Research article

Epidemiology of eczema among adolescents aged 13-14 years from Anuradhapura, Sri Lanka: an analytical cross-sectional study

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Introduction
Eczema is an inflammatory skin condition with characteristic dry, itchy skin with visible lesions. The epidemiology of eczema among adolescents is distinct from that of children and adults.

Methodology
An analytical cross-sectional study recruited 13-14-year-old adolescents from government secondary schools in the Anuradhapura municipal council area, Sri Lanka. The validated International Study of Asthma and Allergy in Childhood questionnaire was used to assess the epidemiology of eczema including the association with demographic, domestic, dietary and allergen factors.

Results
The study sample consisted of 1029 participants(528 male, 501 female) with 826(80.3%) 13-year-olds and 203(19.7%) 14-year-olds. The majority were born in the Anuradhapura district(n=931, 90.5%). One hundred and twenty-eight(12.4%) adolescents have had at least one episode of an itchy rash that was periodical at least for six months and 72(7.0%) had a rash in the preceding year. Most of the adolescents developed these symptoms after 5 years of age(n=55, 76.4%). The prevalence of eczema was 3.2%(n=33, 95%CI 2.1–4.3). Comorbid severe asthma (OR 6.7; 95%CI 3.16-14.07), using kerosene lamps for lighting (OR 6.35; 95%CI 1.79-22.54), having close contact with domestic animals (OR 2.29; 95%CI 1.03-5.09), presence of smokers in the house(OR 2.58; 95%CI 1.04-6.40) and female sex(OR 1.95; 95%CI 0.92-4.12) were independently associated with eczema.

Conclusion
The prevalence of eczema among adolescents of the Anuradhapura municipal council area was 3.2% and it is not different from previously reported prevalence in preschool children of the district. Identified independently associated factors could be used for targeted public health interventions.

Keywords: Eczema, Adolescents, Epidemiology, Rural health

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Introduction

Eczema or atopic dermatitis is a common non-contagious skin disorder characterized by dry, itchy skin with visible lesions most prominently in the back of knees, inside of elbows and neck. This inflammatory skin condition mostly affects children and adolescents. Globally, eczema affects 200 million people [1] with higher numbers reported in developed countries [2]. Generally, eczema begins in the first year of life, however, the first symptoms may appear later [3]. Furthermore, the symptoms of eczema tend to remit and relapse over a long period [4]. The prevalence of eczema among children, adolescents and adults varies because although eczema tends to resolve as the child ages, it may persist to adolescence and even into adulthood [3,5]. A recent study conducted in the United Kingdom showed that the highest prevalence of eczema was among children aged 1-4 years and a gradual decline into adolescence and adulthood [6].

Eczema is caused by defective skin barrier function. Susceptible genetic background with Filaggrin null mutations is seen in eczema [7]. However, genetics is not solely responsible for complex interaction between genetic and environmental factors hypothesized in the pathophysiology of eczema [8]. Eczema is strongly associated with asthma and allergic rhinitis forming a triad of atopic diseases very common in children, adolescents and even adults. The factors associated with eczema differ with age and the subtype of eczema [9]. The factors associated with eczema in different populations require further exploration.

In most countries including Sri Lanka, the International Study of Asthma and Allergy in Childhood (ISAAC) is the only large-scale study conducted to assess the epidemiology of eczema among children and adolescents [10]. However, the epidemiology of eczema among adolescents from the dry zone of Sri Lanka has not been adequately studied. Adolescence is a critical period in life where significant physical, emotional and social change occur and eczema is a stigmatizing condition with a significant effect on the quality of life. Therefore, this study was conducted to determine the prevalence and the factors associated with eczema among adolescents aged 13-14 years from the municipal council area of Anuradhapura, Sri Lanka.

Table 1: Standard definitions recommended by the International Study of Asthma and Allergy in Childhood steering committee

Term	Definition
Eczema	Positive response to the three questions “Has your child ever had an itchy rash which was periodical at least for 6 months?”, “Has your child had this itchy rash at any time in the past 12 months?” and “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?”.
Allergic rhinitis	Positive response to the question “In the past 12 months has your child had a problem with sneezing or runny nose or blocked nose when he/she did not have a cold or the flu?”
Current wheeze	Positive response to the question “Has your child ever had wheezing or whistling in the chest in the past 12 months?”
Severe asthma	Positive response to the question “Has your child ever had ≥ 4 wheezing episodes or wheeze affecting speech or ≥ 1 night per week sleep disturbance?” in current wheezers

Methodology

An analytical cross-sectional study was conducted in grade 8 classes of government schools located in the Anuradhapura municipal council area, Sri Lanka to assess the epidemiology of atopic diseases among adolescents aged 13-14 years. Nine government secondary schools registered in the Department of Education, North Central province and located in the Anuradhapura municipal council area cater for 5365 students in grade 8 and 9 classes. The grade 8 classes of six secondary schools were selected with multistage sampling until a minimum sample size of 847 was achieved. A precision of 2% and a dropout rate of 10% were considered in calculating the minimum sample size. As this study also assesses the epidemiology of asthma and allergic rhinitis, the national prevalence of asthma among 13-14-year-old adolescents was used to calculate the sample size [10]. Ethical approval was obtained from the Ethics Review Committee, Faculty of Medicine and Allied Sciences, Rajarata University of Sri Lanka (ERC/2022/42) and administrative approval was obtained from the Provincial Department of Education of the North Central Province, Zonal Education office of Anuradhapura, and principals of each school.

Participant information sheets, consent forms, and assent forms in the native languages (Sinhalese and Tamil) were provided to the parent(s) or guardian(s) through schools and informed written consent was obtained. Assent was obtained from study participants whose parent(s) or guardian(s) provided informed

written consent at the school classrooms. Validated native language translations of the ISAAC questionnaire for 13-14 years of adolescents were provided to assess the prevalence of eczema and associated factors (Supplementary material 1) [11]. The standard definitions of eczema, allergic rhinitis and severe asthma recommended by the ISAAC steering committee were used (Table 1). The chi-square test was used to determine the statistical significance of factors associated with eczema. Significance was taken at a p-value less than 0.05. Factors associated with eczema with a p-value less than 0.20 were included in a multivariate binary logistic regression to identify independently associated factors

Table 2: Factors associated with eczema among 13-14-year-old adolescents in Anuradhapura municipal council area, Sri Lanka (N=1029)

Risk factor	Adolescents with eczema		Adolescents without eczema		Significance (p value)	Unadjusted odds ratio	95% CI	
	N	%	N	%			Lower	Upper
Demographic factors								
Female gender	20	60.61	481	48.29	0.16[a]	1.65	0.81	3.35
Born in Anuradhapura	30	90.91	901	90.46	1.00[b]	1.05	0.32	3.52
Housing conditions (having)								
cement floor	20	60.61	560	56.22	0.62[a]	1.20	0.59	2.44
marble tiled floor	13	39.39	427	42.87	0.69[a]	0.87	0.43	1.76
clay tile roof	6	18.18	200	20.08	0.74[a]	0.86	0.35	2.11
asbestos roof	26	78.79	726	72.89	0.58[a]	1.27	0.54	2.96
plastered walls	31	93.94	981	98.49	0.10[b]	0.24	0.05	1.08
Exposure to allergens								
Domestic dogs	25	75.76	627	62.95	0.32[a]	1.51	0.67	3.38
Domestic cats	17	51.52	369	37.05	0.09[a]	1.81	0.90	3.62
Domestic birds	10	30.30	162	16.27	**0.03**[a]	2.24	1.05	4.79
cattle	1	3.03	11	1.10	0.33[b]	2.80	0.35	22.34
Ornamental fish	1	3.03	14	1.41	0.389[b]	2.19	0.28	17.18
Close contact with domestic animals	24	72.73	534	53.61	**0.03**[a]	2.31	1.06	5.01
Exposure to smokers at home	7	21.21	87	8.73	**0.03**[b]	2.81	1.19	6.67
Frequent use of mosquito coils	9	27.27	308	30.92	0.66[a]	0.84	0.39	1.82
Frequent use of kerosene lamps	4	12.12	20	2.01	<**0.01**[b]	6.73	2.16	20.95
Frequent use of incense burners	24	72.73	640	64.26	0.32[a]	1.48	0.68	3.23
Using liquid petroleum gas for cooking	16	48.48	567	56.93	0.34[a]	0.71	0.36	1.43
Using firewood for cooking	14	42.42	315	31.63	0.19[a]	1.59	0.79	3.22
Using electricity as cooking	6	18.18	128	12.85	0.37[a]	1.51	0.61	3.72
Sleeping on a rubber mattress	29	87.88	920	92.37	0.32[b]	0.60	0.21	1.75
Sleeping on a rubber-mixed coir mattress	4	12.12	70	7.03	0.29[b]	1.83	0.62	5.33
Physical activity (playing)								
4-6 times a week	4	12.12	122	12.25	1.00[b]	0.99	0.34	2.86
2-3 times a week	10	30.30	272	27.31	0.70[a]	1.16	0.54	2.46
once a week	3	9.09	205	20.58	0.11[a]	0.39	0.12	1.28
once a month	5	15.15	88	8.84	0.21[b]	1.84	0.69	4.89
Dietary habits (frequent consumption of[c])								
pineapple	1	3.03	62	6.22	0.72[b]	0.47	0.63	3.50
tomato	6	18.18	286	28.71	0.71[b]	0.55	0.23	1.35
tuna fish	13	39.39	296	29.72	0.23[a]	1.54	0.76	3.13
king coconut	4	12.12	122	12.25	1.00[b]	0.99	0.34	2.86
sour banana	7	21.21	190	19.08	0.76[a]	1.14	0.49	2.67
ladies' fingers	8	24.24	218	21.89	0.75[a]	1.14	0.51	2.57
curd	5	15.15	93	9.34	0.23[b]	1.73	0.65	4.60
milk powder	13	39.39	302	30.32	0.27[a]	1.49	0.73	3.04
ridge gourd	4	12.12	129	12.95	1.00[a]	0.92	0.32	2.68
Centella	7	21.21	259	26.00	0.54[a]	0.77	0.33	1.79
Other disease conditions								
Comorbid severe asthma	14	42.42	97	9.74	**<0.01**[a]	6.83	3.32	14.05
Comorbid allergic rhinitis	15	45.45	251	25.20	**0.01**[a]	2.47	1.23	4.98

[a] χ^2 test
[b] Fisher's exact test
[c] Frequent consumption is defined as consuming more than twice a week.

Results

The study sample consisted of 1029 participants (528 male and 501 female) with 826 (80.3% 13-year-olds and 203 (19.7%) 14-year-olds. The majority were born in the Anuradhapura district (n=931, 90.5%). One hundred and twenty-eight (12.4%) adolescents have had at least one episode of an itchy rash that was periodical at least for six months and 72 (7.0%) had a rash in the preceding year. Most of the adolescents with recurrent itchy rash developed symptoms after 5 years of age (n=55, 76.4%) and 13 (8.1%) developed symptoms when aged less than 2 years while only 4 (5.6%) developed during 2-4 years. The itchy rash was reported in the folds of the elbows, behind the knees, in front of the ankles, under the buttocks, or around the neck, ears or eyes by 42 (4.1%) of the adolescents. The prevalence of eczema was 3.2% (n=33, 95%CI 2.1 – 4.3) Most of the participants did not have sleep disturbance due to eczema (n=21, 63.6%) and twelve (36.4%) adolescents had less than weekly sleep disturbance.

The association of demographic, household, dietary, activity levels and known allergens with eczema in this study sample is presented in Table 2. The well-known associations of eczema, severe asthma, and allergic rhinitis were observed (Figure 1). Thereafter, independently associated factors for eczema were assessed using multivariate binary logistic regression analysis (Table 3). Comorbid severe asthma (adjusted OR 6.67), using kerosene lamps for lighting (adjusted OR 6.35), close contact with domestic animals (adjusted OR 2.29), presence of smokers in the house (adjusted OR 2.58) and female sex (adjusted OR 1.95) were independently associated with eczema.

Table 3: Independently associated factors for eczema among 13-14-year-old adolescents in Anuradhapura municipal council area, Sri Lanka (N=1029)

Factor	Significance	Adjusted odds ratio	95% confidence interval	
			Lower	Upper
Severe asthma	<0.01	6.67	3.16	14.07
Using kerosene lamps for lighting	<0.01	6.35	1.79	22.54
Close contact with animals	0.04	2.29	1.03	5.09
Presence of smokers at home	0.04	2.58	1.04	6.40
Female sex	<0.01	1.95	0.92	4.12

Discussion

This study explored the epidemiology of eczema among adolescents aged 13-14 years from the Anuradhapura municipal council area. The prevalence of eczema was 3.2%. The study found that eczema was independently associated with severe asthma, female sex, exposure to passive smoking, using kerosene oil for cooking and having close contact with animals in this population.

The eczema prevalence in children aged 6-7 years ranges from 0.9% in India to 22.5% in Ecuador whereas the prevalence among adolescents aged 13-14 years varies from 0.2% in China to 24.6% in Columbia [12]. The prevalence of eczema among adolescents in this study sample (3.2%) was lower than the prevalence reported by the ISAAC study conducted in Sri Lanka among children aged 6-7 years (7.2%) and adolescents aged 13-14 years (7.7%) [10]. The prevalence of eczema in urban Sri Lankan preschool children from the Western province was 5% (95%CI 3.1-7.0) [13] whereas it was 3.3% (95%CI 2.2-4.4) among preschool children of Anuradhapura district [14]. Interestingly, the prevalence of eczema among preschool children and adolescents is not statistically significant (p=0.89) although eczema prevalence it is expected to reduce with age until later stages of life [3,5]. A multinational cross-sectional study representing North America, South America, Europe, the Middle East and Eurasia reported that the prevalence of eczema among children aged 6 months to 6 years (12.1%), 6 years to 12 years (13.0%) and 12-18 years (14.8%) that did not significantly reduce with increasing age which may be due to an underreporting of the disease at young ages [15]. Similarly, a meta-analysis of 7 longitudinal cohort studies from Northern Europe showed that the prevalence of eczema was similar among children and adolescents [16]. However, the selected longitudinal cohorts were not designed specifically to assess eczema, have high rates of dropouts which may not be random and lack of assessment of disease severity, treatment and other skin conditions. The Global Asthma Network Phase I study, which included 122,268 participants from 27 centres in 14 countries, reports a higher increase in prevalence of eczema among children aged 6-7

years (1.21%; 95%CI 0.18%-2.24% per decade) compared to adolescents aged 13-14 years (0.98%; 95%CI 0.014%-1.92%) [17]. Furthermore, a study comparing the prevalence of eczema among adolescents aged 13-14 years from the Anuradhapura and the Kandy districts reported a lower prevalence in the Anuradhapura district (1.8%; 95%CI 1.38-2.34) compared to the Kandy district (7.3%; 95%CI 6.15-8.65) [18]. However, the current study reports a significantly higher prevalence of eczema among adolescents aged 13-14 years from the Anuradhapura ($p<0.01$) which may be because the current study was conducted in the municipal council area.

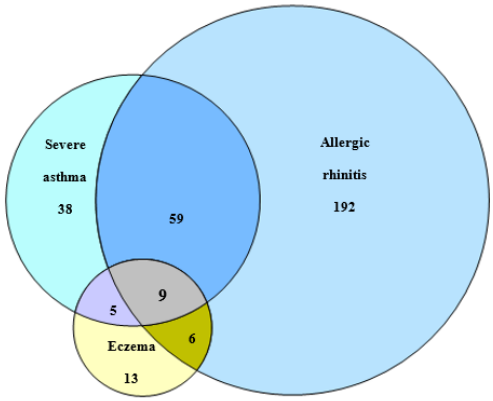

Figure 1: Association of Eczema with severe asthma and allergic rhinitis among 13-14 year old adolescents in Anuradhapura municipal council area in Sri Lanka (N=1029)

Asthma, allergic rhinitis and eczema form the triad of atopic diseases affecting children and adolescents [19] and this well-known association between severe asthma and eczema was also observed in this study. The female sex was independently associated with eczema in the current study sample in concurrence with current evidence. In childhood the prevalence of eczema is similar among males and females, however, in adults, the prevalence is higher among females [7]. The extensive global asthma network study (phase I) conducted in 25 countries between 2015 and 2020 using the ISAAC questionnaire reported that the prevalence of eczema among adolescent females was double that of males [20]. Exposure to passive smoking was an independently associated factor for eczema as shown in other studies [21]. However, the association between exposure to smoking and eczema is still under investigation [22]. Interestingly, the use of kerosene oil lamps for lighting in houses was independently associated with eczema. Repeated skin exposure to kerosene oil is known to cause eczema. However, the current study does not assess the nature of exposure to kerosene oil and suggests future research to explore this association. The known association of close contact with domestic and eczema was observed in the current study [23].

Limitations of the current study include the following. This is a cross-sectional study and, therefore, could only assess the association between factors affecting eczema. Further research is required to ascertain the causative relationship between these factors and eczema. Furthermore, this study did not assess the time, duration and extent of exposure to risk factors. Only the frequency of consumption of selected food items popularly believed in Sri Lanka to exacerbate eczema was assessed. Further studies are required to assess in detail the portion size, the interval between consumption, the effects of long-term consumption and other relevant dietary factors of the food items the current study revealed to be significantly associated with allergic rhinitis. In addition, the symptoms of eczema may be under control in adolescents currently undergoing treatment. Diagnosis and current management of eczema were not assessed in the current study.

In conclusion, this study shows a significantly higher prevalence rate of eczema among adolescents from the dry zone of Sri Lanka than previously known which highlight the importance of future studies being conducted at local and national level to assess the epidemiology of eczema. Furthermore, the current study shows the prevalence of eczema is not statistically significantly different between preschool children of the district and the adolescents of this study sample. Eczema was independently associated with severe asthma, exposure to passive smoking, using kerosene oil lamps for lighting and having close contact with domestic animals. The authors recommend targeted public health interventions in the region based on identified independently associated factors.

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