Original Article

Prevalence and potential risk factors of rhinitis and atopic eczema among schoolchildren in Vientiane capital, Lao PDR: ISAAC questionnaire

Outavong Phathammavong[1], Moazzam Ali[1], Alongkon Phengsavanh[2], Douangphachanh Xaysomphou[1], Hiroshi Odajima[3], Sankei Nishima[3], Chushi Kuroiwa[1,*]

[1] *Department of Health Policy and Planning, School of International Health, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan;*
[2] *The University of Health Sciences, Ministry of Health, Vientiane, Lao PDR;*
[3] *Fukuoka National Hospital, Fukuoka, Japan.*

Summary **In 1998, an epidemiological study on asthma and allergic diseases using ISAAC questionnaire in Laos was first conducted in the recommended schools located in Vientiane capital showing that the prevalence of rhinoconjunctivitis and atopic eczema were 23.7% and 7.1% among children aged 13-14 year-old, respectively. This study aimed to reassess the prevalence of rhinoconjunctivitis and atopic eczema using the same ISAAC questionnaire by employing random sampling method and to identify the potential risk factors for these rhinitis and atopic eczema. This school-based cross-sectional study was conducted in Vientiane capital from December 2006 to February 2007. Of 536 children, prevalence of rhinoconjunctivitis and atopic eczema among schoolchildren were 9.3% and 11.8%, respectively. Children with early respiratory infection (AOR = 4.06; p = 0.001), parasitic infestation especially by *Opisthorchis viverrini* (AOR = 3.41; $p < 0.05$) were more likely to have rhinitis. While history of measles (OR = 2.24; $p < 0.01$) and respiratory infection (OR = 1.96; $p < 0.05$), eating vegetables everyday (AOR = 2.96; $p < 0.01$) were associated with atopic eczema. The similarity of prevalence of rhinitis and rhinoconjunctivitis were also revealed between children aged 13-14 year-old in this study and 6-7 in the previous study in 1998. The validation study on ISAAC questionnaire in Lao language is needed in order to generalize this questionnaire in Lao.**

Keywords: Allergic diseases, Risk factors, Schoolchildren, ISAAC questionnaire, Laos

1. Introduction

High prevalence of allergies among children was observed in many developed countries. In 1990, the international study on asthma and allergies in childhood (ISAAC) questionnaire was developed providing the comparability of prevalence of asthma and allergies among schoolchildren aged 6-7 year-old and 13-14 in different areas around the world (*1*). Based on this standard questionnaire, the international study was conducted in 155 collaborating centers in 56 countries worldwide, and questionnaire was translated into 39 local language (*2*,*3*). In 2000, the worldwide variation of the prevalence of rhinoconjunctivitis and atopic eczema among children aged 13-14 year-old was demonstrated that the highest was reported in Nigeria (39.8% and 17.7%, respectively) and the lowest in Albania (4.0% and 0.8%) (*3*). These prevalence were consequently observed in many developing countries such as Brazil (*4*), Costa Rica (*5*), Turkey (*6*), Thailand (*7*,*8*) and Viet Nam (*9*) using this standard questionnaire.

**Correspondence to:* Dr. Chushi Kuroiwa, Department of Health Policy and Planning, School of International Health, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan;
e-mail: ckuroiw@m.u-tokyo.ac.jp

In 1998, an epidemiological study on asthma and allergic diseases using ISAAC questionnaire in Laos was first conducted in Vientiane capital, showing that the prevalence of rhinitis, rhinoconjunctivitis and atopic eczema among children aged 13-14 year-old were 49.1%, 24.4% and 7.1%, respectively (*10*). The prevalence of rhinoconjunctivitis in this study was higher than some western countries such as New Zealand (18.9%), Australia (19.6%), UK (18.5%), USA (18.9%), as well as Asian countries such as South Korea (10.2%), Japan (14.8%), Indonesia (5.3%), Philippines (15.3%), Thailand (15.5%), Malaysia (13.7%) and Singapore (15.1%) (*3*).

This high prevalence of rhinoconjunctivitis in Laos would have been due to the schools (3 elementary schools and a high school) were non-randomly recruited. Therefore, in this study, the random sampling technique was employed to select schools which were located in the highest densely populated area and to recruit the schoolchildren, aiming at ensuring the representation of schoolchildren in Vientiane capital. The objectives of this study were to reassess the prevalence of rhinitis, rhinoconjunctivitis and atopic eczema and to identify the risk factors for rhinitis and atopic eczema among schoolchildren residing in Vientiane capital, Lao PDR.

2. Methods

2.1. *Study design*

The school based, cross-sectional survey was conducted in the highest densely populated area in Vientiane capital from December 2005 to February 2006. Four elementary and 4 high schools located in this area, and the students aged 13-14 year-old and the parents of students aged 6-7, were recruited by using multistage random sampling: schools were selected using simple random sampling method; while students were selected using systematic random sampling method. The ethical consideration of this study was approved by the University of Tokyo in Japan and the University of Health Sciences, Ministry of Health in Laos. The participants were requested to give the written informed consent before the study was conducted.

2.2. *Data collection*

The original English version of standard ISAAC questionnaire was translated into Lao language by a Laotian researcher in Japan. Additional questions were included into the core questionnaire to investigate the socio-demographics and potential factors which might influence the development of allergies among these children. Two day training course for research assistants and the pilot study was conducted in Vientiane. The questionnaire was revised and back translated by Laotian research assistants in Laos. The face to face interview using ISAAC questionnaire was conducted to students aged 13-14 year-old, and to parents of students aged 6-7 by the trained assistants. The stool examination was performed to investigate the association between allergies and parasitic infestation, so the stool containers were distributed to all participated students and they were requested to bring their stool to the school on the next day.

2.3. *Operational Definition*

The questionnaire was developed mainly based on the English version of ISAAC questionnaire; however, the additional questions exploring the socio-demographic, hygiene behavior, history of infection and eating habit were also included in the main questionnaire for this study.

According to the ISAAC questionnaire, the study therefore defined rhinitis, rhinoconjunctivitis and atopic eczema as follows:

Rhinitis ever:	*Ever had a problem with sneezing, runny, or blocked nose when did not have cold or the flu*
Rhinitis:	*Had a problem with sneezing, runny, or blocked nose when did not have cold or the flu in the past 12 months*
Rhinoconjunctivitis:	*Had a problem with sneezing, runny, or blocked nose when did not have cold or the flu eyes in the past 12 months had been companied by itchy-watery*
Atopic eczema ever:	*Ever had an itchy rash which was coming and going for at least six months*
Atopic eczema:	*Had an itchy rash at any time in the past 12 months*

2.4. *Data analysis*

All data were entered and cleaned in SPSS version 12.01 for window (SPSS Inc., Chicago, IL, USA). The descriptive analysis, Chi-square test and binary logistic regression were employed. Because a few statistically significant differences between rhinitis and atopic eczema, and its potential risk factors were observed, the variables such as socio-demographic, environment, family history of allergies, history of infection and eating habit were input into logistic regression model (Table 3 and 4), and the binary logistic regression was performed backwardly. The *p*-value of less than 0.05 was considered to be statistically significant difference.

3. Results

3.1. *Socio-demographics*

Five hundred thirty six children were recruited in this study. Of these, 186 (34.7%) were children aged 6-7 year-old and 350 (65.3%) were 13-14. Three hundred nine (57.6%) were female, and 535 (97.9%) children were lowland Lao. Of the 536 children, 299 (58.1%) of stool samples were collected from the children.

3.2. *Prevalence of rhinitis*

Of the 536 children, 32.5% children reported on having rhinitis ever, of which 30.1% of 186 children aged 6-7 year-old and 33.7% of 350 children aged 13-14 (Table 1). The prevalence of rhinitis was 21.8% (21.0% of younger children and 22.3% of older). Fifty (9.3%) were rhinitis accompanied with conjunctivitis (rhinoconjunctivitis), in which 7.5% of younger children and 10.3% of older. It was also inline with the prevalence of hay fever of 24.1%, with 23.7% for younger children and 24.3% for older.

The prevalence of rhinitis by month in 2005 is shown in Figure 1. The seasonal pattern of the prevalence was peaked in November and December which were 28.4% and 31.4%, respectively. On the other hand, April and March had the lowest prevalence of only 1.5%.

3.3. *Prevalence of atopic eczema*

Of the 536 children, 15.9% children had experience with atopic eczema ever; 16.7% for children aged 6-7 year-old and 15.4% for children aged 13-14 (Table 1). The prevalence of atopic eczema was 11.8%, in which 13.4% of younger children 10.9% of older. Forty two (7.8%) children reported on having atopic dermatitis ever, in which 16 (8.6%) of younger children and 26 (7.4%) of older.

3.4. *Risk factors for rhinitis*

The bivariate analyses were performed to identify factors associated with having rhinitis; however, only a few factors showed the statistically significant association. In Table 2, children who were from low income family were less likely to have rhinitis in the past 12 months (OR = 0.57; $p = 0.01$); while, children who had history of respiratory infection (OR = 1.64; $p < 0.05$) and those who were infested by *Opisthorchis viverrini* (OR = 1.88; $p < 0.05$), were more likely to have rhinitis.

Because a few variables showed the statistical association with rhinitis, the variables such as socio-demographic, environment, family history of allergies, history of infection and eating habit were input into logistic regression model (Table 3); and the results have

Table 1. The prevalence of rhinitis, atopic eczema, and severity among schoolchildren: Result from ISAAC questionnaire

		Total (*n* = 536)		**6-7 ys (*n* = 186)**		**13-14 ys (*n* = 350)**	
		n	**%**	***n***	**%**	***n***	**%**
Rhinitis ever	Yes	174	32.5	56	30.1	118	33.7
	No	362	67.5	130	69.9	232	66.3
If "yes"							
Rhinitis	Yes	117	21.8	39	21.0	78	22.3
If "yes"							
Rhinoconjunctivitis	Yes	50	9.3	14	7.5	36	10.3
	No	67	12.5	25	13.4	42	12.0
Interfere with your daily activities	Not at all	45	8.4	24	12.9	21	6.0
	A little	51	9.5	9	4.8	42	12.0
	A moderate	14	2.6	4	2.2	10	2.9
	A lot	2	0.3	0	0	2	0.6
	Missing	5	0.9	2	1.1	3	0.9
Hay fever	Yes	129	24.1	44	23.7	85	24.3
	No	403	75.2	141	75.8	262	74.9
	Missing	4	0.7	1	0.5	3	0.8
Atopic eczema ever	Yes	85	15.9	31	16.7	54	15.4
	No	451	84.1	155	83.3	296	84.6
If "yes"							
Atopic eczema	Yes	63	11.8	25	13.4	38	10.9
If "yes"							
Body rash	Yes	52	9.7	20	10.8	32	9.1
	No	8	1.5	3	1.6	5	1.4
	Missing	3	0.6	2	1.1	1	0.3
Precise skin rash	Yes	53	9.9	19	10.2	34	9.7
	No	7	1.3	4	2.2	3	0.9
	Missing	3	0.6	2	1.1	1	0.3
Frequency of skin rash	0	22	41.0	10	5.4	12	3.4
(night/week)	< 1	28	4.2	8	4.3	20	5.7
	≥ 1	13	2.4	7	3.8	6	1.7
Atopic dermatitis ever	Yes	42	7.8	16	8.6	26	7.4
	No	485	90.5	168	90.3	317	90.6
	Missing	9	1.7	2	1.1	7	2.0

shown that children who were from high income family (AOR = 2.23; $p < 0.05$), eating eggs more than once a week (AOR = 3.47; $p < 0.05$), history of respiratory infection (AOR = 4.06; $p = 0.001$), parasitic infestation by *Opisthorchis viverrini* (AOR = 3.41; $p < 0.05$) were more likely to have rhinitis compared to other.

3.5. *Risk factors for atopic eczema*

The bivariate analyses were also performed to identify risk factors for atopic eczema; once again, however, only a few risk factors were identified. As the Table 2 shown, children with history of measles infection (OR = 2.24; $p < 0.01$) and respiratory infection (OR = 1.96; $p < 0.05$) were more likely to have atopic eczema. Moreover, children who spend more than 30 minutes on the road per day, were more likely to have atopic eczema (OR = 1.95; $p < 0.05$).

Similar to rhinitis, all variables were input into logistic regression model (Table 4); and the results have shown that children who eat vegetables everyday were more likely to have atopic eczema (AOR = 2.96; $p <$

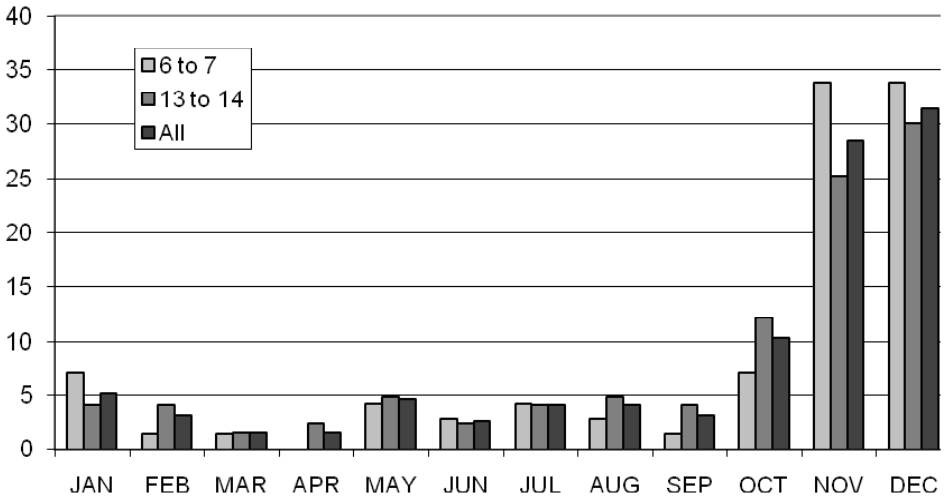

Figure 1. The prevalence of rhinitis by month in year 2005 among schoolchildren residing in Vientiane capital city, Lao PDR.

Table 2. Factors affecting rhinitis and atopic eczema in the past 12 months

	Rhinitis (*n* = 117)		Atopic eczema (*n* = 63)	
	n	**OR (95% CI)**	***n***	**OR (95% CI)**
Demographic status				
Boy	50	1.01 (0.67 - 1.53)	28	1.11 (0.65 - 1.88)
Younger children (6-7 ys)	39	0.92 (0.60 - 1.42)	25	1.27 (0.74 - 2.18)
High income family	48	1.74 (1.14 - 2.67) *	17	0.78 (0.43 - 1.40)
No sibling	6	0.65 (0.27 - 1.60)	5	1.19 (0.44 - 3.16) †
First child	44	0.93 (0.61 - 1.43)	25	1.04 (0.60 - 1.79)
Environmental factors				
Dog ownership	46	0.97 (0.64 - 1.48)	22	0.80 (0.46 - 1.38)
Cat ownership	26	1.30 (0.78 - 2.14)	10	0.78 (0.38 - 1.60)
Feeding chicken/duck	38	0.94 (0.61 - 1.46)	21	1.02 (0.58 - 1.78)
Contact pet > 1 per week	43	0.85 (0.55 - 1.29)	25	1.03 (0.60 - 1.78)
Time on road (> 30 minutes)	49	0.89 (0.59 - 1.34)	37	1.95 (1.15 - 3.33) *
Sharing bed	77	0.69 (0.44 - 1.07)	50	1.65 (0.85 - 3.20)
Air condition used	23	1.12 (0.66 - 1.88)	11	0.91 (0.45 - 1.81)
Parent smoke	46	1.16 (0.76 - 1.76)	24	1.10 (0.64 - 1.90)
Family history of asthma				
Parental asthma and allergy	6	2.23 (0.79 - 6.28) †	3	1.78 (0.49 - 6.44) †
Sibling asthma and allergy	5	1.63 (0.55 - 4.78) †	3	1.83 (0.51 - 6.62) †
History of infection in the past				
Measles infection	12	0.57 (0.30 - 1.09)	17	2.24 (1.21 - 4.14) **
Respiratory infection	37	1.64 (1.04 - 2.59) *	23	1.96 (1.11 - 3.45) *
Food				
Fish ≤ 1 day per week	27	1.04 (0.64 - 1.70)	17	1.34 (0.74 - 2.43)
Milk >1 day per week	59	1.25 (0.83 - 1.88)	28	0.93 (0.55 - 1.58)
Vegetable sometimes	43	0.72 (0.47 - 1.10)	25	0.86 (0.50 - 1.47)
Egg > 1 day per week	95	1.18 (0.70 - 1.99)	52	1.30 (0.65 - 2.58)
Intestinal parasitic infestation (*n* = 299)				
Ascaris lumbricoides	10	0.76 (0.36 - 1.60)	9	1.06 (0.48 - 2.35)
Opisthorchis viverrini	19	1.88 (0.99 - 3.54) *	3	0.36 (0.11 - 1.22) †

Pearson Chi-Square Test; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; † Fisher's Exact Test

Table 3. Multivariate: Binary logistic regression analysis of rhinitis

		Rhinitis	
		AOR (95% CI)	***p* value**
Family income	Low	1	0.04
	High	2.23 (1.04 - 4.81)	
Eating eggs (day per week)	≤ 1	1	0.036
	> 1	3.47 (1.09 - 11.08)	
History of respiratory infection	No	1	0.001
	Yes	4.06 (1.83 - 9.01)	
Opisthorchis viverrini infestation	No	1	0.045
	Yes	3.41 (1.03 - 11.29)	

Model: *-2 Log likelihood = 202.102*; *Cox & Snell R Square = 0.088*; *Nagelkerke R Square = 0.143*. Variables entered on Step 1: *Sex, Age, Number of sibling, Parity, Parents education, Family income, Cat ownership, Dog ownership, Feeding chicken, Pets ownership, Sharing bed, Air condition use, Measles infection, Respiratory infection, Time on road, Frequency of meat consumption, Frequency of fish consumption, Frequency of vegetable consumption, Frequency of cow milk consumption, Frequency of fast food consumption, Frequency of eggs consumption, Intestinal parasitic infestation, Ascaris lumbricoides infestation, Opisthorchis viverrini infestation.*

Table 4. Multivariate: Binary logistic regression analysis of atopic eczema

		Atopic eczema	
		AOR (95% CI)	***p* value**
Feeding chicken/duck	Yes	1	0.092
	No	1.92 (0.90 - 4.07)	
Frequency of contact with pets* (day per week)	≤ 1	1	0.095
	> 1	1.79 (0.90 - 3.53)	
Eating vegetable**	Sometimes	1	0.002
	Everyday	2.96 (1.49 - 5.88)	
Time on the road (minute per day)	< 30	1	0.059
	> 30	1.85 (0.98 - 3.50)	

Model: *-2 Log likelihood = 239.176*; *Cox & Snell R Square = 0.074*; *Nagelkerke R Square* = 0.110; *Pets = dogs or cats; **all types of vegetable. Variables entered on Step 1: *Sex, Age, Number of sibling, Parity, Parents education, Family income, Cat ownership, Dog ownership, Feeding chicken, Pets ownership, Sharing bed, Air condition use, Measles infection, Respiratory infection, Time on road, Frequency of meat consumption, Frequency of fish consumption, Frequency of vegetable consumption, Frequency of cow milk consumption, Frequency of fast food consumption, Frequency of eggs consumption, Intestinal parasitic infestation, Ascaris lumbricoides infestation, Opisthorchis viverrini infestation.*

0.01). While spending time more than 30 minutes on the road seems to be risk for atopic eczema (AOR = 1.85; $p = 0.059$).

4. Discussion

This study revealed much lower prevalence of rhinitis and rhinoconjunctivitis among 13-14 year-old than in the previous study which was also conducted in Vientiane capital, while small difference was observed among children aged 6-7 year-old: among younger children, rhinitis (21.0% *vs*. 26.7%) and rhinoconjunctivitis (7.5% *vs*. 14.2%), and among older children, rhinitis (22.3% *vs*. 49.1%) rhinoconjunctivitis (10.3% *vs*. 22.3%). The previous study was conducted eight years ago, when the older children in the present study were 7-8 year-old. Interestingly, the similar prevalence of rhinitis and rhinoconjunctivitis among the older children in the present study and the younger children in the previous study was observed. High prevalence of rhinitis and rhinoconjunctivitis among the older children in the previous study probably due to unrepresentative schoolchildren of the Vientiane capital: only Vientiane high school, where students were mainly from high society and rich families, was included (*10*). There was also a possibility that the prevalence of rhinitis and rhinoconjunctivitis among schoolchildren in Vientiane capital has been changed over 8 years. A study in Brazil, which compared between ISAAC phases one in 1994 and three in 2001 in 4 cities, suggested changing either decrease or increase in prevalence of asthma and allergies (*4*).

The prevalence of rhinitis was as low as around five percent from January to September, and then sharply increased to 10% in October and peaked as high as 30% in December. This epidemiology was observed regardless of younger or older age group. The fluctuation of its prevalence in Laos was likely to be influenced by characteristics of season. When October and November comes, rainy season shifts to dry season and harvest season begins in Laos; this seasonal change might influence its prevalence of rhinitis. The similar pattern was found from a study among children aged 6-7 year-old in Beijing and Urumqi, China (*11*). Whereas two studies in Bangkok, Thailand, using ISAAC questionnaire showed the perennial fluctuation of its prevalence (*7,8*), notwithstanding that Thailand is more similar to Laos than China in terms of culture, life style and eating habit.

The ISAAC questionnaire has been developed basically for compare the worldwide prevalence. The prevalence of rhinoconjunctivitis (10.3%) among children aged 13-14 year-old in our study was lower than in Hong Kong (24.0%), Thailand (15.5%), Philippines (15.3%), Singapore (15.1%), Malaysia (13.7%), and Japan (13.4%); similar to Taiwan (11.3%), Viet Nam (10.7%), South Korea (10.2%); and higher than China (7.2%), Indonesia (5.3%), and India (5.6%) (*2,3,9*); indicating that the prevalence of rhinoconjunctivitis in Southeast Asia countries, including Laos but excluding Indonesia, ranked in the middle of worldwide prevalence. Unlike rhinoconjunctivitis, the prevalence of atopic eczema (10.9%) among these older children in our study was higher than Thailand (8.2%), Malaysia (8.0%), Taiwan (1.4%), Hong Kong (2.7%), Singapore (7.4%), South Korea (3.8%) and Japan (10.2%), and lower than UK (15.8%), Finland (15.6%), Ireland (13.6%), and New Zealand (12.7%) (*3*). The same standard questions were used in the ISAAC questionnaire; however, the original was written in English, and translated into local languages, which would affect the reliability and validity of the questionnaire. In addition, local languages of Laos and Thai (*8*), there were no specific terms to describe the technical terms used in ISAAC

questionnaire English version such as wheeze, hay fever and atopic eczema. This suggests the necessity of the validation study on ISAAC questionnaire in local languages.

In 1989, the hygiene hypothesis was first introduced by David Strachan that poor hygiene during childhood might prevent the development of allergy in adolescence and adulthood (*12*); The consistent finding was found in our study when children from high income family, where the living condition and hygiene behaviors were better than children from low income family, were more likely to have rhinitis.

Ramsey and Celedon in 2005 reviewed the contradictory findings of the history of infection as a risk for allergy in several studies (*13*). The result in our study shown that the history of respiratory infection was significantly, directly associated with development of rhinitis among targeted children.

Eating behavior was also investigated in our study, and the result showed that eating egg regularly was associated with the development of rhinitis. The consistent finding was found in a many studies: a study, for example, in Italy shown the higher prevalence of sensitization to egg among children with than without rhinitis (*14*).

The helminthic and parasitic infestation has taken to consider as one of factors influencing the development of allergies due to its competitive human immune response. In our study, we found that the *Opisthorchis viverrini* infestation was a risk of rhinitis; whereas there was no association between *Ascaris lumbricoides* infestation and rhinitis (several studies contradictorily demonstrated its association between *Ascaris spp*. infestation and allergic diseases). The study in former East Germany, for example, demonstrated the direct association between *Ascaris*-IgE sero-positive and high prevalence of allergic rhinitis (*15*). Another study in rural China also showed an increasing risk of asthma and skin picked test positive among subjects who were infested by *Ascaris lumbricoides* (*16*). The contradictory finding was found in other studies: a study by Cooper *et al*. reported the protective effect of geohelminth and *Ascaris lumbricoides* infestation against allergen skin test reaction among children aged 5-19 year-old in Ecuador (*17*); and van den Biggelaar *et al*. in Gabon, which reported the anhelminthic treatment of chronically infected children results in increased atopic reaction (*18*). No association between *Ascaris spp*. Infestation and rhinitis was observed in this study probably due to small sample.

Children who spent more than 30 minutes on the road per day were more likely to have atopic eczema; this association was also found when adjudged by other confounding despite being not statistically significant. The air pollution was not measured in our study. Therefore, further study employing the measurement for ambient air pollution is needed to explore its association in Laos.

Eating vegetables everyday had strong association with high prevalence of atopic eczema. Possible explanation is that chemical insecticides and fertilizers have been commonly used for plantation in Laos. A study in China showed the association between regularly contact with chemical insecticide, fertilizers and emissions from domestic fuel and wheezing, asthma attack and asthma medication among general population (*19*), although the study did not include other allergic diseases. The avoidance of using chemical insecticide for plantation in Lao is beneficial not only for reducing risk for atopic eczema, but for Lao people's health due to consuming free chemical vegetable which would not harm their body. Further study is needed to reveal more precise role of vegetables on the development of allergic diseases such as types and amount of vegetable intake and the level of chemical residue on vegetable.

This study revealed the similarity in the prevalence of rhinitis in 13-14 year-old of the present study and 6-7 year-old in the previous study which was also conducted in Vientiane capital eight years ago, and these prevalence were higher than that in some Southeast Asia countries. The validation study on Lao language version of ISAAC questionnaire is needed in order to generalize this questionnaire in Lao. History of respiratory infection and parasitic infestation, egg eating, and children from high family income promoted the development of rhinitis; while increasing in eating vegetable and spending more time on the road promoted atopic eczema. Our study also recommends the avoidance of chemical agents used in plantation is not only for reducing risk for atopic eczema but also for reducing chemical toxicity by consuming free chemical vegetables.

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