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# Comparison of skin prick allergy test in urban and rural children

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## Abstract

***Background*** Children who grow up in rural areas have a lower incidence of atopy and other allergic manifestations than children in urban areas. Several recent studies have suggested that agricultural exposure may protect children from developing asthma and atopy, but these findings are inconsistent.

***Objective*** To examine an association between living in rural or urban areas and skin prick allergy test results in children and to determine associated risk factors for atopy.

***Methods*** We conducted a cross-sectional study in Karo district (rural) and Medan (urban) in October - December 2009. We enrolled primary school children who had a history of atopy in their families. Skin prick testing was done on the volar side of the forearm and included eight aero-allergens: house dust mites, house dust, cotton, chicken feathers, cat dander, cockroaches, mould, and pollen. We analyzed the following risk factors for association with atopy: tobacco smoke, pets, livestock exposure, and having older sibling(s).

***Results*** We recruited 49 children from the Karo district and 52 children from the city of Medan. There were significant associations between living in an urban area and positive skin prick test results for house dust mites and house dust compared to living in a rural area (P=0.04, 95% CI: 1.11 to 5.91; P=0.04, 95% CI: 1.13 to 12.45, respectively). The reverse was true for cockroach allergens (P=0.02, 95% CI: 0.16 to 0.81). Tobacco smoke and livestock exposure were associated with negative skin prick test results in rural children (P=0.03, 95% CI: 0.03 to 0.81 and P=0.002, 95% CI: 0.02 to 0.42, respectively). Multivariate analysis revealed that lack of livestock exposure was the major risk factor associated with any positive skin prick test results in rural children (P=0.004; 95% CI : 0.02 to 0.49).

***Conclusion*** There were differing associations between living in rural and urban areas to various skin prick test results in children. Lack of livestock exposure was the risk factor associated with positive skin prick test results in rural children. **[Paediatr Indones. 2011;51:84-8]**.

***Keywords****: skin prick test, children, rural, urban, risk factor.*

Atopy has been increasing in prevalence in the industrialized world for at least two decades, but this increase has not been noted in the developing world.[1] The increase in atopy was relatively rapid and dramatic, suggesting environmental factors rather than genetic factors contributed to the increase.[2-4] Children who grow up on farms have a lower incidence of atopy and other allergic manifestations as compared with children who do not grow up on farms.[1,3] Several recent studies from Europe, Canada, and Australia have suggested that agricultural exposures may protect children from developing asthma and atopy. However, these findings are inconsistent, and research has not yet identified the underlying mechanisms of this association.[2]

Atopic disorders can be diagnosed by individual or family history and confirmed by specific allergen immunoglobulin (Ig) E or positive skin prick test results. Skin prick tests can be performed in a short time and are appropriate for use in children.[5]

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This test has a high specificity and sensitivity when performed with precise technique and interpretation. It is also easy to perform, fast, inexpensive, safe, and not painful.[5,6]

We performed skin prick tests in rural and urban children to look for associations between living in rural or urban areas and skin prick test results in children. We also sought to determine risk factors for atopy.

## Methods

We conducted a cross-sectional study in Medan and Karo district from October - December 2009. Subjects were school children aged 6-10 years with family history of atopy (in mother, father, or older sibling). The minimum number of subjects needed for this study was 94 (47 children from Medan and 47 children from Karo district). We excluded subjects who took antihistamines in the ten days prior to the study,/ corticosteroids the day before the study, and those with dermatographism. Informed consent was obtained from parents and study . Ethical approval was obtained from the Medical Ethics Committee, Medical School, University of North Sumatera Medical School.

We gathered took data on the subjects' aboutidentity, atopic history in the family, and exposure to risk factors (tobacco smoke, pets, livestocks, and presence of older sibling) from the using a questionnaire. All participants underwent skin prick testing. The procedure involved initial cleaning of the volar side of the child's lower arm using 70% alcohol. The researcher then marked the location of allergens at 2-3 cm intervals and placed one droplet of each allergen, a negative control (0.9% NaCl) and a positive control (histamine 1%) on the skin. Eight aero-allergens were used in this study: include house dust mites, house dust, cotton, chicken feathers, cat dander, cockroaches, mould, and pollen. The skin was pricked through the droplet using a disposable lancet, after which excess allergen droplets were carefully blotted (not wiped) away using a clean, absorbent paper towel.

Test results were interpreted 15 minutes after the researcher pricked the skin. A positive result to a specific allergen was indicated by a mean wheal diameter of 3 mm or more. Subjects were considered to have a positive skin prick test if they had a positive reaction to any one of the allergens used. Epinephrine 1:1,000 was immediately available as antidote forin case of anaphylactic reaction which might happens. The procedure and interpretation of the skin prick tests were performed by trained pediatric residents or pediatricians.

We used the software SPSS version 11 for statistical analysis. Chi-square test was used to determine associations between living in rural or urban areas with skin prick test results. Multivariate analysis was used to determine risk factors. We used a 95% confidence interval (CI) in this study and $P<0.05$ was considered significant.

## Results

Of 101 subjects participating in the study, 49 lived in the Karo district (rural) and 52 lived in Medan (urban). Subject characteristics are summarized in **Table 1**. There were more fFemales than proportionwas males in both the urban and rural groups. Mean age was similar in both groups (8.6 years). We observed that mothers were the most common family member with atopic history in both groups. Allergic rhinitis was

**Table 1.** Subject characteristics

| Characteristic | Rural (n= 49) | Urban (n= 52) |
|---|---|---|
| Male | 19 | 23 |
| Female | 30 | 29 |
| Age, mean (SD), years | 8.6 (1.14) | 8.6 (1.2) |
| Atopic history in family | | |
| Mother | 17 | 21 |
| Father | 9 | 6 |
| Older sibling | 7 | 9 |
| Mother and father | 9 | 8 |
| Mother and older sibling | 6 | 2 |
| Father and older sibling | 1 | 0 |
| Mother, father, and older sibling | 0 | 6 |
| Atopic disease history in child | | |
| Atopic dermatitis | 2 | 7 |
| Allergic rhinitis | 19 | 20 |
| Asthma | 26 | 16 |
| Atopic dermatitis and allergic rhinitis | 0 | 3 |
| Atopic dermatitis and asthma | 0 | 1 |
| Allergic rhinitis and asthma | 2 | 5 |

the most common atopic manifestation in the family history of urban children, while asthma was the most common in rural children.

**Table 2.** Skin prick test results in rural and urban children

| Allergen | Rural | Urban | 95% CI | P |
|---|---|---|---|---|
| | n | n | | |
| House dust mite | | | | |
| Positive | 13 | 25 | 1.11 to 5.91 | 0.04 |
| Negative | 36 | 27 | | |
| House dust | | | | |
| Positive | 4 | 13 | 1.13 to 12.45 | 0.04 |
| Negative | 45 | 39 | | |
| Cotton | | | | |
| Positive | 1 | 2 | -0.17 to 21.87 | 1 |
| Negative | 48 | 50 | | |
| Chicken dander | | | | |
| Positive | 0 | 3 | -1.64 to 2.44 | 0.24 |
| Negative | 49 | 49 | | |
| Cat dander | | | | |
| Positive | 0 | 0 | | - |
| Negative | 0 | 0 | | |
| Cockroach | | | | |
| Positive | 26 | 15 | 0.16 to 0.81 | 0.02 |
| Negative | 23 | 37 | | |
| Mould | | | | |
| Positive | 0 | 0 | | - |
| Negative | 0 | 0 | | |
| Pollen | | | | |
| Positive | 3 | 0 | -1.73 to 2.63 | 0.11 |
| Negative | 46 | 52 | | |

We analyzed each allergen and found association between living in urban and rural area with skin prick test results in children for house dust mite, house dust, and cockroach allergens (P=0.04, 95% CI 1.11 to 5.91; P=0.04, 95% CI 1.13 to 12.45; P=0.02, 95% CI 0.16 to 0.81, respectively) (**Table 2**).

We found a significantly greater percentage of urban children with positive skin prick test for house dust mites and house dust (P = 0.04, 95% CI 1.11 to 5.91; P= 0.04, 95% CI 1.13 to 12.45, respectively) compared to that of rural children. The reverse was true for cockroach allergens (P = 0.02, 95% CI 0.16 to 0.81). **Table 2**

Exposure to tobacco smoke and livestock were negatively associated with at least one positive skin prick test result in rural children (P=0.03, 95% CI 0.03 to 0.81 and P=0.002, 95% CI 0.02 to 0.42, respectively), implying that tobacco smoke and livestock exposure may have a protective effect for atopy. However, none of the four risk factors and yielded similar associations in urban children. (**Table 3**) Multivariate analysis was done to determine whether lack of exposure to tobacco smoke or livestock had a greater influence on positive skin prick test results in rural children. We found that lack of livestock exposure was the major risk factor associated with positive skin prick test results in rural children (P=0.004, 95% CI 0.02 to 0.49).

**Table 3.** Risk factors of skin prick test results in rural and urban children

| Variable | Rural | | | Urban | | |
|---|---|---|---|---|---|---|
| | Skin prick test | | P (95% CI) | Skin prick test | | P (95% CI) |
| | Any positive | All negative | | Any positive | All negative | |
| | n | n | | n | n | |
| Tobacco smoke exposure | | | | | | |
| Yes | 17 | 18 | 0.03 | 12 | 6 | 1 |
| No | 12 | 2 | (0.03 to 0.81) | 23 | 11 | (-0.28 to 3.22) |
| Pets exposure | | | | | | |
| Yes | 12 | 13 | 0.18 | 10 | 3 | 0.5 |
| No | 17 | 7 | (-0.12 to 1.23) | 25 | 14 | (-0.44 to 7.93) |
| Livestock exposure | | | | | | |
| Yes | 3 | 11 | 0.002 | 0 | 0 | * |
| No | 26 | 9 | (0.02 to 0.42) | 35 | 17 | |
| Having older sibling | | | | | | |
| Yes | 18 | 13 | 1 | 18 | 8 | 1 |
| No | 11 | 7 | (-0.35 to 3.71) | 17 | 9 | (-0.26 to 2.68) |

* Data could not be analyzed because there was none of the urban children hadno livestock exposure. found in urban children

## Discussion

For urban children in our study, we found the highest positive skin prick test results were to house dust mites, cockroaches, and house dust. Two of these allergens, house dust mites and cockroaches, resulted in the highest percentage of positive skin prick test results in rural children. A retrospective study in Denpasar using skin prick tests in children with allergic rhinitis, found that house dust, house dust mites, cotton, and cockroaches were allergens with the highest positive skin prick test results.[7] Other studies in Ghana and Crete found that house dust mites was the allergen with the highest positive skin prick test results.[8,9]

We had mixed results in associations between living location and positive skin prick tests to various allergens. Past studies have been done to determine the associations between living in urban or rural areas with atopic sensitization and allergic disease. A cross-sectional study in southern Germany involving 10,163 school children found those in rural areas had a lower prevalence of asthma, hay fever and wheezing compared to children living in urban areas.[10] A Swiss study involving 1,620 children reported an adjusted odds ratio of 0.31 (95% CI 0.13 to 0.73) for an association between atopic sensitization in children and farming as a parental occupation, and no significant associations were noted for hay fever, eczema, or asthma.[11] A study in Finland examined 7,981 children aged 13 to 14 years and found that living on a farm was associated with a decreased prevalence of allergic rhinoconjunctivitis (OR=0.79, 95% CI 0.63 to 0.99), but was not associated with asthma, wheeze, or eczema.[12]

We found that lack of livestock exposure in rural children was associated with positive skin prick test results in rural children when the their age was less than 1 year at exposure. A number of studies have found that decreased prevalence of atopy and asthma is associated not just with living in rural areas, but also with livestock exposure.[2] A cross-sectional survey of 2,283 children in Austria reported a decreased prevalence of asthma, hay fever, and atopic sensitization among children aged 8 to 11 years living on farms. Regular contact with livestock was associated with a decreased prevalence of atopic sensitization.[13] Studies in Crete and Finland reported a reduced prevalence of atopic sensitization among children who had early life contact with livestock. This effect was further observed among urban children who did not live on a farm but reported regular contact with livestock.[9,10]

Children exposed to livestock may be exposed to more bacteria and viruses than are children without livestock exposure. In particular, contact with livestock may increase a child's exposure to endotoxin, a component of the outer membrane of gram negative bacteria and a strong promoter of interleukin-12 and the maturation of naive T cells into Th1 cells. Early childhood exposure to endotoxin may protect against asthma and atopy by promoting Th1 cells and inhibiting Th2 cells. However, further study is needed to clarify the exact nature of the association between livestock exposure and atopic conditions.[2]

We found no association between pet exposure and positive skin prick test results in urban and rural children. On the contrary, studies in Finland and Sweden reported that pet exposure was associated with a decreased risk of atopy when the child's age was less than 1 year.[14,15]

Tobacco smoke exposure was higher in children living in the rural area (75% vs. 35%) and significantly associated with negative skin prick test results in this study. A Swiss study found that maternal smoking was significantly associated with lower rates of atopic sensitization.[11] However, a study in Sweden found that children with genetic predisposition for allergies and exposure to secondhand tobacco smoke during their first year of life had highly increased odds of developing an allergy and seeking medical care for allergic symptoms at the age of 4 years.[16]

Having older siblings was not associated with skin prick test results in urban or rural children in this study. Other studies reported that children living in overcrowded households or with older siblings have a reduced risk of atopy and allergic disease. Previous observations had led to the suggestion that multiple and continued exposures to childhood viral and bacterial infections may protect against the development of allergy.[17,18]

Our study was limited in that we did not assess how long the subjects had been living in urban or rural areas. Other factors that may influence skin prick test results in urban and rural children such as air pollution level, socio-economic level, sanitation and hygiene levels were not assessed in this study.

We observed differing significant associations between living in rural and urban areas and skin prick test results to various allergens in children with atopic histories. Lack of livestock exposure was the most significant risk factor associated with positive skin prick test results in rural children.

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