

Report on the Examination of Children in the Healthy Homes Study

Prepared by

Mary Ellen Gordian, MD, MPH



Institute for Circumpolar Health Studies
University of Alaska Anchorage
3211 Providence Drive
Anchorage, Alaska 99508

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I. Background

The Healthy Homes Project was designed to test whether improving the indoor environmental quality of homes for children with asthma might improve their health. Only children who lived in low income homes were eligible, and the parent or guardian of the child was required to own the home so remediation of potential asthma triggers would be undertaken. Because few low income families can afford to own their own homes, the number of eligible subjects was limited.

This is a report on the health findings. The project was disseminated among several groups, including the University of Alaska Fairbanks for in home environmental assessments, weatherization services in both Hooper Bay and Fairbanks, medical care providers Tim Foote of Tanana Valley Health care in Fairbanks and Yukon Kuskokwim Healthcare Corporation in Hooper Bay, and the University of Alaska Anchorage for data analysis.

The children were seen by a medical doctor. They had a physical examination and laboratory tests. The laboratory tests included pulmonary function tests, skin prick tests for allergy (or RAST testing in Hooper Bay children), IgE level, and complete blood counts. Parents also provided a medical history on their child, with an emphasis on respiratory health.

A total of sixteen children were examined--three in Hooper Bay and thirteen in Fairbanks. The children's ages ranged from 2 to 15 years, with five females and eleven males. Four of the children were Alaska Native/American Indian, two were Asian, and nine were white. No race was indicated for one child.

Fourteen children had a diagnosis of asthma, one had encephalopathy, and another had no diagnosis (the medical history form was not available).

The three children from Hooper Bay were flown to Bethel for the examination. They were all under five years of age. The children were too young to have pulmonary function tests done, and examinations were unremarkable except for the severe encephalopathy in one child, which was not related to asthma. One child had elevated IgE. No follow-up examinations were done in Hooper Bay. Ten children from Fairbanks were seen in follow-up.

II. Medical Examinations

A. Pulmonary Function Tests

Ten children from Fairbanks had pulmonary function tests done, and all had normal forced vital capacity (FVC) ranging from 70% to 127% of predicted value for their age. Two children had a forced expiratory volume in one second (FEV1) that was below 70% of predicted value. Less than 70% of predicted value is considered abnormal. Forced expiratory flow between the 25th to 75th percentile of FVC (FEF₂₅₋₇₅), which is thought to

be an indicator of small airway function, was reduced in four children. In total, six of the ten children tested (60%) had one or more of the parameters of pulmonary function testing in the abnormal range.

B. Indications of Allergy IgE and Skin Prick Test

Twelve children were tested by skin prick for allergies. Three of these had no allergies to any of the antigens tested. The other ten were skin test positive to more than one allergen. Hooper Bay children did not receive skin prick tests, but RAST testing for common allergens was done for two children. One of the Hooper Bay children had elevated specific IgE to four allergens, and the other child had no evidence of allergy. Initial IgE levels were done on nine children in Fairbanks and two in Hooper Bay. Ten of the children had follow-up examination including IgE levels. This included three children who did not have an initial IgE level. Four of these, or 31%, had elevated (>300 units) levels, one as high as 1600 units. Because IgE was done in different laboratories, the normal range for each age is not given; however, >300 is unequivocal elevation in any laboratory.

IgE level was a strong predictor of allergy. Four children had IgE levels below 100 units. Three of these children also had skin prick test which showed no reaction to common allergens. One had mild (1+) reaction to alder and birch, but to no other allergens. All children who had strong reactions to skin prick tests also had elevated IgE.

C. Interval between Examinations

The average time between the first examination and the follow-up examination was a little more than a year. The range was from 90 days to 4 years. The mean age of the children was nine years, with a range of 3 to 15 years.

D. Initial Medical History

Twelve children had a diagnosis of asthma, one had a diagnosis of allergies, one had a diagnosis of encephalopathy, and one had no medical history form filled out. Ten children had had previous hospitalizations of which nine (56%) were for respiratory problems. Six of the children had missed more than 5 days of school in the current semester due to coughing illness. Ten children had a daily cough, eleven had coughing with exercise, twelve had a cough during the night, and ten had had five or more respiratory illnesses in the last year.

All of the children used albuterol inhalers, ten were on inhaled steroids, and six had had a course of oral prednisone which is used for intractable asthma. Thirteen children were taking daily medications, but only one of these listed an inhaled steroid as their daily medication; three listed albuterol. On the initial examination, eleven children reported using an inhaler daily in the last three months. Nine reported having episodes of wheezing, coughing, and/or shortness of breath more frequently than twice a week in the last three months. Six children were awakened with coughing almost nightly in the

last three months, and an additional two had this symptom more than twice a week. Six children had been taken to the Emergency Room in the last three months, three of them on more than one occasion.

None of the children smoked or chewed tobacco, and none of them lived in homes where smoking was allowed indoors, although four had a smoking parent. Seven children lived in homes with wood burning stoves. Eight children had furred or feathered pets living in the home.

III. Follow-up examinations

Ten children in Fairbanks were seen for follow-up. Of these ten, four had been hospitalized for respiratory problems since their previous visit. It is unknown whether these hospitalizations occurred before, during, or after the home remediation.

Three children reported a daily cough, three reported post-exercise cough, and four reported coughing at night. All but two used albuterol inhalers regularly, five used inhaled steroids regularly, and four had been on oral prednisone, including two who were not on inhaled steroids. Three reported using an inhaler daily, two reported using it intermittently, and four reported not using an inhaler at all. None reported taking oral medication regularly. Seven reported having attacks of coughing, wheezing, and/ or breathlessness more than twice a week, including two who said they never used inhalers. Only three children reported frequent night symptoms in the last three months, and all three of these used inhalers daily. In the last three months, two of the ten had been taken to the emergency room once, and two more said that it was needed but they did not go to the emergency room.

A. Physical Examinations

Physical examinations were unremarkable for both the initial examination and the follow-up. Two children had wheezes on initial examination, and only one of them was seen in follow-up when no wheezes were heard. There were no abnormal findings on physical examination in the follow-up examinations. Only seven children had both initial and follow-up examinations that included anthropomorphic information and vital signs. The average height increased by 1.3 inches, the average weight increased by 14.3 pounds, the average heart rate went down by 13.7 beats per minute, and the average respiratory rate went down by 1.7 breathes per minute. Blood pressure data was only available for four children. The average systolic pressure decreased by 7 points, and diastolic pressure decreased by 3 points. These changes in vital signs can be explained by increased familiarity with the procedures and the medical office rather than improvements in the home environment.

B. House Pollutant measurements

Control houses were significantly different from participants' houses in Fairbanks. In control houses, carbon dioxide levels were 20% lower, carbon monoxide levels were 25% lower, and benzene levels were 70% lower. Mycelia and fungal spores counts

were also an order of magnitude lower in control homes than participants' houses; however, only six participants' homes had mycelia and spore count data, and only one home had exceedingly high levels which accounted for the large difference. It is not clear whether control homes were being occupied at the time that the measurements were done. If they were indeed occupied homes with similar occupants, then there may be good evidence that the homes of asthmatic children are higher in indoor air pollutants.

	Average Pre-remediation Values				Average Post-remediation Values			
	CO2	CO	benzene	toluene	CO2	CO	benzene	toluene
Control Homes	816	1.5	2.9	13	964	1	9.1*	30.2
Participant homes	1070	2	10.2	49.7	911	1.3	8.8	37

*this value includes one home with 31 ppb benzene

Because particulate measurements were done as grab samples over less than 30 minutes indoors with particle counters, these measurements would be unusable for health effects research. Benzene and toluene were measured with passive badges exposed over one week time indoors to get an average value for each house.

IV. Pre and Post Evaluations

Post evaluations showed a non-significant reduction in benzene in participants' houses, and a non-significant increase in toluene. There was no correlation between indoor benzene and toluene, indicating that they are probably coming from different sources. Pre and post- benzene levels for the same house were significantly correlated. Although the Pearson's correlation coefficient was always negative for every respiratory indicator, there were no statistically significant correlations of any physical parameter with indoor benzene or toluene levels.

There was improvement of all health related laboratory parameters from pre remediation to post remediation, but none reached statistical significance.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	initial IgE	215.00	7	172.556	65.220
	follow-up IgE	172.71	7	134.888	50.983
Pair 2	initial FVC%predicted	103.83	6	8.886	3.628
	follow-up FVC%predicted	111.17	6	11.197	4.571
Pair 3	initial FEV1%predicted	90.33	6	14.208	5.800
	follow-up FEV1%predicted	96.33	6	15.756	6.433
Pair 4	initial FEF% predicted	75.67	6	29.811	12.170
	follow-up FEF% predicted	77.83	6	25.349	10.349

Paired T-test

	Paired Differences		Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
	Mean	Std. Deviation		Lower	Upper			
initial IgE - follow-up IgE	42.29	54.04	20.42	-7.69	92.26	2.07	6.00	0.08
initial FVC%predicted - follow-up FVC%predicted	-7.33	7.84	3.20	-15.56	0.89	-2.29	5.00	0.07
initial FEV1%predicted - follow-up FEV1%predicted	-6.00	6.32	2.58	-12.64	0.64	-2.32	5.00	0.07
initial FEF% predicted - follow-up FEF% predicted	-2.17	15.52	6.34	-18.46	14.12	-0.34	5.00	0.75

V. Discussion

The results of this study are inconclusive due to the small number of research subjects and the multifactorial nature of asthma. However, there are some interesting suggestive results.

- It is possible that the homes of children with asthma have higher levels of indoor air pollution than the homes of similar people without asthma.
- The remediation may have helped to improve the pulmonary function tests and the IgE levels of asthmatic children, although the numbers were not sufficient to reach statistical significance.