Environmental tobacco smoke and the risk of eczema symptoms among school children in South Africa: a cross-sectional study

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ABSTRACT

Objective: The aim of this study was to investigate the association between eczema ever (EE) and current eczema symptoms (ES) in relation to exposure to environmental tobacco smoke (ETS).

Design: A cross-sectional study using the International Study of Asthma and Allergies in Childhood questionnaire.

Setting: 16 schools were randomly selected from two neighbourhoods situated in Ekurhuleni Metropolitan Municipality, Gauteng Province, South Africa.

Participants: From a total population of 3764 school children aged 12–14 years, 3468 completed the questionnaire (92% response rate). A total of 3424 questionnaires were included in the final data analysis.

Primary outcome: The prevalence of EE and current ES was the primary outcome in this study.

Results: Data were analysed using Multilevel Logistic Regression Analysis (MLRA). The likelihood of EE was increased by exposure to ETS at home (OR 1.30 95% CI 1.01 to 1.67) and at school (OR 1.26 95% CI 1.00 to 1.60). The likelihood of EE was lower for males (OR 0.66 95% CI 0.51 to 0.84). The likelihood of ES was increased by ETS at home (OR 1.93 95% CI 1.43 to 2.59) and school (1.44 95% CI 1.09 to 1.90). The likelihood of ES was again lower for males (OR 0.56 95% CI 0.42 to 0.76). Smoking by mother/female guardian increased the likelihood of EE and ES, however, this was not significant in the multivariate analysis.

Conclusions: Symptoms of eczema were positively associated with exposure to ETS at home and school. The results support the hypothesis that ETS is an important factor in understanding the occurrence of eczema.

BACKGROUND

Eczema (or atopic dermatitis, AD) is a chronic, and the most frequent, inflammatory skin disease; it usually develops in childhood and can persist through to adulthood. It is characterised by dry skin, itchy rash and excoriation, and the condition affects 15–30% of children and 2–10% of adults. The term eczema describes skin diseases with common clinical characteristics involving a genetically determined skin-barrier defect. Decreased barrier function leads to increased water loss through the outermost layer of the skin, resulting in a decrease in water content of this particular layer of skin, increased permeability to hydrophilic substances, decreased ceramides in the skin and decreased barrier to infectious agents. Although not life-threatening, the condition may result in secondary infection and damage to the skin. The quality of life for those having the condition, particularly children and their caregivers, may be affected, for example, by lack of sleep and lack of concentration at school as a result of itching at night. Families of affected children have an extra financial burden to care for the affected child. The prevalence of eczema among children is reported to vary in different countries, with some countries experiencing an increase, and others with high prevalence undergoing a decline.

In Cape Town Province, South Africa, Zar et al reported an increase in the prevalence of eczema from 11.8% in 1995 to 19.4% in 2002, from two International Study of

Strengths and limitations of this study

- The use of a validated International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire, which has been used in many studies globally with consistent results.
- Large sample size of over 3000 children.
- The participation rate was high (92%).
- The results of the study might be higher than the actual prevalence since they are based on self-reported answers from the questionnaire and no objective measures were taken at the time of data collection.
Asthma and Allergies in Childhood (ISAAC) studies that were questionnaire based and conducted 7 years apart. The reason for the increase in the prevalence of eczema is not clearly understood. The pathogenesis of eczema is complex, involving an interaction between several factors, which may include, among others, genetics, socioeconomic status, lifestyle, diet, meteorological and living conditions at home, and environmental air pollutants, such as type of fuel used for cooking and heating in homes, and traffic-related air pollution and exposure to environmental tobacco smoke (ETS). 

Tobacco smoke is one of the most common indoor air pollutants. The literature, as early as in the 1970s, periodically reviewed ETS, or passive smoking and health. Children usually get exposed to tobacco smoke at home due to parents and other family members smoking, but also during transportation and in areas such as schools and restaurants. Although ETS has been considered to be a risk factor for eczema, the relationship between the two has not been sufficiently investigated. Studies have reported that smoking by the mother, or her exposure to smoke during pregnancy, may increase the risk of eczema during childhood.

Many studies focusing on eczema have been mainly reported from studies conducted in developed countries; little is known about the strength of such associations in developing countries such as South Africa. The aim of the study was to investigate the association of eczema ever (EE) and current eczema symptoms (ES) with ETS among children attending schools in urban areas of Tembisa and Kempton Park.

**METHODS**

**Study area**

The study was conducted in Tembisa and Kempton Park areas, situated in the northern region of the Ekurhuleni Metropolitan Municipality (EMM), located in the eastern region of Gauteng Province, South Africa. Tembisa is the second largest township in Gauteng Province, with both formal and informal housing; it is home to mainly African ethnic groups. Kempton Park is a suburban area and the residents are predominantly Caucasian; it has only been in recent years, after the 1994 democratic elections, that some, mostly middle income, African ethnic families have moved into the area.

**Study design, population and sample selection**

A cross-sectional epidemiological study was conducted between February and June 2012, following the ISAAC Phase I protocol. The ISAAC was designed as a multicentre study to investigate the epidemiology of asthma, rhinitis and AD among children, using standardised definitions, thus allowing comparisons worldwide. A list of all schools (primary and secondary) in EMM was provided by the Gauteng Department of Education. All primary schools were excluded and 16 high schools were randomly selected from the list. Each school was contacted and requested to participate in the study. Following the approval of the study by the principal and governing body in each school, all eligible children between the ages of 13 and 14 years and in grade 8 were requested to participate. An appointment was scheduled with the school to deliver the consent forms for the children 2 weeks prior to the study and the children were requested to return them within 3 days. The study population consisted of 3764 children, based on the numbers given by each school prior to data collection. Data were collected using the English versions of ISAAC written and video questionnaires. The questionnaires were completed by the children in the classroom under the supervision of the data collectors, who were specifically trained and briefed to avoid explanations that could interfere in the participant’s answers.

**Health outcomes**

In this study, we estimated health outcomes on the basis of positive answers from the written ISAAC questionnaire. Answers to written questions were self-reported by children.

1. Have you ever had an itchy rash that was coming and going for the past 6 months? (Yes/No)
2. Have you had this itchy rash at any time in the past 12 months? (Yes/No)
3. Has this itchy rash at any time affected any of the following places: the folds of the elbow, behind the knees, in front of the ankles, under the buttocks, or around the neck, ears, or eyes? (Yes/No)
4. Current ES were defined as those children who, according to the written questionnaire, responded positively to questions 1, 2 and 3.
5. EE: have you ever had eczema? (Yes/No)

**Air pollution sources and potential confounding variables**

Air pollution sources included: ETS exposure at home in the past 30 days (yes/no), ETS exposure at school in the past 30 days (yes/no), tobacco smoking by participant (yes/no), mother/father smoking tobacco (yes/no), any other person smoking at home other than participant (yes/no). The following potential confounding variables were included in the study, similar to other ISAAC studies, age, sex (male/female) and type of house (brick, mud, corrugated iron, combination); the children were asked to select the most frequently used energy source at home: for cooking (electricity, gas, paraffin, open fires) and for heating (electricity, gas, paraffin, open fires). The children were asked about the mode of transport to school (walking, taxi/bus, car, combination of car/taxi or train), the frequency of trucks passing near residences on weekdays (never, seldom, frequently through the day, almost all day). Other variables included in the questionnaire and reported in the descriptive analysis included: period lived in the residential area (<6 months, 6–12 months, 1–2 years, ≥3 years), being born in Tembisa/Kempton Park (yes/no) and availability of running water (yes/no).
Data management and statistical analysis
The data were entered into a database set up in EpInfo V.3.5.3 and Stata V.12 was applied for the data analysis. Prevalence rates for the each health outcome and proportion of risk factors under investigation were calculated by dividing the number of participants who responded affirmatively to a particular question, by the number of questionnaires completed. Observations marked as ‘do not know’, ‘not stated’ or ‘other responses’ were set as missing. This resulted in each question having a slightly different sample size. Crude and adjusted OR and 95% CI were calculated with Multilevel Logistic Regression Analysis (MLRA) with random effect to estimate the likelihood of having EE and current ES given ETS exposure variable.

The multilevel data included 16 schools within two residential areas (Kempton Park and Tembisa) at level 1. ETS and confounding variables were added in a stepwise manner, starting with the most significant from the univariate analysis. Each time a new potential confounder was added to the model, if the effect estimate between the exposure of interest and respiratory outcome already was added to the model, if the effect estimate between variables, the likelihood of ES was lower for boys (OR 0.56 95% CI 0.42 to 0.76). The use of taxi/bus as the mode of transport to school (OR 1.79 95% CI 1.27 to 2.59). Smoking by mother/female guardian increased the likelihood of EE, however, the association was not significant. Among the confounding variables, significant association was observed for sex, the likelihood of EE was lower for males (OR 0.66 95% CI 0.51 to 0.84), gas frequently used for heating at home (OR 1.76 95% CI 1.28 to 2.43) and frequency of truck passing near residences on weekdays, frequently throughout the day (OR 1.60 95% CI 1.03 to 2.51) and almost all day (OR 1.70 95% CI 1.13 to 2.54). The use of the motor car as mode of transport to school was significant in the univariate analysis, however, it was not significant in the multivariate analysis. No association was observed for age and type of house.

Table 4 summarises the results of the MLRA for current ES. The likelihood of current ES was significantly increased by exposure to ETS at home (OR 1.93 95% CI 1.43 to 2.59) and school (1.44 95% CI 1.09 to 1.90). Smoking by mother/female guardian increased the likelihood of current ES, however, this was not significant in the multivariate analysis. Among confounding variables, the likelihood of ES was lower for boys (OR 0.56 95% CI 0.42 to 0.76). The use of taxi/bus as the mode of transport to school (OR 1.79 95% CI 1.27 to 2.59). Smoking by mother/female guardian increased the likelihood of current ES, however, this was not significant in the univariate analysis. Among confounding variables, the likelihood of ES was lower for boys (OR 0.56 95% CI 0.42 to 0.76). The use of taxi/bus as the mode of transport to school (OR 1.79 95% CI 1.27 to 2.59). Smoking by mother/female guardian increased the likelihood of current ES, however, this was not significant in the univariate analysis. 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2.53) and the frequency of trucks passing near residences almost all day on weekdays (OR 1.95 95% CI 1.19 to 3.20). No association was observed for the age and type of house. Smoking by participant was not significant in either the univariate or the multivariate analysis, in the stepwise analysis; the inclusion of smoking by participant did not have an effect on the final model and was therefore left out.

**DISCUSSION**

The aim of the study was to investigate the association of EE and current ES with ETS among children attending schools in urban areas of Tembisa and Kempton Park, EMM. The prevalence of current ES in this study was 9.6%. In a cross-sectional study of centres participating in the ISAAC, the prevalence of eczema was from <1% in Albania to more than 17% in Nigeria for the age range of 13–14 years. High prevalence of ES was reported in Australia and Northern Europe, and lower prevalences were reported in Eastern and Central Europe, and Asia. Similar patterns were seen for symptoms of severe eczema. Some centres in Africa were reported to be among those with the highest prevalence of eczema. In Brazil, Porto Neto reported a prevalence of 13.6% for eczema in a study conducted among 2948 school children aged 13–14 years following the ISAAC methodology. The prevalence of current ES in this study is lower than that reported by the study conducted in Polokwane (17%) and the two studies conducted in Cape Town, 11.8% in 1995 and 19.4% in 2002. The slightly lower prevalence for this study might be attributable to the fact that the study area was situated in the Highveld region, with a higher altitude than Polokwane, which is in the Lowveld, while Cape Town is located on the coast.

The study found that EE and ES were positively associated with ETS exposure at home and school. For current ES, the risk of exposure appears to be much higher at home than at school (OR 1.93 at school vs 1.42 at home) as 42% of the children were exposed to tobacco smoke at home, while 34% were exposed at school. For ETS at home, the likelihood of ES was much higher in the adjusted model, OR 1.93 versus 1.33. The findings were in line with other studies that identified ETS as one of the most common indoor air pollutants; the home being the most important site of such exposure. The association between eczema and ETS exposure has been reported previously. The likelihood of current ES was also associated with smoking by participants.

**Table 1**

Demographic characteristics and household conditions of the study participants (n=3424)

| Variable                                    | Total | Percentage |
|----------------------------------------------|-------|------------|
| Age (years)                                 |       |            |
| 12                                           | 111   | 3.2        |
| 13                                           | 1582  | 46.2       |
| 14                                           | 1731  | 50.6       |
| Sex of child                                 |       |            |
| Female                                       | 1790  | 52.3       |
| Male                                         | 1634  | 47.7       |
| Residential area                             |       |            |
| Kempton Park                                 | 1117  | 32.6       |
| Tembisa                                      | 2301  | 67.2       |
| Missing                                      |       | 0.2        |
| Period lived in the residential area         |       |            |
| <6 months                                    | 253   | 7.4        |
| 6–2 months                                   | 216   | 6.3        |
| 1–2 years                                    | 346   | 10.1       |
| ≥3 years                                     | 2609  | 76.2       |
| Born in the areas of Tembisa and Kempton Park|       |            |
| Yes                                          | 1812  | 52.9       |
| No                                           | 1609  | 47.0       |
| Missing                                      | 6     | 0.2        |
| Type of house                                |       |            |
| Brick                                        | 2938  | 85.8       |
| Mud                                          | 45    | 1.3        |
| Corrugated iron                              | 184   | 5.5        |
| Combination                                  | 126   | 3.7        |
| Missing                                      | 126   | 3.7        |
| ETS exposure at residence in the past 30 days |       |            |
| Yes                                          | 1452  | 42         |
| No                                           | 1460  | 43         |
| Missing                                      | 512   | 15         |
| ETS exposure at school in the past 30 days   |       |            |
| Yes                                          | 1177  | 34.4       |
| No                                           | 1452  | 42.4       |
| Missing                                      | 755   | 23.2       |
| Residential cooking fuel type most frequently used |       |            |
| Electricity                                  | 2995  | 87.5       |
| Gas                                          | 179   | 5.2        |
| Paraffin                                     | 200   | 5.8        |
| Open fires (wood, coal)                      | 30    | 0.9        |
| Missing                                      | 20    | 0.6        |
| Residential heating fuel type most frequently used |       |            |
| Electricity                                  | 2041  | 59.6       |
| Gas                                          | 426   | 12.4       |
| Paraffin                                     | 631   | 18.4       |
| Open fires (wood, coal)                      | 270   | 7.9        |
| Missing                                      | 56    | 1.64       |
| Mode of transport to school                  |       |            |
| Walk                                         | 1728  | 50.5       |
| Informal taxi/Bus                            | 708   | 20.1       |
| Car                                          | 683   | 20         |
| Combination car and informal taxi           | 201   | 5.9        |
| Train                                        | 100   | 2.9        |
| Missing                                      | 4     | 0.1        |
| Frequency of trucks passing near homes on weekdays |       |            |
| Never                                        | 563   | 16.4       |
| Seldom                                       | 1033  | 30.2       |
| Frequently through the day                   | 580   | 16.9       |

ETS, environmental tobacco smoke.
mother/female guardian. Yi et al. found AD to be highly correlated with ETS among children whose mothers had smoked during pregnancy and/or in the first year after birth, in a study conducted in Korea among 7030 children between 6 and 13 years of age.

In a cross-sectional study conducted among 3153 Lebanese adolescents 13–14 years of age, females and passive smokers were at a 1.5 times risk of having eczema than their counterparts. An ecological analysis of ISAAC Phase I data from 463,801 children aged 13–14 years in 155 countries and in 257,800 children aged

| Table 2 | Self-reported prevalence of eczema symptoms (ES) among boys and girls aged 12–14 years (n=3424) |
|---------|---------------------------------------------------------------------------------------------|
| ES                           | Total | Females | Males |
| Ever had recurrent itchy rash in the past 6 months | 714 (20.9) | 418 (23.4) | 296 (18.2) |
| Itchy rash in the past year | 575 (16.8) | 349 (74.9) | 226 (67.3) |
| Ever had this rash in flexures | 343 (10.2) | 224 (12.5) | 119 (7.3) |
| Eczema ever | 481 (14.1) | 289 (16.2) | 192 (11.8) |
| Current eczema (ES) | 329 (9.6) | 214 (12.0) | 115 (7.0) |

| Table 3 | The prevalence of ever having had EE among the participants along with crude and adjusted ORs |
|---------|---------------------------------------------------------------------------------------------|
| Variable                          | Total* | EE (%) | Crude OR (95% CI)† | p Value | Adjusted OR (95% CI)† | p Value |
| Age (years)                       |        |       |                     |         |                     |         |
| 12                                | 111    | 16.2  | 1                    | 1       | 1.36 (1.10 to 1.68) | 0.003   |
| 13                                | 1577   | 13.8  | 0.80 (0.47 to 1.36) | 0.430   | 0.88 (0.43 to 1.77) | 0.721   |
| 14                                | 1726   | 14.1  | 0.85 (0.50 to 1.44) | 0.561   | 1.09 (0.54 to 2.20) | 0.804   |
| Sex                               |        |       |                     |         |                     |         |
| Female                            | 1784   | 16.2  | 0.69 (0.56 to 0.83) | 0.000   | 0.66 (0.51 to 0.84) | 0.001   |
| Male                              | 1630   | 11.8  |                     |         |                     |         |
| Type of house                     |        |       |                     |         |                     |         |
| Brick                             | 2928   | 14.11 | 1                    | 1       | 1.16 (0.51 to 2.62) | 0.716   |
| Mud                               | 45     | 15.56 |                     |         | 0.81 (0.23 to 2.75) | 0.738   |
| Corrugated iron                   | 189    | 15.34 | 1.19 (0.78 to 1.80) | 0.406   | 1.22 (0.71 to 2.12) | 0.459   |
| Combination                       | 126    | 12.70 | 0.85 (0.49 to 1.45) | 0.560   | 0.74 (0.39 to 1.39) | 0.352   |
| ETS exposure at home in the past 30 days |        |       |                     |         |                     |         |
| No                                | 1453   | 12.6  | 1                    | 1       |                     |         |
| Yes                               | 1449   | 16.2  | 1.36 (1.10 to 1.68) | 0.003   | 1.30 (1.01 to 1.67) | 0.038   |
| ETS exposure at school in the past 30 days |        |       |                     |         |                     |         |
| No                                | 1447   | 12.99 | 1                    | 1       |                     |         |
| Yes                               | 1175   | 16.34 | 1.29 (1.04 to 1.61) | 0.019   | 1.26 (1.00 to 1.60) | 0.050   |
| Mother/female guardian smoke cigarettes |        |       |                     |         |                     |         |
| No                                | 3028   | 13.38 | 1                    | 1       |                     |         |
| Yes                               | 342    | 20.18 | 1.55 (1.16 to 2.08) | 0.003   | 1.18 (0.80 to 1.73) | 0.394   |
| Fuel frequently used for heating at home |        |       |                     |         |                     |         |
| Electricity                       | 2033   | 12.7  | 1                    | 1       |                     |         |
| Gas                               | 425    | 19.5  | 1.62 (1.23 to 2.13) | 0.001   | 1.76 (1.28 to 2.43) | 0.000   |
| Paraffin                          | 631    | 14.3  | 1.25 (0.95 to 1.65) | 0.104   | 1.22 (0.85 to 1.75) | 0.273   |
| Open fires                        | 270    | 16.3  | 1.43 (1.01 to 2.03) | 0.043   | 1.40 (0.90 to 2.18) | 0.127   |
| Mode of transport to school       |        |       |                     |         |                     |         |
| Walk                              | 1723   | 12.71 | 1                    | 1       |                     |         |
| Taxi/bus                          | 705    | 14.18 | 1.13 (0.87 to 1.46) | 0.329   | 1.11 (0.80 to 1.54) | 0.511   |
| Motor car                         | 683    | 17.13 | 1.42 (1.11 to 1.81) | 0.005   | 1.24 (0.84 to 1.85) | 0.271   |
| Combination                       | 200    | 14.00 | 1.12 (0.73 to 1.71) | 0.587   | 0.97 (0.57 to 1.68) | 0.930   |
| Train                             | 99     | 17.17 | 1.44 (0.83 to 2.47) | 0.186   | 1.48 (0.77 to 2.85) | 0.232   |
| Frequency of trucks passing near homes on weekdays |        |       |                     |         |                     |         |
| Never                             | 562    | 12.28 | 1                    | 1       |                     |         |
| Seldom                            | 1030   | 14.08 | 1.10 (0.81 to 1.51) | 0.519   | 1.21 (0.81 to 1.81) | 0.347   |
| Frequently through the day        | 578    | 15.05 | 1.28 (0.91 to 1.08) | 0.151   | 1.60 (1.03 to 2.51) | 0.037   |
| Almost all day                    | 1208   | 14.57 | 1.27 (0.94 to 1.72) | 0.114   | 1.70 (1.13 to 2.54) | 0.010   |

*Total for each risk factor is different due to difference in missing values.
†Model adjusted for all the variables.
Values that are statistically significant at less than 0.02 for the crude OR and less than 0.05 for the adjusted OR are in bold font.
EE, eczema ever; ETS, environmental tobacco smoke.
6–7 years in 91 centres in 38 countries, found an association between several factors including smoking by women and the symptom prevalence of three conditions (asthma, rhinoconjunctivitis and eczema). In South Africa, in the study that was conducted in Polokwane Province, Wichmann et al. reported that the likelihood of having ES was significantly increased by 43% in rural areas and by 54% when exposed to tobacco smoke at home. The current study was conducted in Gauteng Province, 10 years after the Polokwane study; seemingly, exposure to tobacco smoke is still a problem in different communities in South Africa, with the home still the main environment where children are exposed to tobacco. This study was conducted in an urban setting where the majority of the children lived in formal housing, which may be one of the reasons for the lower prevalence than that in the Polokwane study.

Time spent in the school environment is second to the time children spend at home, and seems to be another area where children are exposed to tobacco smoke. Children start experimenting with cigarettes while in their early teens and rates of tobacco use among school children aged 13–15 years are high (WHO). The Global Tobacco Surveillance System Collaborative group has analysed a sample of 747 603 adolescents from different countries and continents, and report that the frequency of current tobacco use varies from 11.4% in the Western Pacific Region to 22.2% in the Americas, with a global average of 17.3%. In general, girls were reported to smoke less than boys both in the Americas and Europe, while in the leading regions the frequency is almost the same between genders.

In a study conducted in Israel, to investigate the association of smoking and exposure to ETS with prevalence of atopic eczema in a national sample of 10 298 children aged 13–14 years, Graif et al. reported a dose–response association between smoking and atopic eczema compared to those not smoking. Furthermore, tobacco smoking has been proposed to promote hand eczema; a large population-based study in Sweden reported an

| Variable                              | Total* | ES (%) | Crude OR (95% CI)† | p Value | Adjusted OR (95% CI) † | p Value |
|---------------------------------------|--------|--------|-------------------|---------|------------------------|---------|
| **Age (years)**                       |        |        |                   |         |                        |         |
| 12                                    | 111    | 16.22  | 1                 |         | 1                      |         |
| 13                                    | 1582   | 10.24  | 0.58 (0.34 to 0.99)| 0.046   | 0.67 (0.33 to 1.38)    | 0.289   |
| 14                                    | 1731   | 8.61   | 0.48 (0.28 to 0.82)| 0.007   | 0.63 (0.31 to 1.30)    | 0.219   |
| **Sex**                               |        |        |                   |         |                        |         |
| Female                                | 1790   | 12.0   | 0.55 (0.43 to 0.70)| 0.000   | 0.56 (0.42 to 0.76)    | 0.000   |
| Male                                  | 1634   | 7.0    |                   |         |                        |         |
| **Type of house**                     |        |        |                   |         |                        |         |
| Brick                                 | 2938   | 9.98   | 1                 |         | 1                      |         |
| Mud                                   | 45     | 8.89   | 0.89 (0.31 to 2.50)| 0.829   | 0.62 (0.14 to 2.72)    | 0.529   |
| Corrugated iron                       | 189    | 8.99   | 0.90 (0.54 to 1.50)| 0.699   | 0.67 (0.31 to 1.42)    | 0.301   |
| Combination                           | 126    | 5.56   | 0.53 (0.24 to 1.16)| 0.115   | 0.44 (0.17 to 1.12)    | 0.088   |
| ETS exposure at home in the past 30 days|        |        |                   |         |                        |         |
| No                                    | 1460   | 7.5    | 1                 |         | 1                      |         |
| Yes                                   | 1452   | 12.4   | 1.73 (1.34 to 2.22)| 0.000   | 1.93 (1.43 to 2.59)    | 0.000   |
| ETS exposure at school in the past 30 days|        |        |                   |         |                        |         |
| No                                    | 1452   | 8.6    | 1                 |         | 1                      |         |
| Yes                                   | 1177   | 11.6   | 1.40 (1.08 to 1.80)| 0.010   | 1.44 (1.09 to 1.90)    | 0.009   |
| Mother/female guardian smoke cigarettes|        |        |                   |         |                        |         |
| No                                    | 3037   | 9.10   | 1                 |         | 1                      |         |
| Yes                                   | 343    | 13.12  | 1.48 (1.06 to 2.08)| 0.020   | 1.48 (0.97 to 2.26)    | 0.067   |
| **Mode of transport to school**       |        |        |                   |         |                        |         |
| Walk                                  | 1728   | 8.2    | 1                 |         | 1                      |         |
| Taxi/bus                              | 708    | 12.3   | 1.56 (1.18 to 2.08)| 0.002   | 1.79 (1.27 to 2.53)    | 0.001   |
| Motor car                             | 683    | 9.8    | 1.21 (0.89 to 1.65)| 0.207   | 1.12 (0.75 to 1.66)    | 0.576   |
| Combination                           | 201    | 10.5   | 1.31 (0.80 to 2.12)| 0.273   | 1.29 (0.72 to 2.30)    | 0.389   |
| Train                                 | 100    | 12.0   | 1.55 (0.83 to 2.92)| 0.166   | 0.94 (0.39 to 2.26)    | 0.892   |
| **Frequency of trucks passing near homes on weekdays** | | | | | | |
| Never                                 | 563    | 7.3    | 1                 |         | 1                      |         |
| Seldom                                | 1033   | 9.5    | 1.33 (0.91 to 1.95)| 0.135   | 1.46 (0.89 to 2.41)    | 0.132   |
| Frequently through the day            | 580    | 9.3    | 1.30 (0.85 to 1.99)| 0.219   | 1.35 (0.77 to 2.36)    | 0.293   |
| Almost all day                        | 1212   | 11.1   | 1.59 (1.10 to 2.29)| 0.012   | 1.95 (1.19 to 3.20)    | 0.008   |

*Totals for each risk factor are different due to difference in missing values.
†Model adjusted for all the variables.
Values that are statistically significant at less than 0.02 for the crude OR and less than 0.05 for the adjusted OR are in bold font.
ES, eczema symptoms; ETS, environmental tobacco smoke.
association between heavy smoking and 1-year prevalence of hand eczema, and a dose–response relation was also indicated. Conversely, studies such as those by Fedortsiv et al., Ciaccio et al., Schafer et al., and Strachan and Cook did not observe any association between atopic eczema and tobacco smoke. The debate as to whether exposure to tobacco smoke is associated with atopic eczema warrants further investigation, as the aetiology of the disease may differ from one country to another due to other risk factors. While research on the matter still continues, policies that are currently available to protect the public and children against exposure to the harmful effects of tobacco smoke should be implemented and enforced. Health education programmes on the harmful effects of tobacco smoke should be strengthened with more resources allocated to such programmes; these should focus on school children.

Limitations of the study

Certain limitations should be taken into account in the interpretation of the results, which should be interpreted as a whole. First, the study had a cross-sectional epidemiological design, as in all ISAAC studies. Cross-sectional studies are weak in providing causation as they are subject to difficulties in interpreting the temporal sequence of events since health status and determinants are measured simultaneously. However, our findings are supported by other studies, as discussed previously. Second, the results of the study might be higher than the actual prevalence since they are based on self-reported answers from the questionnaire and no allergy testing was performed at the time of data collection.

Third, no quantitative exposure assessment was conducted as part of the study; the number of cigarettes smoked was not included. Fourth, only age, sex, type of house, mode of transport to school, fuel frequently used for cooking and heating at home, and the frequency of trucks passing near residences, were included as confounding variables, of which most were highly significant in the final multilevel model. This supports the hypothesis that the development of eczema is associated with many other factors, therefore, studies on ETS should explore the co-existence of such factors in the development and exacerbation eczema. Despite these limitations, this study will contribute to the existing literature because very little data are available on the prevalence of eczema specifically in Gauteng Province, South Africa. The strength of our study is mainly the use of a validated ISAAC questionnaire, which has been used in many studies globally, with consistent results. Furthermore, cross-sectional studies are important indicators of health problems occurring in communities and serve as a baseline for further analytical and experimental investigation. The study had a large sample size and the participation rate was very high, which eliminated the risk of selection bias.

CONCLUSION

The study found that eczema was associated with ETS at home and in school. In the literature, most studies investigating eczema in relation to tobacco smoke were cohort studies following children from birth up to the ages of 6–7 years; there are limited studies focusing on the age group of 13–14 years. Studies have also suggested that ETS is associated with increased health symptoms during infancy and that the effect diminishes with the increasing age of the child, however, the results of this study suggest the condition may persist until teenage years through to adulthood. Most epidemiological studies have been conducted in developed countries. The aetiology of the disease may differ from that of children in other parts of the country or children in developed countries. The results of this study will add to the number of limited studies in developed countries, such as South Africa. The baseline data will serve as a benchmark for future epidemiological studies to build more evidence on the effect of ETS on eczema, in order to inform and influence policy decisions and to protect the public against the harmful effects resulting from exposure to tobacco smoke.

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Correction

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