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RESEARCH ARTICLE

Asthma Prevalence in an Inner-city Head Start Sample: Links with Family Income, Education and Race/Ethnicity

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The Head Start Bureau has described asthma as a "growing problem" and "top chronic disease among Head Start children" (Rehnquist, 2002). This study examined the racial/ethnic and SES-based contributors to asthma prevalence among children attending three Head Start centers in a multi-ethnic, densely populated city in the U.S. Sample consisted of 1312 families. Findings indicated that poverty -over and above the effects of race/ethnicity- was a primary risk factor for asthma in this population: every thousand dollars increase in yearly income decreased the odds of asthma by 4%. In addition, Hispanic/Latino ethnicity and Asian race were predictive of very high and very low rates of asthma, respectively. There was a positive relationship between asthma status and caregivers' education level, which may play a role in reporting of asthma cases. These findings are of significant value to inform formulation of effective intervention programs at Head Start centers.

Keywords: asthma, inner-city; childhood; poverty; race/ethnicity; Head Start

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Given that early childhood asthma may negatively impact socio-emotional development (Mrazek, Schuman, & Klinnert, 1998), school readiness (Halterman et al., 2001), school attendance (Diette et al., 2000; Ladebauche et al., 2001; Moonie, Sterling, Figgs, & Castro, 2006; Taras & Potts-Datema, 2005), and primary caregivers' ability to retain full time jobs (Baydar, Joesch, Kieckhefer, Kim, & Greek, 2006), high asthma prevalence among Head Start children is a cause for serious concern. These disruptions in families' work and education routines ultimately interfere with Head Start's primary mission of providing comprehensive social, cognitive and health experience for young, low-income children (Rehnquist, 2002). This study aims to describe the asthma prevalence and its relationship with socio-economic status (SES) among a diverse sample of Head Start children living in a densely populated metropolitan city in the U.S. Although it is a well-established and consistent finding that asthma is more prevalent among Head Start children (McGill et al., 1998; Nelson, Awad, Alexander, & Clark, 2009; Rundle et al., 2009; Slezak, Persky, Kviz, Ramakhishan, & Byers, 1998; Vargas et al., 2004), research has yet to elucidate the ways in which race/ethnicity and SES are linked with asthma among this population and how cultural factors may play a role in the detection and reporting of asthma.

Increased risk for asthma among Head Start children is highly associated with the disproportionate burden of this disease among preschool children from low-income, ethnic minority backgrounds. It is estimated that approximately 1.7 million children in the U.S. develop asthma by the time they reach the age of five, which corresponds to 8% of all children in this age range (American Lung Association (ALA), 2012). Emergency room visits and hospitalization rates are the highest among children between birth and four years (Akinbami, Moorman, Garbe & Sondik, 2009). Of children within this age range, those of a low socio-economic status are 1.5 to 2.4 times more likely to have asthma than children coming from high-SES backgrounds (Bloom, Cohen, & Freeman, 2011; Seguin, Nikiema, Gauvin, Zunzunegui, & Xu, 2007), and according to 2011 lifetime prevalence estimates, black preschool-aged children are approximately 2.3 times more likely than their white peers to develop this illness (American Lung Association, 2012). These income and racial/ethnic disparities in early childhood asthma represent the largest gap among all age cohorts (Halfon & Newacheck, 1993), and tend to diminish by the age of nine (Case, Lubotsy & Paxson, 2002; Chen, Matthews & Boyce, 2002). In addition, studies have reported several specific risk factors for high asthma morbidity among Head Start children including obesity (Jacobson, et al., 2008b), increased exposure to allergens such as mold, cockroaches and mice (Ladenbauche et al., 2001) and tobacco smoke (Rotsides et al, 2010; Vergas et al., 2004), which are strongly associated with economically disadvantaged environments (Brooks-Gunn & Duncan, 1997; Currie, 2005; Federico & Liu, 2003).

However, studies drawing from national survey data to investigate race- and SES-based disparities in pediatric asthma generated mixed results. In one large, nationally representative sample (N = 20,717), Chen, Martin and Matthews (2006b) found both race and parental education to be unassociated with asthma prevalence among children younger than 18. Other findings suggest that poverty qualifies the effects of race/ethnicity on asthma status (Brooks-Gunn & Duncan, 1997; Claudio, Stingone, & Godbold, 2006; Currie, 2005; Federico & Liu, 2003; Smith, Hetcher-Rose, Wertheimer, & Kahn, 2005). Still other research has found asthma rates among black children to be less reactive to changes in family income compared to those of non-black children (Fox-Ray, Thamer, Fadillioglu, & Gergen, 1998; Halfon & Newacheck, 1993; Miller, 2000). Discrepant results may stem from collapsing the data across ages, since

SES-based disparities in asthma prevalence differ in magnitude and direction across different age cohorts, which can counterbalance the findings (Chen, Matthews, & Boyce, 2002).

Our study sought to investigate (1) the prevalence of asthma within each racial/ethnic minority group within a low-income Head Start sample, (2) the associations between caregivers' income and education, and children's asthma prevalence after race/ethnicity and other covariates are taken into account, and (3) if the observed relationships can be explained by a third variable, e.g., pre/post term birth or the neighborhood/area of the Head Start center. We believe that furthering our understanding of the relationship between asthma, race/ethnicity and SES is crucial if we are to design well-informed and cost-effective interventions to reduce the burden of health disparities among Head Start families.

METHOD

Data used in this study were drawn from a larger longitudinal project which was completed between the years of 1999 and 2004 by the Relationships for Growth and Learning (*RfGL*) Program (Shahmoon-Shanok, Lamb-Parker, Halpern, Grant, Lapidus, & Seagle, 2005; Shahmoon-Shanok, Welton, & Lapidus, 1989). *RfGL* is a community-based, ongoing early screening and intervention program, which delivers mental health services to diverse low-income children between two and nine years and their families on-site in Head Start, day care and other preschools. *RfGL* is run by the Institute for Infants, Children and Families (IICF), and is overseen by the Jewish Board of Family and Children's Services (JBFCS), a large, non-sectarian, multi-program mental health and social service agency in New York City.

Participants

Participants were recruited from three Head Start centers where the *RfGL* provided mental health services. Centers were located in Washington Heights, Lower East Side and Brooklyn in New York City. During the five year period, 1951 caregivers provided data on one or more of the variables of interest in this study during their first enrollment at the centers. Children between the ages of two and five with complete data on asthma status, race/ethnicity and income were included in the analyses. The final sample consisted of 1312 children. Cases that are excluded from the final sample did not differ from the ones that are retained on income, gender and pre/post term birth. Due to high rates of incomplete data for Chinese children, whose caregivers reported having fewer years of education (M = 9.2) and only 1.1% of asthma prevalence rate for their children, asthma prevalence and caregivers' years of education were lower among the excluded cases compared to the retained cases. However, asthma prevalence rates or the education level of the caregivers were not significantly different between retained and excluded cases among black and Hispanic/Latino participants. Thus, the final sample's characteristics are found to be highly consistent with the larger sample.

Measures

A 41-item Health Record Questionnaire (HRQ) was completed with all caregivers at the time of registration to the Head Start centers. HRQ included questions about pregnancy/birth history, hospitalizations/illnesses, health problems, and physical/psychological/social development of target children. A positive asthma status was assigned if the primary caregiver answered affirmatively to the question "Has your child had asthma?" The primary measure of SES was yearly household income, self-reported by the primary caregiver. Income was coded in $1000 increments from $0 to $20,000 and in $5000 increments for amounts more than $20,000, in line with the previous research (Case, Lubotsky, & Paxson, 2002; Chen, Martin,& Matthews, 2006a). Secondly, data for education levels of caregivers were available for a large subsample of children (n = 907) and this variable represented the number of school years that primary female caregivers completed. Caregivers were asked to identify their children's ethnicity/race in an open ended question format. Answers were categorized first as Hispanic/Latino, then as non-Hispanic black, non-Hispanic white, and Asian. Hispanic/Latino category included children who were identified as Hispanic, Latino, Hispanic/Latino, Mexican, Dominican, Spanish, Panamanian, Honduran, Salvadoran, Puerto-Rican, and Guatemalan. The black racial category included children who are identified as black, Jamaican, and Haitian. Asian category included children who were identified as Chinese or Asian. Ethnicities not belonging to any of the above categories (e.g. Bengali, Trinidadian) were included in the "other" category. White children were also included in the "other" category because there were too few white cases (n = 4) to permit separate analyses. Child's age was calculated based on the date of the interview with the primary caregiver. Information on child's gestational age was gathered by asking the question "Was the child born more than three weeks early or late?"

RESULTS

Demographics

Table 1 displays demographic characteristics of the sample. Our sample mainly consisted of racial and ethnic minority children: approximately 16% of children were black, 77% were Hispanic/Latino, 5% were Asian, and 2% was categorized as "other". Approximately 52% of children were female. Age ranged from 28 to 60 months with an average of 42 months (SD = 6.3). The average yearly income of families was $11,812, and it ranged from $1,300 to $32,942. Approximately 90% of the families had less than $20,000 annual income. Yearly family income did not significantly differ among racial/ethnic groups.

The average education level of primary female caregivers was 11.5 years (SD = 2.87, n = 907), with significant differences between racial/ethnic groups, F (2, 886) = 22.99, p <.001. Lowest level of school education was found among the primary female caregivers of Asian children (M = 9.3 years), which was significantly less than of the caregivers of Hispanic/Latino children (M = 11.5 years), t(68.7) = -6.21, p <.001, and caregivers of black children (M = 12.3), t(92.2) = 7.57, p <.001. The difference in years of schooling between the caregivers of Hispanic/Latino and black children was also significant, t(204.6) = 3.36, p <.01. There was a significant but small positive correlation between family income and primary female caregivers' years of schooling, r(907) = .08, p <.05. When different racial/ethnic groups were examined

separately, correlations between income and education within black and Hispanic/Latino groups became stronger ($r(119) = .22$, $p < .05$; $r(712) = .12$, $p < .01$, respectively), whereas a negative relationship appeared within the Asian group, $r(58) = -.40$, $p < .01$.

TABLE 1
Participants Characteristics

	M (SD)	n (%)
Age (in months, n = 1312)	42.16 (6.33)	
Gender (female, n = 1285)		673 (52.4)
Race/Ethnicity		
Hispanic/Latino		1014 (77.3)
Black		202 (15.4)
Asian		65 (5.0)
Other		31 (2.4)
Total		1312 (100%)
Primary female caregiver education (in years, n = 907)	11.47 (2.88)	
Less than high school		317 (35.0)
High school or more		590 (65.0)
Annual family income (n = 1312)	$11, 812 ($5,540)	
Hispanic/Latino	$11, 823 ($5,278)	
Black	$11, 642 ($6,664)	
Asian	$12, 149 ($4,638)	
Other	$11, 859 ($7,532)	
Child was born 3 weeks early or late (n = 1282)		113 (8.8)

Pre-term or post-term birth rate was 8.8% in this sample. Caregivers who were more educated reported more incidents of pre/post term birth, $t(108.68) = 2.08$, $p < .05$. Income was not a significant predictor of pre/post-term birth status.

The prevalence of asthma was 10.4%, with more males (12.3%) compared to females (8.6%) found to have asthma, $\chi^2(1, N = 1285) = 4.57$, $p < .05$. Asthma prevalence also differed significantly between the three racial/ethnic groups, $\chi^2(2, N = 1281) = 12.33$, $p < .05$. The prevalence of asthma was almost two times higher among Hispanic/Latino children (11.4%) than black children (6.4%), $\chi^2(1, N = 1216) = 4.45$, $p < .05$. Further, none of the Asian children were reported to have asthma.

The three Head Start centers had different racial/ethnic profiles. The vast majority of participants at the Washington Heights site were Hispanic/Latino (99%), whereas the Brooklyn site had 50% Hispanic/Latino and 44% black children. About 77% of the children at the Lower East Side site were Asian and 22% were Hispanic/Latino. A comparison of asthma rates between these three sites revealed that Washington Heights site had the highest rate of asthma (12%), followed by Brooklyn (9%) and the Lower East Side (4%). The difference in asthma rates between the sites was significant, $\chi^2(2, N = 1312) = 8.46$, $p < .05$. In order to further investigate the relationship between the effects of neighborhood and race/ethnicity, we created cross-

tabulations between race/ethnicity and asthma status for the Brooklyn site, which consisted of both Hispanic/Latino and black children. In this site, 51% of asthma cases were accounted for by Hispanic/Latino children, and 33% and 15% were accounted for by black and Other race children, respectively, $\chi^2(3, N = 459) = 8.23$, $p < .05$. We also compared the rates of asthma only among Hispanic/Latino children using the location of the Head Start center as a predictor variable. Analyses did not yield any significant effects of neighborhood on asthma prevalence among Hispanic/Latino children.

Prevalence of asthma among each racial/ethnic subgroup is displayed in Table 2. Within the Hispanic/Latino subsample, children from Mexico had a lower asthma prevalence rate (n = 25, 4%) compared to children from the Dominican Republic (n = 30, 13.3%) or from children who were identified as Hispanic/Latino (11.5%). Among the black subsample, 15.8% of Jamaican (n = 19) and 6.5% of children who were identified as "black" were reported to have asthma, whereas none of the Haitian (n = 30) children were reported to have asthma. These within racial/ethnic group differences were not significant.

TABLE 2
Prevalence of Asthma among Different Racial/Ethnic Groups (*N* = 1312)

Racial/Ethnic Group	n	% of Asthma Cases
Black	153	6.5
Haitian	30	0
Jamaican	19	15.8
Hispanic/Latino[a]	933	11.5
Mexican	25	4.0
Dominican	30	13.3
Other Hispanic/Latino[b]	26	15.4
Asian/Chinese	65	0
Other Race/Ethnicity	31	22.6

[a] Includes children whose ethnicity were reported as 'Hispanic', 'Latino' or 'Hispanic/Latino'.
[b] Includes children whose ethnicity were reported as 'Spanish', 'Panamanian', 'Honduran', 'Salvadoran', 'Puerto-Rican' or 'Guatemalan'.

Asthma status was significantly associated with lower yearly family income, $t(1310) = -2.57$, $p < .05$. When racial/ethnic groups were analyzed separately, this relationship between asthma status and income remained significant only among Hispanic/Latino children, $t(1012) = -2.26$, $p < .05$. Within black and "other" race categories, family income levels were still higher among children who did not have asthma compared to the ones who did, although these differences were not significant. Bivariate analyses were not conducted within the Asian group since no asthma cases were reported for these children.

The education level of the primary female caregivers was not significantly associated with asthma prevalence, although there was a marginally significant positive relationship between the two variables, $t(132.8) = 1.81$, $p = .07$. To further investigate this relationship, years of education was coded into ordinal values which reflected whether the primary female caregiver has completed high school or not. Cross-tabulation of this education variable with asthma status

revealed that reports of asthma were 8% among children whose primary female caregivers did not complete the high school, whereas it increased to 12% within children of at least high school educated caregivers, $\chi^2(1, N = 907) = 4.38$, $p < .05$.

Child age was not found to be significantly associated with asthma status. Being born three weeks earlier or later than the due date was also not significantly related to having asthma, although these children had a higher rate of asthma (14.2%) compared to children who were born around the due date (9.9%).

To investigate the unique variance explained by the effects of socio-demographic variables on asthma prevalence, logistic regression models were employed. In these analyses, "other" category in race/ethnicity was excluded from the sample since this group does not provide a theoretically meaningful comparison group. Asian children were also excluded in order to prevent the complications stemming from zero-cell variance (Hosmer & Lemeshow, 1989), since none of the Asian parents reported positive asthma status. Age, gender, and pre/post-term gestational age were entered in the first step as control variables. Dummy codings for Hispanic/Latino were entered in the second step. With this coding, black children subsample served as the reference group. Finally, the SES indicator variable (income or years of education of the primary female caregiver) was entered.

Results of logistic regression analyses are displayed in Table 3. Males were 31% more likely to have asthma compared to females (p =.055), whereas age and pre/post-term birth were not significantly associated with asthma status. Hispanic/Latino children were approximately two times more likely to have asthma compared to black children. The effect of income was significant over and above that of race/ethnicity: one unit increase in family income was associated with a 4.4% decrease in the odds of having asthma among this sample of preschool children, after removing the effects of race/ethnicity and other covariates.

TABLE 3
Logistic Regression Analyses Predicting Asthma Prevalence from Income and Race/ethnicity among Hispanic/Latino and Black children (N=1162)

		OR	95% CI	p
			LL UL	
Block 1	Age	1.00	.97-1.03	.89
	Gender (female)	.69	.48-1.00	.055
	Born 3 weeks early/late	1.55	.88-2.78	.14
Block 2	Age	1.00	.97-1.03	.96
	Gender (female)	.69	.48-1.00	.056
	Born 3 weeks early/late	1.59	.85-2.75	.16
	Hispanic/Latino ethnicity	2.19	1.15-4.16	<.05
Block 3	Age	1.00	.97-1.03	.95
	Gender (female)	.69	.47-1.00	.055
	Born 3 weeks early/late	1.59	.88-2.86	.13
	Hispanic/Latino ethnicity	2.25	1.18-4.28	<.05
	Annual income	.96	.92 - 1.00	<.05

Note. OR = odds ratio, CI = confidence interval; LL = lower limit; UL = upper limit.

When racial/ethnic groups and Head Start sites were analyzed separately, the multivariate relationship between income and asthma status remained significant only for Hispanic/Latino children, *OR* = .95, 95% CI = [0.91, 1.0], and only at the Head Start center located in Washington Heights, which serves primarily Hispanic/Latino families, *OR* = .94, 95% CI = [0.90, 0.99]. We also tested whether an interaction term between race/ethnicity (with Hispanic/Latino and black children) and income would predict the asthma outcome by including this variable in the last step of the logistic regression analysis; yet, this interaction was not significant, *OR* = .98, 95% CI = [0.87, 1.09].

The education level of the primary female caregiver was not significantly associated with asthma status after control variables and race/ethnicity were entered into the model (see Table 4).

TABLE 4
Logistic Regression Analyses Predicting Asthma Prevalence From the Primary Female Caregivers' Education and Race/Ethnicity among Hispanic/Latino and Black children (*N*=789)

		OR	95% CI	*p*
			LL UL	
Block 1	Age	1.00	.96 - 1.03	.89
	Gender (female)	.87	.56 - 1.37	.55
	Born 3 weeks early/late	1.8	.96 - 3.48	.07
Block 2	Age	1.00	.97 - 1.04	.99
	Gender (female)	.89	.57 - 1.40	.62
	Born 3 weeks early/late	1.77	.93 - 3.38	.09
	Hispanic/Latino ethnicity	3.01	1.19 - 7.60	<.05
Block 3	Age	1.00	.97 - 1.04	.94
	Gender (female)	.88	.56 - 1.38	.58
	Born 3 weeks early/late	1.71	.89 - 3.28	.11
	Hispanic/Latino ethnicity	3.27	1.29 - 8.30	<.05
	Less than high school education	0.64	.38. - 1.07	.09

Note. OR = odds ratio, CI = confidence interval; LL = lower limit; UL = upper limit

DISCUSSION

Overall, our findings indicated that approximately one in ten children in our sample had asthma, and being from a low-income household was a significant predictor of asthma morbidity, even within the restricted income range of Head Start families. Specifically, we found that approximately every thousand dollars increase in annual family income decreased the probability of having asthma by 4% for each child regardless of race/ethnicity, age, gender, and pre/post term gestational age. The significant relationship between asthma and family income in this

minority sample highlights the importance of risk factors that are highly associated with family income. Asthma is an inflammatory disease and its premorbidity and course are considerably affected by allergens like dust, mold, roaches and pesticides, commonly found in economically disadvantaged neighborhoods (Claudio et al., 2006, Perera et al., 2002). In case of an asthma risk indicated by a physician, improving suboptimal environmental conditions to prevent and manage asthma symptoms (e.g., buying air conditioners, air purifiers, replacing a carpet) proves to be financially challenging for low-income families (Mansour, Lanphear, & DeWitt, 2000). In addition, low-income may generate additional parental stress, which can act as a risk factor both for the onset (Klinnert, Kaugars, Strand, & Silveira, 2008) and exacerbation of asthma symptoms through compromised immune systems and increased allergic reactions in infants (Klinnert et al, 2001), and suboptimal treatment adherence (Celano et al., 2010; Rohan et al.,2010).

We found the relationship between income and asthma prevalence to exist for Hispanic/Latino children, but not black children as has been reported in other studies (Halfon & Newacheck, 1993; Fox-Ray, Thamer, Fadillioglu, & Gergen, 1998; Miller, 2000). It is also of note that Hispanic/Latino ethnicity remains as a significant predictor of asthma prevalence even after income was included in the model. Neighborhood location of the Head Start center was not a significant predictor of asthma prevalence when race/ethnicity's effects were taken into account. These findings indicate that race/ethnicity acts as a co-determinant of disparities in asthma prevalence in a way that is not fully mediated by poverty, but may be mediated through some other variables that are associated with race/ethnicity (Kawachi, Daniels, & Robinson, 2005).

First, genetic vulnerability can be viewed as a primary mechanism through which racial/ethnic differences operate (Joseph, Ownby, Peterson, & Johnson, 2000). Yet, studies have also found that people who come from the same racial background, but live in different countries, have significantly different asthma prevalence rates (Eldeirawi et al., 2009; Holguin et al., 2005). A second explanation could lie within cultural beliefs and practices associated with certain racial/ethnic backgrounds. For example, in a sample of 40 parents of low-income black children, Mansour, Lanphear, and DeWitt (2000) reported that some parents refrain from using a daily asthma management/prevention medication in an effort to protect their children from developing an addiction. Similarly, Dominican-American and Puerto-Rican parents have been found to prefer using alternate, natural remedies and relaxation techniques in lieu of prescribed medication to treat asthma symptoms (Koinis-Mitchell et al., 2008). Thirdly, chronic stress and language/culture-based communication problems in minority populations may relate the distinct variance explained by race/ethnicity (Clark, Anderson, Clark, & Williams, 1999; Zanchetta & Poureslami, 2006). In line with this final explanation, Flores, Bauchner, Feinstein, and Nguyen (1999) reported that even after controlling for parental education and income, minority status is still associated with not having visited a physician within the past year. Since our findings indicate that both race/ethnicity and family income are associated with asthma status, albeit probably through separate pathways, they add to existing suggestions for further research to determine the particular mechanisms through which the effects of race/ethnicity are carried to disparities in asthma prevalence.

Another finding in our study was that no Asian children were reported to have asthma. Although previous research stated that Asian children had lower levels of asthma prevalence compared to other ethnicities in the U.S. (Akinbami, Moorman, Garbe, & Sondik, 2009; Claudio et al., 2006; Lee, Brugge, Francis, & Fisher, 2003), and studies conducted in China reported asthma rates as low as 1.1% in rural areas and 6.3% in urban areas (Ma et al., 2009; Zheng et al.,

2002), underreporting is still a possible explanation for the absence of asthma cases among Asian children in this sample (Nolan & May, 2002; Partridge, 2000). In addition, the low rate could simply reflect high levels of undiagnosed asthma cases among Asian children, which would indicate serious obstacles to access to health care among these families. Moreover, 94% of Asian families in our study listed their primary language as Chinese. Language barrier is one of the major causes of suboptimal health care received by immigrants (Andersen & Newman, 1973), which may explain unawareness and therefore underreporting of asthma cases in our sample.

Consistent with at least one other study (Chen, Martin, & Matthews, 2006a), parental education was found to be positively related with asthma prevalence, i.e., more educated parents reported more asthma cases. This finding highlights the problems related to detection and diagnosis of asthma symptoms among less educated families in Head Start centers. One study conducted in Head Start centers in East and Central Harlem reported that only 41% of children with probable asthma were under the care of a physician for this disease (Bonner et al., 2006) and due to poor parental management practices, between 30 and 46% of Head Start children who have asthma used emergency departments in the previous year to manage symptoms (Jacobson et al., 2008a; McGill et al., 1998; Vargas et. al., 2004).

Our results should be viewed in light of several limitations. First, our detection of asthma cases relies on parental report and not on physician diagnosis, which might have resulted in underestimation of asthma rates in our study (Roberts, 2003). Secondly, our sample did not include white or high-SES children, therefore we were not able to evaluate the magnitude of the disparity in asthma burden associated with racial/ethnic minority status or financial disadvantage. Another caveat is that we could not differentiate whether children were born pre- or post-term, as this information was gathered within one self-report variable. This may have obscured our results, since premature and post-term birth do not exert the same level of negative influence on lung functioning in young children (Harju et al., 2013). Finally, the education data was missing for a substantial number of primary female caregivers, limiting our analyses of this predictor to a smaller subsample, and potentially introducing a non-random responding bias.

The Head Start Bureau has described asthma as a “growing problem” and “top chronic disease among Head Start children” in the past decade (Rehnquist, 2002). To the best of our knowledge, this study has been the first to investigate the effects of family income and parental education on asthma status among Head Start children coming from Hispanic/Latino, black and Asian backgrounds. We found that even a small increase in family income makes a significant difference in the odds of having asthma, even in the restricted income range of Head Start families. Should our results be replicated, they provide important data to inform the formulation of cost-effective prevention and intervention programs that can be utilized in Head Start centers, in service of improving children's health and learning as well as decreasing the overall negative economic impact of the disease stemming from medical expenses, loss of school days and work hours.

Our findings also highlight the possibility of suboptimal detection of asthma among Head Start children especially in immigrant and lower-educated families. Thus, Head Start staff may benefit from more training on how to recognize asthma symptoms in preschool children and educating children and parents on symptom detection and management (Walders, McQuaid, & Dickstein, 2004).

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