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Traffic Air Pollution Associated with Childhood Asthma in Taipei, Taiwan

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Introduction

- Asthma prevalence
  - According to World Health Organization (WHO) 2003 estimates, 300 million people suffer from asthma and the victims may increase to 400 million in two decades.
  - Asthma is one of the common chronic diseases in children
- Childhood asthma
  - International Study of Asthma and Allergies in Childhood (ISAAC) had screened 463,801 school children 13 and 14 years of age with the assistance of 155 collaborating centers among 56 countries using a standard questionnaire
    - The highest 12-month prevalence was 30-35% found by the centers of the UK, Australia, New Zealand and Republic of Ireland.
    - The lowest prevalence was 2-5% in the centers of some Eastern European countries, Indonesia, Greece, China, Taiwan, Uzbekistan, India, and Ethiopia

Environment pollutants to Asthma

- Traffic pollutants are main sources of outdoor pollution
  - Ozone, nitrogen oxides, sulfur oxides, aldehydes, particulate matters (PM), and carbon monoxide, they tend to occur together in the traffic exhaust
- Mar et al (2004) found a strong association between cough and PM_{10}, $PM_{2.5}$, PM coarse fraction, and $PM_{1.0}$
- Barnnet et al (2005) also found the air pollutants, NO_2, $PM_{2.5}$, PM_{10}, and SO_2 had a consistent relationship of respiratory hospital admissions in children

Previous studies of childhood asthma

Table 1 Prevalence of childhood asthma in Taipei city

Study period	Ages of participants	Prevalence of Asthma (%)	Reference
1974	7-15	1.30 [a]	Hsieh, KH et al
1985	7-15	5.08 [a]	Hsieh, KH et al
1991	7-15	5.80 [a]	Hsieh, KH et al
1994	7-15	10.79 [a]	Hsieh, KH et al
1995-1996	~13-15	9.51 [b]	Lee, YH et al
2001	~13-15	11.44 [b]	Lee, YH et al
2001	~11-12	13.1 [b]	Kuo, YL et al

a. by questionnaire: physician diagnosed at least 3 recurrent, paroxysmal attacks of wheezing and dyspnea in the past 12 months.
b. by ISAAC questionnaire

Study Objectives

- We conducted a study in Taipei attempting to identify air pollution markers that may have association with the disease
  - This study aimed to investigate the prevalence of asthma among elementary school children in Taipei by conducting a survey among schools selected based on the traffic density of the school area.
  - We use ISAAC questionnaire to identify children with asthma history in the past 12 months.

Methods and Materials

- Traffic density
  - Based on the daily traffic density, this subproject divided Taipei metropolitan into 3 areas:
    - high, moderate and low density areas
  - Three to four primary schools were randomly selected for a questionnaire screening survey to identify students with the complaint of asthma

Red dots - high density
Blue dots – moderate density
Green dots – low density
1*1 km grid

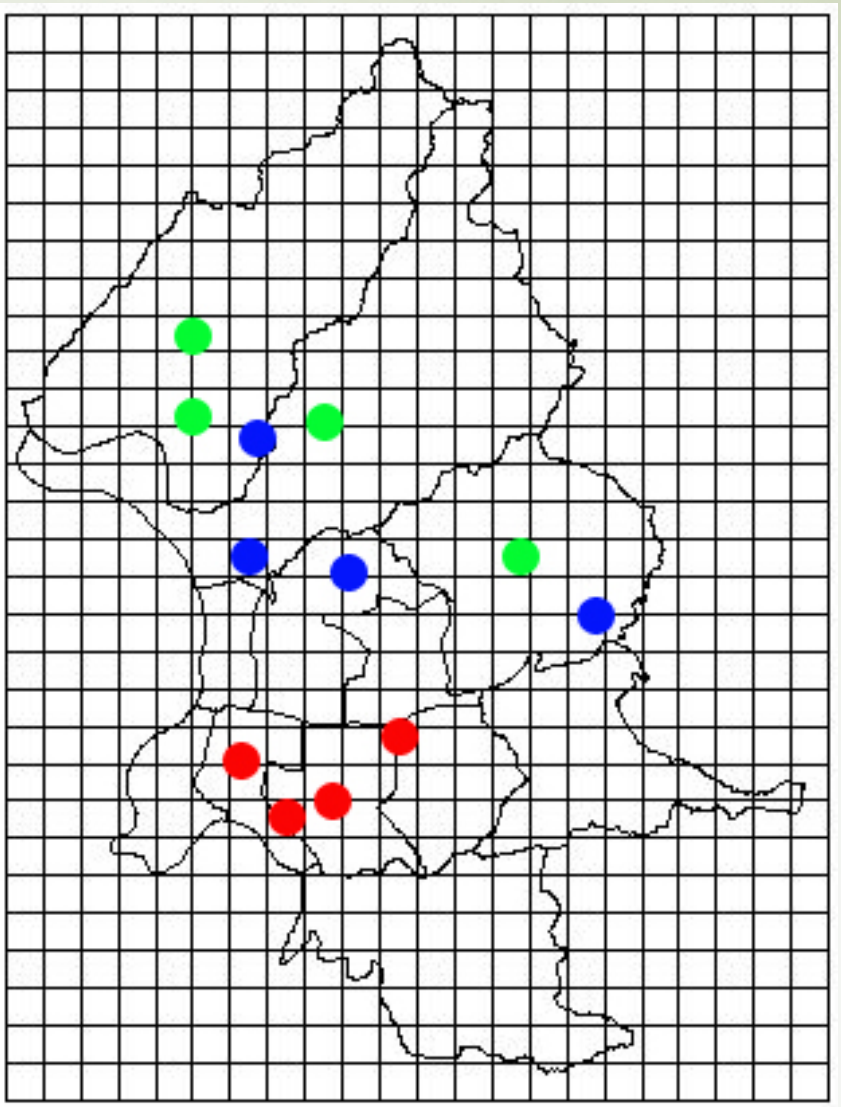

Figure 1 Location of selective schools in Taipei city

Methods and Materials

- Questionnaires
  - All data were collected using questionnaires completed by parents.
  - The ISAAC standard questionnaire was adapted with modification to include basic socio-demographic characteristics, parental education, family smoking behavior, histories of asthma, rhinitis and eczema diseases, family medical history, and self-perceived pollution level at the resident area where students lived in, etc.

Methods and Materials

- Statistical analysis
  - Data were established by Microsoft Excel software, and analyzed the correlations between variables using SAS 8.2 software (SAS Inc., Cary, NC).
  - The association between gender and health status were evaluated using Chi-square test.
  - We used the logistic regression analysis to evaluate the association between asthma occurrence and potential risk factors,
    - such as traffic density near the campus, family smoking behavior, maternal smoking history during pregnancy, and self-perceived pollution exposure.
    - Odds ratios and 95% confidence intervals were calculated.

Table 2 Prevalence of childhood asthma in Taipei City

	Study subjects N=4952		
	Male (n=2440) n (%)	Female (n=2512) n (%)	p-value
Have you had ever diagnosed as asthma by physician?			**<0.0001**
No	1937(79.4)	2149(85.5)	
Yes	**432(17.7)**	**289(11.5)**	
Yes, but need no medicine now	332(13.6)	220(8.76)	
Yes, need to take medicine occasionally	76(3.11)	58(2.31)	
Yes, I need to take medicine daily	24(0.98)	11(0.44)	
Data missing	71(2.91)	54(2.15)	
Have you had ever diagnosed as rhinitis by physician?			**<0.0001**
No	881(36.1)	1242(49.4)	
Yes	**1435(58.8)**	**1184(47.1)**	
Data missing	124(5.08)	86(3.42)	
Have you had ever diagnosed as eczema by physician?			0.2324
No	1772(72.6)	1903(75.8)	
Yes	**500(20.5)**	**493(19.6)**	
Data missing	168(6.88)	116(4.62)	

Table 3 The odds ratios of asthma occurred and potential risk

	Odd ratio (95% confidence interval)		
		Male	Female
Traffic density of childrens' school			
Low density	1.0	1.0	1.0
Moderate density	**1.28(1.03-1.60)**	1.27(0.95-1.70)	1.28(0.91-1.81)
High density	1.04(0.83-1.32)	1.04(0.77-1.42)	1.03(0.72-1.48)
Parent's education			
<= Primary school	1.0	1.0	1.0
Junior high school	0.64(0.29-1.41)	0.55(0.20-1.48)	0.60(0.14-2.51)
Senior high school	0.63(0.33-1.21)	0.44(0.19-1.01)	0.97(0.33-2.81)
College/university	0.84(0.45-1.56)	0.62(0.28-1.38)	1.16(0.41-3.27)
Maternal smoking during the pregnancy?			
None	1.0	1.0	1.0
1-10 cigs/ day	1.25(0.59-2.65)	1.28(0.48-3.38)	1.19(0.36-3.98)
11-20 cigs/day	0.75(0.18-3.21)	1.07(0.24-4.84)	-[a]
Over 20 cigs/day	**7.49(1.51-37.2)**	5.08(0.37-94.2)	**9.92(1.39-70.8)**

a: under estimated

Table 3 The odds ratios of asthma occurred and potential risk (continued)

	Odd ratio (95% Confidence Interval)		
		Male	Female
Do your family members have taken cigarettes habits?			
None	1.0	1.0	1.0
Yes	0.86(0.72-1.03)	1.00(0.79-1.27)	0.70(0.52-0.93)
How many cigarettes do your family members take at home?			
None	1.0	1.0	1.0
1-10 cigs/day	0.90(0.72-1.12)	0.98(0.74-1.29)	0.78(0.55-1.11)
11-20 cigs/day	0.85(0.61-1.17)	0.86(0.55-1.34)	0.89(0.55-1.44)
Over 20 cigs/day	0.91(0.54-1.53)	0.80(0.39-1.63)	1.09(0.51-2.31)
In your opinion, the environment of your house belong to			
No pollution	1.0	1.0	1.0
Light pollution	**1.33(1.04-1.70)**	1.37(0.99-1.89)	1.26(0.86-1.83)
Median pollution	**1.65(1.21-2.24)**	**1.67(1.11-2.51)**	**1.61(1.01-2.59)**
Severe pollution	**2.13(1.17-3.88)**	**1.96(0.93-4.16)**	2.23(0.81-6.10)

Discussion

- **17.7% boys and 11.5% girls had been diagnosed with asthma**
  - The prevalence was much higher than the prevalence found in previous studies for children in Taipei city
- **Prevalence of rhinitis approximated to fifty percent in the study subjects**
  - High humidity in Taipei city (70% of annual average)
  - Singapore study showed the home dampness was significantly associated with symptoms of rhino-conjunctivitis (adjusted prevalence ratios (PR) 1.53, 95% CI: 1.00-2.33)
- **Boys are at higher risk than girls for asthma, rhinitis and eczema**

Conclusion

- **Children born to mothers with heavy smoking were at the greatest risk of asthma**
  - This finding implies that maternal smoking has a greater impact than from pollution in the community on the asthma risk in children
- In conclusion, this study demonstrates that traffic pollution, residential condition and maternal smoking may increase the childhood asthma risk.

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