Supplemental Information

Additional details about measures taken in this study are provided below.

NEIGHBORHOOD CHARACTERISTICS VIA GOOGLE STREET VIEW

Street segments 0.06 to 0.15 miles in length and centered on the family's home address were drawn in Google Earth Pro, following previously outlined procedures.[19] Trained raters completed virtual walks through identified street segments using Google Earth Pro and Google Street View imagery and systematic social observation methods.[19] Imagery dates ranged from 2007 to 2016, with 95% of coded imagery taken within 2 years of the study period (95% of images were taken between 2011 and 2016, with visits occurring between 2013 and 2016). Virtual walks down street segments involved detailed inspection of streets, sidewalks, signage, all buildings, and adjacent yards or land. Neighborhood characteristics recorded during virtual walks included signs of physical disorder and raters' global assessment of neighborhood dangerousness. Specifically, physical disorder was indicated by the presence (coded 0–1) of litter, run-down cars, small graffiti, large graffiti, scrubbed or painted-over graffiti, or other defaced property. A physical disorder score was generated by summing disorder items with higher scores, indicating more disorder. Neighborhood dangerousness was evaluated by raters using a global scale (coded 1–5) for the following statements: "This neighborhood appears to be a safe place to live" and "I would feel safe walking in this neighborhood at night." Ratings were based on the presence of abandoned and/or boarded-up homes, vacant lots, bars on windows and/or doors, and police cameras; in addition, the presence of institutions such as churches or schools were considered mitigating factors. Scores for neighborhood danger were created by taking the mean of the above 2 items (rater's responses were highly correlated; $r = 0.81$). Raters included 7 trained research staff (across the 4-year study period) who went through 2-day training on Google Street View coding with an expert in neighborhood coding (1 of the developers of the Google Street View coding system) and then a month-long training period during which trainees were taught from a coding manual and then reviewed cases with an established rater until they established their own reliability in making codes. Interrater reliability for the 2 scales ranged from 0.77 to 0.90. Because of their high correlation ($r = 0.65$; $P < .001$), the dangerousness and disorder scales were standardized and averaged to create a single neighborhood danger and/or disorder score. Validity of this measure has been previously demonstrated via its associations with local resident reports of neighborhoods and its ability to predict children's problem behaviors.[19] In the current study, the neighborhood danger and/or disorder score was significantly correlated with family socioeconomic status (family income; $r = 0.25$; $P < .001$).

FAMILY RELATIONSHIP QUALITY

Family relationship quality was determined via interviews with youth using the University of California Los Angeles Life Stress Interview.[21,22] This semistructured interview probes aspects of the family relationship over the past 6 months, including trust, support, and conflict. Interviewers rate the quality of the child's relationship with family members on a continuum of a 1 to 5 scale (including 0.5 ratings). To facilitate interpretation, ratings were reverse scored from the original measure such that higher numbers reflected better-quality family relationships. Each interviewer went through a 2-month training process in which they first reviewed training materials (published articles and training manual), listened to tapes with consensus ratings provided, made ratings on their own of tapes with feedback provided by established interviewers, and then conducted their own interviews and made ratings with feedback provided by established interviewers. Each interviewer, once trained, made ratings of the participants they interviewed. Reliability and validity for this interview have been demonstrated in children as young as 8.[22,59] Interrater reliability (intraclass correlation coefficients) across interviewers on our team was 0.89.

ASTHMA CLINICAL OUTCOMES

Pulmonary function was assessed in the laboratory by using spirometry (MicroLoop; CareFusion), according to American Thoracic Society guidelines.[23] Measures were taken ≥4 hours after the last use of a short-acting bronchodilator and ≥24 hours after the use of a long-acting bronchodilator following the protocols of a multisite clinical asthma trial.[60] Typically, 4 to 8 spirometry loops were obtained on each participant, and the best loop was determined in consultation with a pediatric asthma specialist. Spirometry was conducted by research technicians who were trained by a pediatric asthma specialist and his team of respiratory therapists. The pediatric asthma specialist reviewed pulmonary function loops monthly and provided feedback to the team of research assistants. FEV_1 percentile was calculated as a percentage of predicted values based on child age, sex, ethnicity, and height.[24]

Asthma activity limitations were measured by child report by using the Activity Limitations subscale of the Pediatric Asthma Quality of Life Questionnaire. This scale contains 5 items rated on a 7-point scale (eg, "How much were you bothered by your asthma during activities you did in the past week?") and has high reliability and validity.[25] We focused on activity limitations to get an assessment of functional physical limitations in day-to-day activities (we did not want the overall score because it includes emotional functioning, which was not the focus of this article). Responses were coded such that higher scores indicate greater activity limitations.

Parent report of child asthma symptoms was queried with a question for parents: "How often has your child had a cough, wheeze, shortness of breath, or chest tightness during the past month?" Responses were coded on a 4-point scale, with higher numbers indicating more asthma symptoms. This measure has been used and validated in previous research.[26]

ASTHMA MANAGEMENT BEHAVIORS

The FAMSS was used to probe family asthma management behaviors.[27] This semistructured interview is used to query how families and children respond when they perceive breathing problems in the child (family response to symptoms and child response to symptoms) as well as how well families balance managing asthma within their daily lives and how having asthma has changed family activities or routines (balanced integration of asthma into daily life). FAMSS interviews were conducted and rated by a team of 7 interviewers (across the 4-year study period). Each interviewer went through a 2-month training process in which they first reviewed training materials (published articles and the training manual), listened to tapes with consensus ratings provided, made ratings on their own of tapes with feedback provided by established interviewers, and then conducted their own interviews and made ratings with feedback provided by established interviewers. Each interviewer, once trained, made ratings of the participants they interviewed. Raters were blind to neighborhood conditions and study hypotheses. Monthly consensus meetings were held to listen to tapes and to make group consensus ratings for the purposes of assessing reliability. Interrater reliability (intraclass correlation coefficients) from these consensus meetings across all 7 interviewers for the various scales ranged from 0.87 to 0.93. Validity for this interview has been established.[27] For this measure, interviewers made ratings on a 9-point scale, with higher scores indicating better responses to symptoms and better balanced integration.

ASTHMA IMMUNOLOGIC MEASURES

Th1 and Th2 cytokine production were measured by ex vivo stimulated PBMCs. Although airway cells better reflect activity at the site of disease, obtaining them requires an invasive procedure difficult for children without a clinical indication. Thus, authors of pediatric asthma studies often rely on PBMC-derived cytokines, which correlate with results obtained via bronchoalveolar lavage and with eosinophil counts and disease severity.[61,62] A total of 0.5×10^6 PBMCs were isolated from venous blood by density-gradient centrifugation and incubated with 25 ng/mL of PMA and 1 μg/mL of ionomycin for 24 hours at 37°C in 5% CO_2.[28–30] A nonspecific ligand, PMA-ionomycin, was used to induce lymphocyte cytokine production; variability in allergen sensitization made it difficult to compare participant responses with specific triggers (eg, dust mites). An unstimulated well was prepared with PBMCs but no mitogen. After incubation, supernatants were harvested and assayed in duplicate via electrochemiluminescence on a Sector Imager 2400A (Meso Scale Discovery).[31] We used a Human Th1/Th2 7-Plex Tissue Culture Kit (Meso Scale Discovery), which is used to measure both Th2 (interleukin 4, interleukin 5, interleukin 10, and interleukin 13) and Th1 (interferon-γ and interleukin 2) cytokines. Mean interassay coefficients of variation for duplicate pairs ranged from 1.50% to 3.64%. Values in the unstimulated wells were subtracted from those in the PMA-ionomycin wells. Composite Th1 and Th2 scores were derived by standardizing each cytokine and then averaging values as described in Ehrlich et al.[32]

Glucocorticoid sensitivity (or sensitivity to glucocorticoid

inhibition) was measured by repeating the above protocol, this time with hydrocortisone added. A total of 0.5×10^6 PBMCs were coincubated with 25 ng/mL PMA, 1 μg/mL ionomycin, and 1.38×10^{-6} M hydrocortisone for 24 hours at 37°C in 5% CO_2, similar to previous studies.[33,34] At this dose, cortisol suppresses production of Th1 and Th2 cytokines, so higher values reflect greater insensitivity or decreased sensitivity to glucocorticoid inhibition.

COVARIATES

All models included a panel of covariates selected because of their established association with neighborhood conditions and/or asthma outcomes. The covariates included child sex, age, ethnicity (coded as white versus nonwhite), family income, asthma severity (determined from the National Asthma Education and Prevention Program/Expert Panel Report 2 guidelines based on the higher of symptom frequency and medication use[26]), and whether the child was using an inhaled corticosteroid (yes or no) and a β-agonist (yes or no for either short acting or long acting). A method for classifying asthma severity in patients on controller medications based on symptom frequency in quantitative and qualitative terms and medication dosage and usage has been established by Bacharier et al,[26] and was used in this study. This classification was completed by research study staff in consultation with a pediatric asthma specialist. Because 90% of participants came from a single site (NorthShore HealthSystem), we did not include recruitment site as a covariate in primary analyses in the main article.

SUPPLEMENTAL ANALYSES

Because there were only a small number of participants who did not have a β-agonist, we reran all analyses without β-agonist status as a covariate. All patterns of results remained the same.

Because of the 2 recruitment sites, we reran supplemental analyses, including recruitment site as a covariate. All patterns of results remained the same.

We also reran analyses including FEV_1 and/or forced vital capacity as a covariate. All patterns of results remained the same.

SUPPLEMENTAL REFERENCES

59. Rudolph KD, Hammen C. Age and gender as determinants of stress exposure, generation, and reactions in youngsters: a transactional perspective. *Child Dev*. 1999;70(3):660–677

60. Childhood Asthma Management Program Research Group. The Childhood Asthma Management Program (CAMP): design, rationale, and methods. *Control Clin Trials*. 1999;20(1):91–120

61. Gemou-Engesaeth V, Kay AB, Bush A, Corrigan CJ. Activated peripheral blood CD4 and CD8 T-lymphocytes in child asthma: correlation with eosinophilia and disease severity. *Pediatr Allergy Immunol*. 1994;5(3):170–177

62. Corrigan CJ, Kay AB. CD4 T-lymphocyte activation in acute severe asthma. Relationship to disease severity and atopic status. *Am Rev Respir Dis*. 1990;141(4, pt 1):970–977