithmetic or percentage-based statements or questions derived from the National Asthma Education and Prevention Program guidelines that patients with asthma might encounter during a clinic visit.¹⁵ Because peak flow meters are seldom used in Puerto Rico,²¹ we replaced two of the original questions in the ANQ with one about weight (e-Table 1). This modification was done with the permission of the developer (Dr Apter). The questionnaire was translated into Spanish by a certified translator and then back-translated into English, with comparison of the two English versions. The number of correct questions ranges from zero to three.

Height and weight were measured to the nearest centimeter and pound, respectively. Spirometry was conducted with an Easy-One spirometer (NDD Medical Technologies, Inc). All subjects had to be free of respiratory illnesses for ≥ 4 weeks before spirometry, and they were also instructed (when possible) to avoid use of inhaled short- and long-acting bronchodilators for ≥ 4 and ≥ 12 h before testing, respectively. Forced expiratory maneuvers were judged to be acceptable if they met or exceeded American Thoracic Society criteria modified for children.²² After performing baseline spirometry, subjects were given two puffs (180 μg) of albuterol through a metered-dose inhaler with a spacer. After waiting 15 min, each subject repeated the spirometric maneuvers to assess bronchodilator responsiveness. The best FEV₁ and FVC were selected for data analysis. Serum levels of total IgE and IgE specific to common allergens (dust mite [Der p 1], cockroach [Bla g 2], cat dander [Fel d 1], dog dander [Can f 1], and mouse urinary protein [Mus m 1]) were determined using the UniCAP 100 system (Pharmacia & Upjohn). For each allergen, an IgE ≥ 0.35 IU/mL was considered positive.

Written parental consent was obtained for participating children, from whom written assent was also obtained. The study was approved by Institutional Review Boards of the University of Puerto Rico (San Juan, Puerto Rico), Brigham and Women's Hospital (Boston, Massachusetts), and the University of Pittsburgh (Pittsburgh, Pennsylvania).

Statistical Analysis

Parental numeracy was treated as a binary variable (ie, 0 vs ≥ 1 correct answer) based on the distribution of correct responses in

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