Effects of Primary Child Care Arrangement on Asthma in Preschool-Aged Children Dependent on Poverty Status

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Asthma prevalence in the United States increased from 7.3% to 8.4% between 2001 and 2010, and the most recent trend shows a higher prevalence for children than for adults (Akinbami, Moorman, & Bailey, 2012). Based on the 2011 National Health Interview Survey (NHIS), over 10 million children in the U.S. have ever been diagnosed with asthma, and 10% of these persisted with asthma symptoms at the time of the survey (Bloom, Cohen, & Freeman, 2011). Eighty percent of child asthma cases began before age 6 (Martinez, 2002). The authors state that childhood asthma is determined by both early environmental exposures and genetic factors that lead to airway inflammation that often results in asthma. Genetic factors are often defined as self-reported parental history of asthma or atopy. Children with a parental history of asthma are more likely to be diagnosed with asthma, as well as more likely to have respiratory tract infections in early childhood (Burke, Fesinmeyer, Reed, Hampson, & Carlsten, 2003; Nystad, Skrondal, & Magnus, 1999).

Although parental history has been found to be a strong factor in predicting childhood asthma, it does not fully account for its development (Burke et al., 2003). Early environmental exposures have also been found to predict asthma diagnosis and include prenatal and postnatal environment as well as aspects of the home environment (e.g., household tobacco smoke) (Ball & Castro-Rodriguez, 2000; Burke et al., 2012; Butz et al., 2011; Celedon, Litonjua, Weiss, & Gold, 1999; Marbury, 1997; Nystad, Skrondal, & Magnus, 1999; Slack-Smith, Read, & Stanley, 2002). Overall, breastfeeding and normal birth weight are protective against the later development of childhood asthma while exposure to tobacco smoke and other allergens increases the likelihood of wheezing and asthma diagnosis (Burke et al., 2012).

Although much of the research on environmental exposures has focused on the home environment, research also needs to take into account that some children may spend a significant portion of their time in other environments that may play a role in asthma diagnosis. Besides the home environment, children below the age of 5 are often in some kind of child care environment. A majority of children below the age of 5 are in regular child care arrangements (Capizzano, Adams, & Sonenstein, 2000; Laughlin, 2013). Child care arrangements include center-based care or Head Start, non-relative home care, and relative care. Therefore the question remains of whether child care environments may be an independent risk factor for childhood asthma.

Child Care Attendance and Health

Attendance in child care is associated with asthma and respiratory infections, as well as a number of other health outcomes (e.g., ear infections, gastrointestinal problems, and nasal congestion) (Celedon, Litonjua, Weiss, & Gold, 1999; Nystad, Skrondal, & Magnus, 1999; Sun & Sundell, 2011). Regular child care attendance has been found to be associated with respiratory illnesses and wheezing in preschool-aged children (Ball & Castro-Rodriguez, 2000; Caudri et al., 2009; Hagerhed-Engman, Bornehag, Sundell, & Aberg, 2006). Marbury (1997) found that even when controlling for other risk factors for respiratory illnesses, children in child care were more likely to have lower respiratory infections than children who did not attend child care. Similarly, Hurwitz and colleagues (1991) found that child care attendance was predictive of respiratory illnesses in children, and this effect was larger for preschoolers than for infants and toddlers.

Various characteristics of child care have been found to be associated with respiratory illnesses and asthma in children, including the type of child care, number of regular child care

arrangements, the number of children in child care, the starting age, and the length of attendance (Hatakka et al., 2010; Nystad et al., 1999; Slack-Smith et al., 2002; Sun & Sundell, 2011). When investigating the type of childcare arrangement, researchers have found that center-based care is worse for asthma incidence and severity when compared to non-relative, family-based care or parental care in preschool-aged children (Nystad et al., 1999; Slack-Smith et al., 2002; Sun & Sundell, 2011). For example, Sun and Sundell (2011) found that children in center-based care and non-relative, family-based care were more likely to have respiratory infections and allergic symptoms than children cared for at home, and children in center-based care had increased infections compared to children in non-relative care. Slack-Smith et al. (2002) reported that center-based care (versus non-relative care) was predictive of increased respiratory problems and a higher likelihood of being hospitalized for respiratory problems. It is expected that the underlying mechanism behind the effect of child care arrangement type on childhood asthma is the exposure to larger numbers of unrelated children and adult providers. Generally, center-based care is more likely to have larger class sizes and more adult providers than other types of child care. Children in both types of care are more likely to be exposed to other sick children and adults than children in parental care.

In addition to type of child care, another issue for childhood respiratory health is whether children attend multiple child care arrangements regularly rather than a single arrangement. Adams and Rohacek (2010) define multiple childcare arrangements as one form of child care instability that may affect many child outcomes, including health. However, the reason for the multiple childcare arrangements may be an important factor in whether it is considered unstable (Adams & Rohacek, 2010; Morrissey, 2008). In a study of infants in the Netherlands, it was found that infant health was impacted by multiple childcare arrangements depending on the arrangement type and specific health complaint (Beijers, Jansen, Riksen-Walraven, & de Weerth, 2011). Overall, the infants in multiple arrangements (i.e., two or more) were more likely to have skin illnesses but less likely to have respiratory and other illnesses. However, the researchers also found when considering the type of child care setting, being in center-based care was associated with respiratory illnesses.

In another study of multiple child care arrangements, the author also found that multiple childcare arrangements had a negative impact on children's health (Chen, 2013). Using responses from the Early Childhood Longitudinal Study-Birth Cohort (ECLS-B), she found that an increase in the number of total arrangements was associated with increased incidence of asthma diagnosis and other negative health outcomes. In contrast to the earlier study, the type of child care setting that was most associated with asthma was the number of non-relative (which includes center-based care) child care arrangements.

It is also important to note that the age at which health outcomes are measured may play a role in the findings. For school-age children (i.e., age 5 and older), previous daycare attendance has been found to be protective for asthma diagnosis. One study found that although daycare attendance was related to increased respiratory symptoms during the preschool years, it was actually protective against later asthma and respiratory problems during the school-age years (Sun & Sundell, 2011). However, other research suggested that early daycare attendance is not necessarily a protective factor against respiratory problems and asthma (Caudri et al., 2009). Instead, daycare attendance may only shift the burden of asthma to an earlier age. Regardless of whether childcare attendance has a potential protective factor for asthma incidence at a later age, it still may affect child health during the preschool years.

Patterns in Childcare Use

In order to understand how child care characteristics may affect respiratory problems and asthma incidence in children, it is necessary to examine the factors that may affect parents' choice of child care arrangements. Among all preschoolers, center-based is the most common child care arrangement among preschool-aged children, but many sociodemographic factors play a role in the selection process (Early & Burchinal, 2001; Laughlin, 2013).

Early and Burchinal (2001) found racial/ethnic differences in the type of child care arrangement used: Black children were more likely to be in center-based care than White or Hispanic children. The use of relative care was not found to be different among the ethnic groups for preschoolers. Additionally, black children were found to spend the most time in child care overall. The authors suspected that the underlying effect was not due to race/ethnicity, but instead due to racial/ethnic disparities in income.

Poverty status also plays an important role in the access to child care options. Generally, low-income families tend to use relative care while non-low-income families are more likely to use center-based care (Capizzano & Adams, 2004; Meyers & Jordan, 2006). In a study of income and child care quality, the researchers noted that low-income parents reported more restrictions on their access to child care options than non-low-income parents (Torquati, Raikes, Huddleston-Casas, Bovaird, & Harris, 2011). Low-income families reported difficulty finding appropriate child care due to varying work shifts and cost of care. Additionally, income and work shift both play a major role in parents' decisions to use multiple child care arrangements. For parents who work nonstandard shifts, multiple arrangements are necessary because other types of informal care (such as relative care) are not sufficient to cover all hours of employment (Laughlin, 2013; Morrissey, 2008). Child care centers and non-relative care are not normally available during non-standard shifts.

Using a nationally representative sample, this study examines associations between sociodemographic characteristics and types of primary child care options In addition, this study determine the predictors of child asthma diagnosis with the emphasis on primary child care type while also paying attention to potential differences between low-income and non-low-income families. The specific aim of the present paper is to analyze the impact of the type of primary child care on childhood asthma diagnosis among preschool-aged children after controlling for sociodemographic characteristics and child health risk factors, including birth weight, breastfeeding, parental asthma, and parental smoking.

Method

Sample

The Early Childhood Study-Birth Cohort (ECLS-B) includes four waves of data collection that provide nationally representative data on children's health, development, care, and education from birth through kindergarten entry (U.S. Department of Education, 2007). The ECLS-B follows a nationally representative probability sample of children born between January and December 2001. Data for analyses were taken from the preschool wave of the data collection and include information from the parental interview, the resident father questionnaire, and the non-resident father questionnaire. The sample was limited to only include the biological mother as the respondent on the parent interview and singleton children. After cases were removed for missing responses on the variables of interest, the sample size included 6,604 responses (7,169 originally). Data from the ECLS-B are used to analyze the effects of primary child care arrangements in addition to sociodemographic and other child health risk factors on the child's asthma diagnosis. Variables used in this analysis are detailed below.

Asthma

The mother was asked at each wave whether a doctor, nurse, or other medical professional ever told her that her child has asthma. If the mother responded yes at any wave, the child was coded as having a current asthma diagnosis.

Child Care Arrangement

Primary child care arrangement was defined as the type of care in which the child spent the most hours per week on a regular basis at the time of the parent interview. Primary child care arrangement for the child was originally a 10-level variable that was then recoded into five categories: 1) parental care (reference), 2) relative care, 3) non-relative care, 4) center-based care, and 5) multiple care arrangements. Parental care defines a child care arrangement in which children are cared for in the home by at least one parent and are not in non-parental care. Relative care defines care provided by a relative regardless of location (i.e., in the child's home, in another home, or varying location). Non-relative care is defined as child care provided by an unrelated caregiver regardless of location and does not include center-based care or Head Start programs. Center-based care includes any center-based or Head Start programs. Respondents who reported an equal number of hours in more than one type of care were coded as having multiple care arrangements.

Sociodemographic Characteristics

Child demographics in addition to family socioeconomic factors were included as predictors of childhood asthma diagnosis. These were included since research has found that children most likely to be diagnosed with asthma include boys, non-Hispanic black, and children from poor families (Bloom et al., 2011; Miller, 2000). The child's sex and race/ethnicity were included as predictors of child asthma diagnosis. Race/ethnicity of the child was recoded into a four-level categorical variable that included non-Hispanic white (reference), Hispanic, non-Hispanic black, and non-Hispanic other. The other category includes Asian, Native Hawaiian or other Pacific Islander, American Indian or Alaska Native, and respondents who reported more than one race. Poverty threshold and the mother's age, marital status, education level, and work status were included as predictors of child asthma diagnosis. Poverty was dichotomized to represent low-income families (i.e., below 185% of the poverty threshold) and non-low-income families (i.e., at or above 185% of the poverty threshold) (reference). The mother's age in years was included in the models as a continuous variable. Marital status was dummy-coded to compare single mothers (i.e., never married, divorced, separated, widowed) to mothers (reference) who reported as being married. Education level was dichotomized to compare mothers with less than a high school education to mothers with a high school degree or higher level of education (reference). Finally, work status was originally a four-level variable that was recoded to compare working mothers (full-time and part-time) and mothers looking for work to mothers not in the labor force (reference).

Child Health Risk Factors

Other potential child health risk factors for childhood asthma were included in the analyses: birth weight of the child, breastfeeding, parental history of asthma, and smoking status of the mother. These factors were included due to their potential effects on childhood asthma diagnosis (Midodzi, Rowe, Majaesic, Saunders, & Senthilselvan, 2008; Salam, Li, Langholz, & Gilliland, 2003). Birth weight was dichotomized to compare children born with a low birth weight (i.e., <2500 g) to children born with a normal birth weight (i.e., ≥ 2500 g). Breastfeeding was dichotomized to compare children who were breastfed four months or longer to children breastfed less than 4 months or not at all (reference).

Parental history of asthma was based on report of an asthma diagnosis by the respondent on the parent interview as well as report of asthma diagnosis on the resident father and non-resident father questionnaires. Asthma was defined as having at least one parent with an asthma diagnosis (reference) based on information collected on the parent interview, resident father questionnaire, or the non-resident father questionnaire. Parental history of asthma was only collected during the second wave of the longitudinal study.

Statistical Methods

First, the associations between the five primary child care arrangements and various sociodemographic characteristics were examined. The svychisq procedure in R version 3 was used due to the complex sample design of the ECLS-B. All unweighted sample sizes are rounded to the nearest 50 value in order to protect the confidentiality of respondents in the ECLS-B, a specification of the restricted data license agreement. The dichotomous and categorical measures are presented proportionally by type of primary child care arrangement. The continuous variables are presented as means and standard deviations. Chi-square significance tests for differences in each characteristic by primary child care arrangement and *P*-values from those comparisons are displayed in Table 1. Next, the associations between child asthma diagnosis and four child health risk factors are examined, again using the svychisq procedure in R version 3. The dichotomous measures are presented proportionally by asthma diagnosis of the child, and chi-square significance tests are computed to determine significant differences by each health risk factor (displayed in Table 2).

In order to test for significant predictors of the child's asthma diagnosis, nested binary logistic regression models were performed. Table 3 displays the odds ratios (ORs) and 95% confidence intervals (CIs) for each variable for the full sample. Additionally, each model was compared to the previous model using chi-square likelihood ratio tests. The first model estimated the association between sociodemographic factors and child asthma diagnosis. The second model included factors from the first model in addition to childhood asthma risk factors. The third model included factors from the second model in addition to primary child care arrangement. To determine whether different sets of factors predict the child’s asthma diagnosis by poverty status, separate nested binary logistic regressions are performed for low-income respondents and non-low-income respondents (Table 4). In each stratified sample, three nested models are computed as they were for the full sample (with the removal of poverty status as a predictor). Statistics were computed using the svyglm procedure in R version 3.

Results

Statistically significant differences are found for the five categories of the primary child care arrangements and most sociodemographic variables, and the association between primary child care arrangements and child asthma diagnosis was marginally significant (Table 1). The majority of children without an asthma diagnosis are in center-based or parental care. Among children with asthma, the patterns are similar except that fewer children are in parental care (17% vs. 21%) and more children are in center-based care (61% vs. 56%).

Choice of primary child care arrangement shows different patterns based on various sociodemographic characteristics. While over 60% of children in non-low-income families are in center-based care, only 49% of children in low-income families are in center-based care. There was also a higher proportion of non-low-income children in non-relative care (10% vs. 5%), but percentages for both groups were relatively small. Additionally, there are proportionally more low-income children in parental care (28% vs. 14%) and relative care (16% vs. 10%). Although

percentages are smaller, there are also differences between low-income and non-low-income children and relative and non-relative care. Percentages of children in multiple care arrangements were similar for both poverty groups.

There are also different patterns of the primary child care arrangement based on the race/ethnicity of the child. Within each race/ethnic group, center-based care is the most popular type of primary care overall; however, among non-Hispanic white children and Hispanic children, 61% are in center-based care compared to 49% among Hispanic children and 55% among non-Hispanic other children. Among Hispanic children, a higher percentage of them were in parental care (29%) compared to children in other racial/ethnic categories (16-19%). Non-Hispanic black children also had higher percentages in multiple care arrangements (3.4%) than other children (0-2%).

Primary care arrangements also differ depending on the mother's marital status and education. For marital status, the largest differences are for center-based and relative care. Among married mothers, 59% of their children are in center-based care compared to 52% of children of unmarried mothers. On the other hand, a larger proportion of unmarried mothers (18%) are using relative care for their children compared to children of married mothers (11%). Regarding the mother's education status, 60% of mothers with at least a high school degree are using center-based care as the primary arrangement for their children compared to 46% of mothers with less than a high school education. Less educated mothers are reporting proportionally more arrangements for parental care, relative care, and multiple care arrangements than more educated mothers. The use of non-relative care was similar between married and unmarried mothers.

There is variation of the primary child care arrangement depending on the mother's work status. Across all three categories of the mother's work status, most children are in center-based care (54-57%). However, there were differences by work status for relative care, parental care, and non-relative care. Mothers not in the labor force and mothers looking for work are most likely to use parental care (36% and 29%, respectively) compared to mothers who were working full- or part-time (11%). However, a larger proportion of mothers who were looking for work or working were using relative care (14% and 18%, respectively) compared to mothers not in the labor force (4%). There were also differences in the use of non-relative care, with a larger proportion of working mothers using this care (12%) as compared to the other two groups (1-2%).

Table 1 Weighted percentages of sociodemographic characteristics and asthma diagnosis by primary child care arrangement with design effects, $n \sim 6750$

	(%)[1]				
	Parental ($n \sim 1300$)	Relative (n ~ 850)	Non-relative (n ~ 500)	Center (n ~ 4000)	Multiple (n ~ 150)
Sociodemographic factors					
Poverty status***					
Not in poverty	28.0	15.9	5.1	49.0	2.0
At or above 185% of poverty	14.1	10.0	9.9	64.2	1.9
Child's gender					
Male	19.6	12.9	7.8	57.4	2.2
Female	21.5	12.5	7.6	56.7	1.6
Child's race/ethnicity***					
Non-Hispanic white	18.5	10.7	9.5	61.2	0.2
Non-Hispanic black	15.9	15.0	4.4	61.4	3.4
Hispanic	28.5	15.2	6.2	48.9	1.2
Non-Hispanic other	19.0	16.5	7.3	55.2	1.9
Mother's age	30.9(.2)	30.1(.2)	32.9(.3)	32.5(.2)	30.1(.7)
Mother's marital status***					
Not married	19.8	18.3	7.4	52.0	2.6
Married	20.9	10.5	7.8	59.1	1.7
Mother's education***					
Less than high school	31.3	16.0	5.1	46.0	1.7
High school degree or higher	17.0	11.6	8.6	60.8	2.0
Mother's work status***					
Not in labor force	35.9	4.3	1.4	57.4	1.0
Looking for work	28.8	13.2	2.1	53.7	2.2
Working	10.5	17.8	12.0	57.3	2.5
Child's current asthma diagnosis†					
No current child asthma	21.3	12.6	7.7	56.3	2.1
Current child asthma	16.7	13.3	7.5	61.2	1.3

[1]Means and standard deviations presented for continuous variables. * $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

Significance tests were also performed for four child health risk factors and child asthma diagnosis, and all associations were statistically significant (Table 2). There was a higher proportion of children with asthma if they were born with a low birth weight (26%) as compared to children born with a normal birth weight (15%). Breastfeeding seems to be protective since 10% of children who were breastfed at least 4 months had asthma while 17% of children who were breastfed less than 4 months or not at all had asthma. Higher proportions of children who had at least one parent with asthma also had an asthma diagnosis (29% vs. 13%). Additionally, there was a higher proportion of children with asthma for mothers who smoked cigarettes (19%) compared to mothers who did not smoke (15%).

Table 2 Weighted percentages of child health risk factors and primary child care arrangement by asthma diagnosis with design effects (n ~ 6750)

	(%)	
	No asthma (n ~ 5550)	Asthma (n ~ 1200)
Child health risk factors		
Birth weight***		
Low birth weight	73.8	26.2
Normal birth weight	85.1	14.9
Breastfeeding***		
Breastfed less than 4 mos.	83.2	16.8
Breastfed 4 mos. or more	90.4	9.6
Parental history of asthma***		
No parents with asthma	86.8	13.2
At least 1 parent with asthma	71.0	29.0
Mother's smoking status**		
Does not smoke cigarettes	85.5	14.5
Currently smokes cigarettes	81.3	18.7

* P ≤ 0.05; ** P ≤ 0.01; *** P ≤ 0.001

First, nested binary logistic regressions using sociodemographic, child health risk factors, and primary child care arrangement were computing using the full sample. When only sociodemographic factors are included in the regression model, child's sex and race/ethnicity and mother's age are significant (Model 1, Table 2). Boys are 44% more likely to have asthma than girls, and non-Hispanic black children were 123% and non-Hispanic other children were 38% more likely to have asthma than non-Hispanic white children. There was no significant effect for Hispanic children compared to non-Hispanic white children in having an asthma diagnosis. Additionally, poverty status was a marginally significant predictor of asthma such that children from low-income families were more likely to have asthma than children from non-low-income families. In this model, mother's marital status, education, and work status were not significant predictors of child asthma.

When child health risk factors are added to the model, the pattern of results for the sociodemographic factors is similar to the results found in Model 1. Mother's age was no longer significant, but it was marginally significant in the same direction. For the child health risk factors added to the model, low birth weight, breastfeeding, and parental history of asthma are all significant predictors of asthma (Model 2, Table 2). Children who were born with low birth weight are 71% more likely to have asthma. Children who were breastfed at least 4 months or more are 32% less likely to have asthma. Children with at least one parent with a reported asthma diagnosis are 185% more likely to have asthma. The mother's smoking status was not a predictor of child asthma.

In the final model, the type of primary child care arrangement is added to the sociodemographic and child health risk factors (Model 3, Table 2). When adding primary child care arrangement, the pattern of results among the sociodemographic factors changes. In this model, children in all racial/ethnic categories are more likely to have asthma compared to non-Hispanic white children. Additionally, poverty status is also significant, but in the same direction

as the marginal effect found in Model 2. Children from low-income families are 23% more likely to have asthma than children from non-low-income families. Regarding care arrangement, children in center-based care are 54% more likely to have asthma than children in parental care after controlling for the sociodemographic and child health risk factors. Although there are no significant differences in asthma diagnosis for children in other types of care, children in non-relative care are marginally more likely to have an asthma diagnosis than children in parental care. When examining model fit, each successive model was a significant improvement over the previous model.

Table 3 Binary logistic regressions of the effects of child care and covariates on preschool-aged children's diagnosis of asthma for the total sample (n ~ 6750)

	Model 1	Model 2	Model 3
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Sociodemographic factors			
Child gender (ref = female)			
Male	1.44 (1.23-1.69)***	1.43 (1.21-1.68)***	1.42 (1.20-1.68)***
Child race/ethnicity(ref=non-Hispanic white)			
Non-Hispanic black	2.23 (1.66-2.99)***	2.37 (1.79-3.15)***	2.36 (1.78-3.13)***
Hispanic	1.09 (0.83-1.44)*	1.29 (0.99-1.68)†	1.32 (1.02-1.71)*
Non-Hispanic other	1.38 (1.05-1.82)	1.43 (1.09-1.87)*	1.44 (1.10-1.89)**
Poverty status(ref=non-low-income)			
Low-income	1.20 (0.99-1.47)†	1.18 (0.97-1.44)†	1.23 (1.02-1.49)*
Mother's age	0.98 (0.96-0.99)**	0.99 (0.97-1.00)†	0.98 (0.97-1.00)†
Mother's work status (ref=Not in labor force)			
Single	1.18 (0.94-1.48)	1.13 (0.89-1.43)	1.12 (0.88-1.42)
Mother's education (ref=HS degree or higher)			
Less than high school	1.20 (0.95-1.51)	1.22 (0.97-1.54)†	1.25 (0.98-1.59)†
Mother's work status (ref=Not in labor force)			
Looking for work	1.26 (0.89-1.78)	1.21 (0.86-1.73)	1.20 (084-1.71)
Working	1.13 (0.93-1.36)	1.11 (0.92-1.34)	1.06 (0.87-1.31)
Child health risk factors			
Birth weight (ref=normal birth weight)			
Low birth weight		1.71 (1.35-2.18)***	1.72 (1.35-2.18)***
Breastfeeding (ref=breastfed < 4 mos.)			
Breastfed 4 mos. or more		0.68 (0.54-0.86)**	0.68 (0.54-0.87)**
Parental asthma history (ref=none)			
Parental history of asthma		2.85 (2.34-3.47)***	2.86 (2.35-3.49)***
Mother's smoking status (ref=non-smoker)			
Smoker		1.14 (0.93-1.39)	1.17 (0.95-1.44)
Child care characteristics			
Primary child care arrangement (ref=parental c			
Relative care			1.20 (0.86-1.68)
Non-relative care			1.46 (0.98-2.18)†
Center-based care			1.54 (1.15-2.06)**
Multiple care			0.70 (0.37-1.33)
χ^2	134.7***	142.4***	18.0**
AIC_{min}=5401.4	5219.2	5072.7	5051.3

† $P \leq 0.10$ * $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

When the models are computed for the sample stratified by poverty status, the results display different sociodemographic characteristics and child health risk factors associated with child asthma diagnosis (Table 4). In the first model with only sociodemographic characteristics included, child's sex and race/ethnicity continue to have similar patterns for both low-income and non-low-income groups. For both poverty groups, boys are more likely to have asthma than girls, and non-Hispanic black children are more likely to have asthma than non-Hispanic white children. In the low-income sample, non-Hispanic other children are more likely to have asthma

compared to non-Hispanic white children. This effect is not found in the non-low-income group. The mother's age is also a significant predictor of child asthma for the low-income children but is not a predictor for asthma in the non-low-income children. For low-income children, children of younger mothers were more likely to have asthma than children with older mothers. Marital status is also a predictor of child asthma diagnosis, but only for the non-low-income children. Non-low-income children of unmarried mothers are 61% more likely to have asthma than children of married mothers. In Model 1 for each poverty group, neither education nor work status were significant predictors of child asthma.

For each of the stratified samples, the child health risk factors were added in Model 2 and did not change the previous pattern of results found in Model 1 for either group. The effects of the child health risk factors display similar patterns in both poverty groups except for breastfeeding. Low-income children born with a low birth weight are 64% more likely to have asthma, and non-low-income children born with a low birth weight are 83% more likely to have asthma. Similarly, in both samples, children with at least one parent diagnosed with asthma are more likely to have childhood asthma. Breastfeeding is a significant predictor of child asthma diagnosis, but only for the non-low-income group. Non-low-income children who were breastfed at least 4 months after birth are 36% less likely to have asthma than children who were breastfed less than 4 months or not at all.

When the primary child care arrangement was added to the model for each poverty group (Model 3, Table 3), the pattern of results is different between the two samples. Low-income children in center-based care are 53% more likely to have asthma than low-income children in parent care. The other types of care are not significant predictors of asthma for low-income children. For non-low-income children, none of the child care arrangements are significant predictors of asthma. However, both non-relative care and center-based care are marginally significant predictors of asthma. In both cases, children in these types of care are more likely to have asthma than children in parent care. Additionally, in Model 3 the effect of the mother's smoking status is also significant. Low-income children with mothers who smoke cigarettes are 28% more likely to have asthma. This effect was marginally significant in Model 2. Mother's smoking status is not a significant predictor of child asthma for the non-low-income group. When examining model fit in the low-income sample, each successive model was a significant improvement over the previous model. However, for the non-low-income group, Model 3 was only marginally significantly improved over Model 2.

Table 4 Stratified binary logistic regressions of the effects of sociodemographic characteristics, child health risk factors, and primary child care arrangement on preschool-aged children's diagnosis of asthma

	Low income (< 185% of poverty threshold) (*n* ~ 3100)			Non-low-income (≥ 185% of poverty threshold) (*n* ~ 3650)		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Sociodemographic factors						
Child gender (ref = female)	1.41 (1.11-1.79)**	1.41 (1.11-1.79)**	1.39 (1.09-1.77)**	1.50 (1.18-1.90)**	1.46 (1.13-1.88)**	1.45 (1.12-1.87)**
Child race/ethnicity(ref=non-Hispanic white)						
Non-Hispanic black	2.30 (1.61-3.27)***	2.57 (1.74-3.81)***	2.52 (1.70-3.74)***	2.03 (1.22-3.39)**	2.06 (1.27-3.36)**	2.09 (1.29-3.38)**
Hispanic	1.05 (0.74-1.49)	1.34 (0.93-1.94)	1.35 (0.93-1.94)	1.24 (0.81-1.90)	1.33 (0.88-2.02)	1.38 (0.91-2.11)
Non-Hispanic other	1.60 (1.06-2.41)*	1.62 (1.07-2.45)*	1.60 (1.06-2.42)*	1.19 (084-1.68)	1.28 (0.90-1.80)	1.32 (0.94-1.85)
Mother's age	0.96 (0.95-0.98)***	0.97 (0.95-0.99)**	0.97 (0.95-0.99)**	1.00 (0.98-1.02)	1.01 (0.98-1.03)	1.00 (0.98-1.03)
Mother's marital status (ref=married)						
Not married	1.02 (0.79-1.33)	0.99 (0.75-1.31)	0.98 (0.74-1.29)	1.61 (1.11-2.34)*	1.55 (1.04-2.29)*	1.55 (1.04-2.31)*
Mother's education (ref=HS degree or higher)						
Less than high school	1.15 (0.87-1.53)	1.17 (0.88-1.57)	1.21 (0.89-1.63)	1.36 (0.84-2.22)	1.35 (0.90-2.05)	1.41 (0.93-2.14)
Mother's work status (ref=Not in labor force)						
Looking for work	1.30 (0.88-1.93)	1.26 (0.84-1.89)	1.23 (0.82-1.84)	0.62 (0.24-1.59)	0.61 (0.23-1.57)	0.64 (0.25-1.67)
Working	0.99 (0.75-1.31)	0.99 (0.75-1.32)	0.94 (0.69-1.28)	1.31 (0.95-1.79)	1.28 (0.95-1.73)	1.24 (0.91-1.69)
Child health risk factors						
Birth weight (ref=normal birth weight)						
Low birth weight		1.64 (1.22-2.21)**	1.63 (1.21-2.20)**		1.83 (1.31-2.56)***	1.86 (1.32-2.69)***
Breastfeeding (ref=breastfed < 4 mos.)						
Breastfed 4 mos. or more		0.73 (0.49-1.10)	0.73 (0.49-1.09)		0.64 (0.42-0.97)*	0.64 (0.42-0.98)*
Parental asthma history (ref=none)						
Parental history of asthma		2.72 (2.06-3.61)***	2.73 (2.07-3.61)***		2.94 (2.19-3.94)***	2.97 (2.21-3.99)***
Mother's smoking status (ref=non-smoker)						
Smoker		1.25 (1.00-1.56)†	1.28 (1.02-1.60)*		0.97 (0.66-1.40)	0.97 (0.67-1.41)
Child care characteristics						
Primary child care arrangement (ref=parental care)						
Relative care			1.29 (0.85-1.97)			1.00 (0.57-1.74)
Non-relative care			1.31 (0.70-2.43)			1.62 (0.92-2.84)†
Center-based care			1.53 (1.07-2.19)*			1.55 (0.98-2.44)†
Multiple care			0.45 (0.18-1.15)			1.08 (0.39-3.00)
χ^2	68.3***	71.3***	12.8*	χ^2	41.1***	59.7***	8.3†
AIC_{min}=2865.6	2775.9	2713.3	2701.3	AIC_{min}=2471.6	2424.9	2352.2	2348.6

† P ≤ 0.10 * P ≤ 0.05; ** P ≤ 0.01; *** P ≤ 0.001

Discussion

This study examined the associations between sociodemographic characteristics and choice of primary child care arrangement. There were associations between sociodemographic characteristics and primary child care arrangements that might begin to explain the potential effects of child care arrangements on child asthma. When the sample was stratified by poverty status, differences in the pattern of asthma risk factors became clearer. Based on these results, there might be a better understanding of what affects choice of child care and how that choice ultimately affects the risk of child asthma diagnosis.

Sociodemographic Characteristics and Child Care

In the current study and in previous research, preschoolers (i.e., aged 3-4) are more likely to be in center-based care (including Head Start) than other types of arrangements (Laughlin, 2013). Preschool-aged children were in center-based care (59%) more than any other type of care. However, the pattern of child care use changed based on sociodemographic characteristics of the child and the mother. Generally, low-income families in which mothers were unmarried and had less than a high school education were relying more on parental or relative care than other groups, although center-based care was still the preferred choice overall. This finding matches previous research on poverty status, education, and child care options (Capizzano & Adams, 2004; Meyers & Jordan, 2006; Torquati et al., 2011). Parents with fewer resources may need to rely more on care that is convenient and cost effective, such as care by a family member. Low-income parents will also tend to choose cost effective care and sacrifice on quality out of necessity. Additionally, mothers who were working were more often relying on relative-care and non-relative care than mothers who were not in the labor force or mothers looking for work. Torquati and colleagues (2011) found that low-income parents were more constrained than non-low-income parents by their work schedule limits when choosing child care and, therefore, access to quality care was limited.

Child care choices also varied by race/ethnicity though poverty status was included in the model. There were higher percentages of both non-Hispanic black, non-Hispanic other, and non-Hispanic white children in center-based care than of Hispanic children. Less than half of Hispanic children were in center-based care, and almost a third of them were in parental care. Additionally, non-Hispanic white children were less likely to be in relative care than children in the other three racial/ethnic categories.

Child Care and Asthma

For the full sample of respondents, type of primary child care arrangement was predictive of child asthma even after controlling for various sociodemographic and child health risk factors. Center-based care was the only type of care predictive of asthma compared to parental care (although non-relative care was marginal and displayed a similar result). This is consistent with past research that finds that children in center-based care and non-relative care are more likely to have respiratory problems (Slack-Smith et al., 2002; Sun & Sundell, 2011). Although the current study did not specifically account for amount of exposure to unrelated children, there is an indication that this could be the case behind why children in center-based care are more likely to have asthma than other types of care, and children in non-relative care are more likely to have asthma than children in parental care or relative care. Child care centers and Head Start generally have larger groups of children than family-based centers (i.e., non-relative care), and both have larger groups of children than is found in relative care (Dowsett & Huston, 2008). Other child care characteristics that should be explored in future research include the number of hours in

care, age at which the child started formal care, and aspects of the quality of child care. Various child care characteristics may play a role in the respiratory health of children (Hatakka et al., 2010; Sun & Sundell, 2011), and these are also all factors that have been found to differ based on poverty status (Dowsett & Huston, 2008; Torquati et al., 2011).

Additionally, however, the effects of child care varied when the sample was stratified based on poverty status. Center-based care was still a significant predictor of child asthma, but only for the low-income children. Among the non-low-income children, type of child care arrangement did not predict asthma. More research is needed to determine whether it is the quality of center-based care or some other aspects of center-based care that might differ between low-income and non-low-income children, and whether these differences are related to respiratory health in children. There has been evidence that poverty status does affect quality of child care overall (Dowsett & Huston, 2008), but further research should begin to look at variations in quality of care by income and type of care.

Sociodemographic Characteristics and Asthma

Although not a primary focus in the current study, there were sociodemographic predictors of asthma that warrant discussion. For the full sample, female, non-Hispanic black, and non-Hispanic other children were more likely to have asthma. The effect of sex is consistent with previous research that finds boys tend to be at a higher risk for asthma than girls (Bloom et al., 2011; Midodzi et al., 2008). For race/ethnicity of the child, non-Hispanic black children were more likely to have asthma than non-Hispanic white children. This finding is consistent with previous research in which non-Hispanic black children have been found to have higher rates of prevalence, hospitalization, and death due to asthma (Akinbami, Moorman, Garbe, & Sondik, 2009; Gold & Wright, 2005; McDaniel, Paxson, & Waldfogel, 2006).

In terms of how sociodemographic characteristics related to the mother predicted asthma, it depended on the sample selected for analysis. The mother's sociodemographic characteristics did not predict asthma for the full sample of respondents, but did predict asthma depending on whether mothers came from low-income or non-low-income families. For low-income children, the mother's age was a predictor of asthma, but mother's marital status was a predictor of asthma for non-low-income children. In the low-income sample, children of younger mothers might be more likely to have asthma because of lack of life experience and lack of resources while income may be a buffer for age for the sample of non-low-income mothers. For the effect of marital status among non-low-income families, it might be that single mothers face hardships (e.g., worries about bills, clothing, and food) that all low-income mothers face regardless of marital status.

Child Health Risk Factors and Asthma

Birth weight, breastfeeding, parental asthma, and parental smoking have all been associated with respiratory problems and asthma (W. Burke et al., 2003; Gold & Wright, 2005; Midodzi et al., 2008; Salam et al., 2003). For the full sample, low birth weight and parental history of asthma increased the risk of child asthma while breastfeeding was protective against asthma. Mother's smoking status was not a significant predictor of asthma.

When the sample was stratified, parental history of asthma was still a strong predictor of child asthma for both low-income and non-low-income children. However, low birth weight and mother's smoking status (but not breastfeeding) were significant predictors of asthma for low-income children. For non-low-income children, breastfeeding was a protective against asthma, but there were no effects of birth weight and mother's smoking status. The different pattern of results based on poverty status for these variables deserves further research.

Limitations

One of the limitations of this study is how the category for multiple child care arrangements was defined. Since the focus was on the child's primary arrangement, children were only assigned to multiple arrangements if they spent an equal number of hours at more than one care facility. Based on this definition, there were fewer children reported in this kind of care (~ 2% of the full sample). Other research has defined multiple care arrangements in a number of ways, including the total number of regular arrangements (regardless of the number of hours spent in care) and even separating the multiple arrangements by type of care (e.g., number of non-relative care arrangements versus number of relative care arrangements) (Beijers et al., 2011; Chen, 2013; Morrissey, 2008).

Another potential limitation is how poverty status was defined. Although poverty status was defined to stratify by low-income and non-low-income families, it does group together low-income (e.g., 100-200% of the poverty threshold) with those considered poor (e.g., < 100% of the poverty threshold) (definitions from the National Center for Children in Poverty; Addy, Engelhardt, & Skinner, 2013). Other researchers have found a U-shaped curve between poverty level and child care quality such that families from low- and high-income families are able to select better quality child care than middle-income families (Torquati et al., 2011). While low-income families cannot usually afford the cost of high quality care, they are more likely to be eligible for child care subsidies that allow them a wider range of child care options than middle-income families who do not receive subsidies. Future research should include the subsidies in analyses since this could increase parents' use of center-based care, regardless of income level.

Future research should explore the complexities behind child care choice as it relates to poverty status and potentially other sociodemographic characteristics and how those relationships influence how child care arrangements affect children's health. Although there is much research on socioeconomic disparities in child care arrangements (Capizzano & Adams, 2004; Early & Burchinal, 2001; Laughlin, 2013; Torquati et al., 2011) and in child asthma (Akinbami et al., 2009; Bloom et al., 2011; Gold & Wright, 2005; McDaniel et al., 2006), research needs to further explore the connections between restrictions on child care options and child asthma diagnosis.

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